3GPP TSG CN Plenary Meeting #16 **NP-020227**
5th - 7th June 2002. Marco Island, USA.

Source: TSG CN WG 1

Title: CRs to Rel-5 on Work Item IMS-CCR towards 24.228

Agenda item: 8.1

Document for: APPROVAL

Introduction:

This document contains **10** CRs on **Rel-5 on** Work Item **"IMS-CCR"**, that have been agreed by **TSG CN WG1**, and are forwarded to TSG CN Plenary meeting #16 for approval.

Spec	CR	Rev	Phase	Subject	Cat	Version Current	Versio n-New	Meeting-2nd-Level	Doc-2nd-Level
24.228	002	1	Rel-5	Update of the authorization flows	F	5.0.0	5.1.0	N1-23	N1-020904
24.228	004	3	Rel-5	MO, S-S, MT #1a reference flow update	F	5.0.0	5.1.0	N1-SIP0204	N1-021061
24.228	005		Rel-5	Addition of Max-Forwards Header to Registration Flows	F	5.0.0	5.1.0	N1-23	N1-020813
24.228	010	1	Rel-5	Integrity protection signal from P-CSCF to S-CSCF	F	5.0.0	5.1.0	N1-23	N1-020916
24.228	017	2	Rel-5	DNS-NAPTR Query	B	5.0.0	5.1.0	N1-SIP0204	N1-021090
24.228	018	3	Rel-5	General update of sections 10.1, 10.2 and 10.3	F	5.0.0	5.1.0	N1-24	N1-021416
24.228	019	5	Rel-5	MO, S-S, MT #2 reference flows update	F	5.0.0	5.1.0	N1-24	N1-021505
24.228	020	2	Rel-5	Session Redirection Flow Update	F	5.0.0	5.1.0	N1-24	N1-021413
24.228	021	2	Rel-5	Session Transfer Flow Update	F	5.0.0	5.1.0	N1-24	N1-021414
24.228	022	1	Rel-5	Addition of DHCPv6 references to 24.228	F	5.0.0	5.1.0	N1-SIP0204	N1-021087

CR-Form-v5

CHANGE REQUEST

⌘	24.228	CR	017	⌘ rev	2	⌘	Current version:	5.0.0	⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: ⌘	(U)SIM		ME/UE	X	Radio Access Network		Core Network	X

Title:	⌘	DNS-NAPTR query		
Source:	⌘	Lucent Technologies		
Work item code:	⌘	IMS-CCR	***Date:*** ⌘	2002-04-24
Category:	⌘	**F**	***Release:*** ⌘	*REL-5*
		Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change:	⌘	Current DNS prosedure incorrectly specifies the access to the DNS.
Summary of change:	⌘	When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. Since the transport protocol, port and the destination is not a numeric IP address, the DNS NAPTR query is performed.
Consequences if not approved:	⌘	Incorrect procedure.

Clauses affected:	⌘	2, 5.2.2, 6.2, 6.3, 6.9.3, 16.2, and 16.3		
Other specs affected:	⌘	[ ] Other core specifications [ ] Test specifications [ ] O&M Specifications	⌘	
Other comments:	⌘	Modifications are only shown in the clause 6.2. The same modifications have to be made in the clauses listed above Revision 1 includes the modifications that were made in other clauses as listed above. Revision 2 indicate that the proposed change also effect UE, and changes the category to F from B.		

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be

downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 23.228: "IP multimedia subsystem; Stage 2".

[3] IETF 2543bis: “SIP: Session Initiation Protocol” (ietf-sip-rfc2543bis-05.txt)

[4] IETF RFC 2782: "A DNS RR for specifying the location of services (DNS SRV)".

[5] IETF RFC 2806: "URLs for Telephone Calls".

[6] IETF RFC 2916: "E.164 number and DNS".

[7] 3GPP TS 33.203: "Access security for IP based services".

[8] 3GPP TS 23.060: "General Packet Radio Service (GPRS) Service description; Stage 2".

[9] 3GPP TS 29.207: "End to end Quality of Service (QoS); stage 3".

[10] 3GPP TS 29.060: "General Packet Radio Service (GPRS); GPRS Tunnelling Protocol (GTP) across the Gn and Gp Interface".

[11] 3GPP TS 29.228: "IP Multimedia (IM) Subsystem Cx Interface; Signalling flows and message contents".

[12] 3GPP TS 24.008: "Mobile radio interface layer 3 specification; Core Network Protocols; Stage 3".

[13] IETF RFC 3263: "SIP: Locating SIP Servers".

5.2.2 DHCP procedure for P-CSCF discovery

In DHCP procedures for P-CSCF discovery, the UE employs DHCP and if needed DNS to obtain the P-CSCF address.

Editor's Note: This approach needs further study on the interactions with the restrictions on the Signalling PDP Context, TS 23.228 subclause 4.2.6.

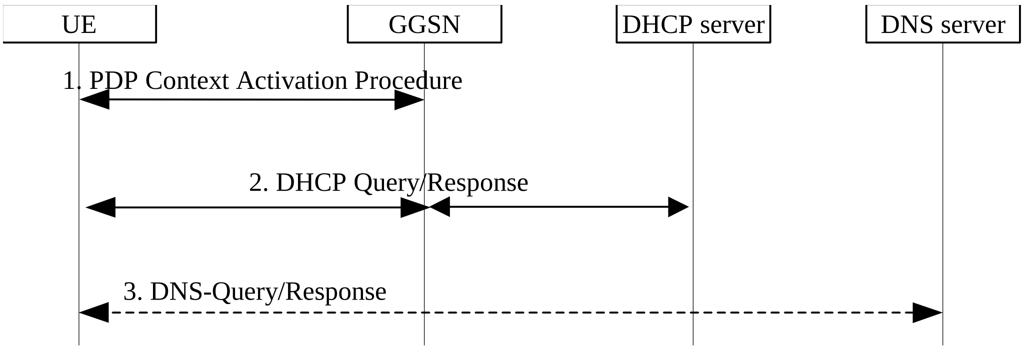


Figure 5.2.2-1: P-CSCF discovery using DHCP and DNS

1. **PDP Context Establishment Procedure (UE to GPRS)**

   Establishment of appropriate PDP context bearer by using the PDP Context Establishment procedure as specified in 3GPP TS 24.008.

2. **DHCP Query/Response (UE to DHCP)**

   The UE sends a request to a DHCP server. It may requesta list of fully qualified domain names of P-CSCF(s) and the IP addresses of the DNS servers, or it may request a list of P-CSCF(s) IP address(es). Multiple DHCP Query/Response message exchange may be required to retrieve the requested information.

3. **DNS Query/Response (UE to DNS)**

   If P-CSCF address(es) are not received in the DHCP Query/Response, and the transport protocol and port number are not known to UE, the UE performs a NAPTR query (for the domain returned in DHCP response) to select the transport protocol. Subsequently, the UE performs a SRV DNS query to retrieve a list of P-CSCF(s) IP addresses from which one is selected. If the response does not contain the IP addresses an additional AAAA DNS query is needed to resolve a Fully Qualified Domain Name (FQDN) to an IP address.

Table 5.2.2-3a DNS: DNS Query (UE to DNS)

```
OPCODE=SQUERY
QNAME=pcscf.visited1.net, QCLASS=IN, QTYPE=NAPTR
```

The DNS records are retrieved according to RFC 3263 [13].

Table 5.2.2-3b DNS Query Response (DNS to UE)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=pcscf.visited1.net,  QCLASS=IN, QTYPE=NAPTR

registrar.home1.net     0 IN NAPTR 50   50 "s" "SIP+D2U"    ""  _sip._udp. pcscf.visited1.net.net
                        0 IN NAPTR 90   50 "s" "SIP+D2T"    ""  _sip._tcp. pcscf.visited1.net.net
                        0 IN NAPTR 100  50 "s" "SIPS+D2T"   ""  _sips._tcp. pcscf.visited1.net.net
```

Since the UDP is prefered, the UE performs a DNS SRV lookup according to RFC 2782 [4].

Table 5.2.2-3~~a~~c DNS: DNS Query (UE to DNS)

```
OPCODE=SQUERY
QNAME=_sip._udp.pcscf.visited1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 5.2.2-3~~b~~d DNS Query Response (DNS to UE)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=_sip._udp.pcscf.visited1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.pcscf.visited1.net         0 IN SRV 1 10 5060 pcscf1.visited1.net
                                     0 IN SRV 1  0 5060 pcscf7.visited1.net

pcscf1.visited1.net                 0 IN AAAA     5555::aba:dab:aaa:daa
pcscf7.visited1.net                 0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each P-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the P-CSCF (i.e. the pcscf1.visited1.net).

Since the Additional Data field of the query-response also contains the IP address of the selected P-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

6.2 Registration signalling: user not registered

Figure 6.2-1 shows the registration signalling flow for the scenario when the user is not registered. For the purpose of this registration signalling flow, the subscriber is considered to be roaming. This flow also shows the authentication of the private user identity. In this signalling flow, the home network does not have network configuration hiding active.

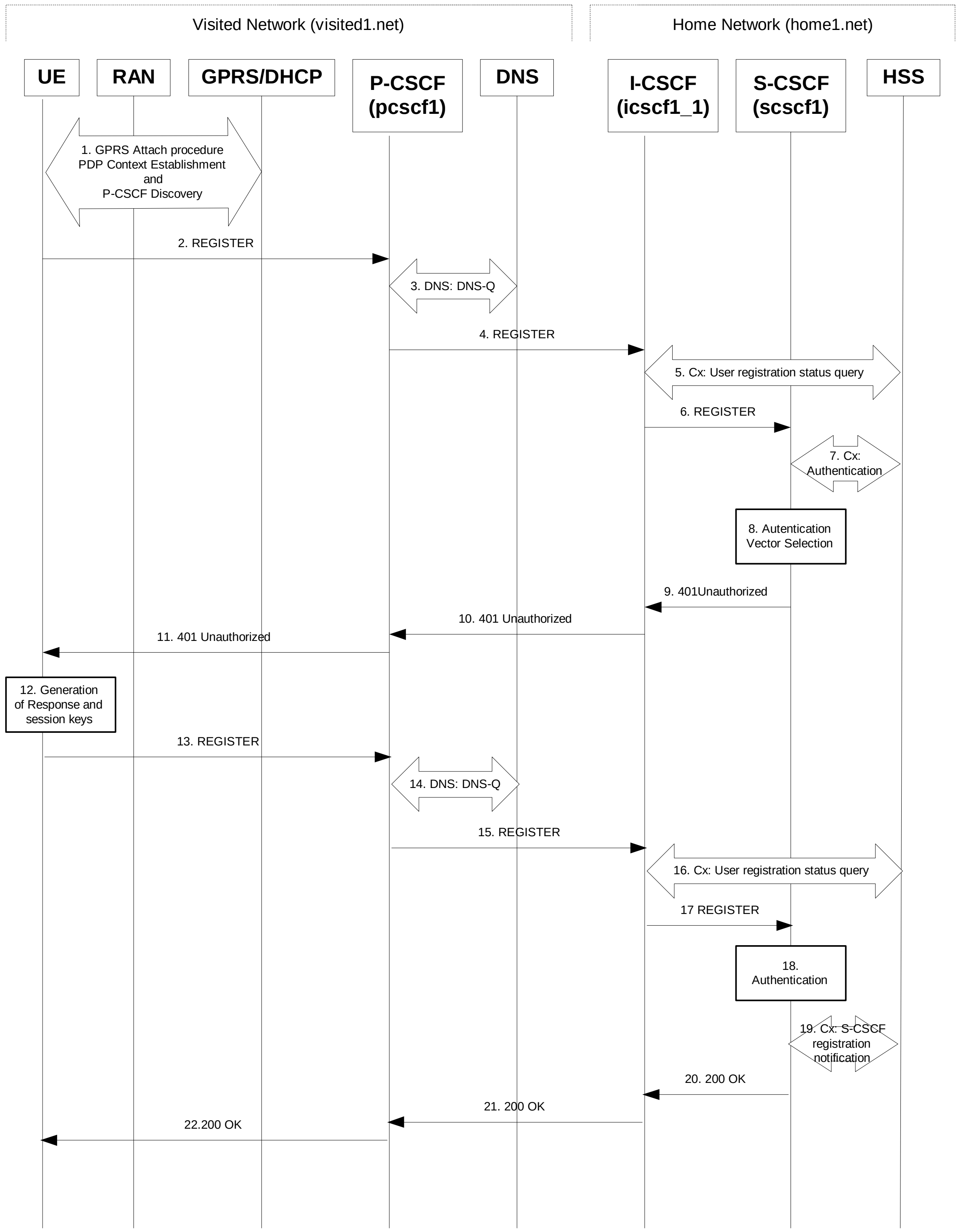


Figure 6.2-1: Registration signalling: user not registered

1. **GPRS Attach / PDP Context Establishment and P-CSCF Discovery (UE to GPRS)**

   This signalling flow is shown to indicate prerequisites for the registration signalling.

   See subclause 5.2 for details.

2. **REGISTER request (UE to P-CSCF) – see example in table 6.2-2**

The purpose of this request is to register the user's SIP URI with a S-CSCF in the home network. This request is routed to the P-CSCF because it is the only SIP server known to the UE. In the following SIP request, the Contact field contains the user's host address.

The P-CSCF will perform two actions, binding and forwarding. The binding is between the User's SIP address (user1_public1@home1.net) and the host (terminal) address ([5555::aaa:bbb:ccc:ddd]) which was acquired during PDP context activation process.

[Editor's note: The security mode set-up procedure supports the negotiation of different protection mechanisms. This will involve the addition of a "security-setup" field to the SIP REGISTER request and the REGISTER response performing the authentication challenge containing the parameters:

- list of Authentication (integrity} algorithms, and optionally list of encryption (confidentiality) algorithms
- SA-ID that is used to uniquely identify the SA at the receiving side.
- Key length: the length of encryption and authentication (integrity) keys is 128 bits.

The exact format and use for the security mode setup is being worked through IETF and is FFS]

Table 6.2-2: REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: eap eap-p=base64(user1_private1@home1.net)
CSeq: 1 REGISTER
Expires: 7200
Content-Length: 0
```

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Via: IPv6 address of the SIP session allocated during the PDP Context Activation process.

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates the public user identity being registered. This is the identity by which other parties know this subscriber. It may be obtained from the USIM.

Contact: This indicates the point-of-presence for the subscriber - the IP address of the UE. This is the temporary point of contact for the subscriber that is being registered. Subsequent requests destined for this subscriber will be sent to this address. This information is stored in the P-CSCF and S-CSCF.

Authorization: It carries authentication information. The private user identity (user1_private1@home1.net) is carried in the user ID field of the extensible authentication protocol (EAP).

NOTE: The actual Authorization header value may look like this as it is in base64 form:
Authorization: eap eap-p=QWxhZGRpbjpvcGVuIHNlc2FtZQ==

Upon receiving this request the P-CSCF will set it's SIP registration timer for this UE to the Expires time in this request.

3. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs ~~a~~ the DNS queriesy to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify a numeric IP address, and the transport protocol and port number are not indicated, the P-CSCF ~~CSCF~~ performs an NAPTR query for the domain specified in the Request-URI ~~selects the UDP~~.

Table 6.2-3a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=registrar.home1.net, QCLASS=IN, QTYPE=NAPTR
```

The DNS records are retrieved according to RFC 3263 [13].

Table 6.2-3b DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=registrar.home1.net,  QCLASS=IN, QTYPE=NAPTR

registrar.home1.net         0 IN NAPTR 50   50 "s" "SIP+D2U"    ""  _sip._udp.registrar.home1.net
                            0 IN NAPTR 90   50 "s" "SIP+D2T"    ""  _sip._tcp.registrar.home1.net
                            0 IN NAPTR 100  50 "s" "SIPS+D2T"   ""  _sips._tcp.registrar.home1.net
```

Since the UDP is prefered, the P-CSCF finds the I-CSCF by a DNS SRV lookup according to RFC 2782 [4].

Table 6.2-3ac: DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=_sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 6.2-3bd: DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=_sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net        0 IN SRV 1 10 5060 icscf1_p.home1.net
                                            0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                 0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                 0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

4. **REGISTER request (P-CSCF to I-CSCF) - see example in table 6.2-4**

The P-CSCF needs to be in the path for all mobile originated and mobile terminated requests for this user. To ensure this, the P-CSCF adds itself to the Path header value for future requests.

The P-CSCF binds the public user identity under registration to the Contact header supplied by the user.

The P-CSCF adds also the Roaming-Info header (if not present). The P-CSCF adds the *vnid* parameter with the contents of the identifier of the P-CSCF network. This may be the visited network domain name or any other identifier that identifies the visited network at the home network.

This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 6.2-4: REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

Require:/Proxy-Require: These headers are included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating "path". Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

5. **Cx: User registration status query procedure**

The I-CSCF makes a request for information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF required capabilities and the I-CSCF uses this information to select a suitable S-CSCF.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-5a provides the parameters in the REGISTER request (flow 4) which are sent to the HSS.

Table 6.2-5a Cx: User registration status query procedure (I-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
I-CSCF to HSS	Private User Identity	Authorization:	The Private User Identity is encoded according to the Authorization protocol.
	Public User Identity	To:	Identity which is used to communicate with other users
	Visited Network Identifier	Roaming Info: vnid	This information indicates the network identifier of the visited network

6. **REGISTER request (I-CSCF to S-CSCF) – see example in table 6.2-6**

I-CSCF does not modify the Path header.

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 6.2-6: REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

Upon receiving this request the S-CSCF may set its SIP registration timer for this UE to the Expires time in this request or the S-CSCF may assign another registration timer for this registration

7. **Cx: Authentication procedure**

On receiving a REGISTER request from an unauthenticated user, the S-CSCF requires at least one authentication vector to be used in the challenge to the user. If a valid AV is not available, then the S-CSCF requests at least one AV from the HSS.

The S-CSCF indicates to the HSS that it has been assigned to serve this user.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-7a provides the parameters in the REGISTER request (flow 6) which are sent to the HSS.

Table 6.2-7a Cx: S-CSCF authentication information procedure (S-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
S-CSCF to HSS	Public User Identify	To:	Identity which is used to communicate with other users
	Private User Identity	Authorization:	The Private User Identity is encoded according to the Authorization protocol.
	S-CSCF Name	Request-URI:	This information element contains the name of the S-CSCF. The presence of this IE indicates that the user has not been authenticated yet by the S-CSCF

8. **Authentication vector selection**

The S-CSCF selects an authentication vector for use in the authentication challenge. For detailed description of the authentication vector, see 3GPP TS 33.203.

NOTE 1: The authentication vector may be of the form as in 3GPP TS 33.203 (if IMS AKA is the selected authentication scheme):

- AV = $RAND_n||AUTN_n||XRES_n||CK_n||IK_n$ where:
  - RAND: random number used to generate the XRES, CK, IK, and part of the AUTN. It is also used to generate the RES at the UE.
  - AUTN: Authentication token (including MAC and SQN).
  - XRES: Expected (correct) result from the UE.
  - CK: Cipher key (optional).
  - IK: Integrity key.

9. **401 Unauthorized response (S-CSCF to I-CSCF) - see example in table 6.2-9**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.2-9: 401 Unauthorized response (S-CSCF to I-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Call-ID: apb03a0s09dkjdfglkj49111
WWW-Authenticate: eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)
CSeq: 1 REGISTER
Content-Length: 0
```

NOTE 2: The actual WWW-Authenticate header value may look like this as it is in base64 form: WWW-Authenticate: eap eap-p=QWxh4ZGRpb2jpvcGVuNlctZQ==

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

10. **401 Unauthorized response (I-CSCF to P-CSCF) - see example in table 6.2-10**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.2-10: 401 Unauthorized response (I-CSCF to P-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate:
CSeq:
Content-Length:
```

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

11. **401 Unauthorized response (P-CSCF to UE) - see example in table 6.2-11**

The P-CSCF removes any keys received in the 401 Unauthorized response and forwards the rest of the response to the UE.

Table 6.2-11: 401 Unauthorized response (P-CSCF to UE)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate: eap eap-p=base64(user1_private1.home1.net, RAND, AUTN)
CSeq:
Content-Length:
```

12. **Generation of response and session keys at UE**

Upon receiving the Unauthorised response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in the REGISTER request.

13. **REGISTER request (UE to P-CSCF) - see example in table 6.2-13**

Table 6.2-13 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49112
Authorization: eap eap-p=base64(user1_private1@home1.net, RES)
CSeq: 2 REGISTER
Expires: 7200
Content-Length: 0
```

Authorization: This carries the response to the authentication challenge received in step 11 along with the private user identity both encoded in base64 format.

14. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs ~~a~~ the DNS quer~~y~~ies to locate the I-CSCF in the home network. The look up in the DNS is based on the ~~address~~ domain name specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify a numeric IP address, and the transport protocol and port number are not indicated, the~~,~~ P-CSCF ~~selects the UDP~~performs an NAPTR query for the domain specified in the Request-URI.

Table 6.2-14a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=registrar.home1.net, QCLASS=IN, QTYPE=NAPTR
```

The DNS records are retrieved according to RFC 3263 [13].

Table 6.2-14b DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=registrar.home1.net,  QCLASS=IN, QTYPE=NAPTR

registrar.home1.net         0 IN NAPTR 50   50 "s" "SIP+D2U"    ""  _sip._udp.registrar.home1.net
                            0 IN NAPTR 90   50 "s" "SIP+D2T"    ""  _sip._tcp.registrar.home1.net
                            0 IN NAPTR 100  50 "s" "SIPS+D2T"   ""  _sips._tcp.registrar.home1.net
```

Since the UDP is prefered, the P-CSCF finds the I-CSCF by an DNS SRV lookup according to RFC 2782 [4].

Table 6.2-14~~a~~c DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 6.2-14~~b~~d DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net        0 IN SRV 1 10 5060 icscf1_p.home1.net
                                            0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                 0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                 0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

15. **REGISTER request (P-CSCF to I-CSCF) - see example in table 6.2-15**

This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.

Table 6.2-15 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

16. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF name which was previously selected in step 5 (Cx: User registration status query procedure).

For detailed message flows see 3GPP TS 29.228.

Table 6.2-16a provides the parameters in the REGISTER request (flow 15), which are sent to the HSS.

Table 6.2-16a Cx: User registration status query procedure (I-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
I-CSCF to HSS	Private User Identity	Authorization:	The Private User Identity is encoded according to the Authorization protocol.
	Public User Identity	To:	Identity which is used to communicate with other users
	Visited Network Identifier	Roaming-Info: vnid	This information indicates the network identifier of the visited network

17. **REGISTER request (I-CSCF to S-CSCF) - see example in table 6.2-17**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF.

Table 6.2-17: REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

18. **Authentication**

Upon receiving the REGISTER request carrying the authentication response, RES, the S-CSCF checks that the user's active, XRES matches the received RES. If the check is successful then the user has been authenticated and the public user identity is registered in the S-CSCF.

19. **Cx: S-CSCF registration notification procedure**

On registering a user the S-CSCF informs the HSS that the user has been registered at this instance. Upon being requested by the S-CSCF , the HSS will also include the user profile in the response sent to the S-CSCF.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-19a provides the parameters in the REGISTER request (flow 17), which are sent to the HSS.

Table 6.2-19a Cx: S-CSCF registration notification procedure (S-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
S-CSCF to HSS	Public User Identify	To:	Identity which is used to communicate with other users
	Private User Identity	Authorization:	The Private User Identity is encoded according to the Authorization protocol. Unique identity in IMS which is used by network to authenticate this user
	S-CSCF name	Request-URI:	This information indicates the serving CSCF's name of that user

20. **200 OK response (S-CSCF to I-CSCF) - see example in table 6.2-20**

The S-CSCF sends acknowledgement to the I-CSCF indicating that Registration was successful.

Table 6.2-20: 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact: sip:[5555::aaa:bbb:ccc:ddd]
CSeq:
Date: Wed, 11 July 2001 08:49:37 GMT
Expires: 7200
Content-Length:
```

Path: The S-CSCF inserts its own name to the front of the list.

21. **200 OK response (I-CSCF to P-CSCF) - see example in table 6.2-21**

The I-CSCF forwards acknowledgement from the S-CSCF to the P-CSCF indicating that Registration was successful.

Table 6.2-21: 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

22. **200 OK response (P-CSCF to UE) - see example in table 6.2-22**

The P-CSCF removes its address from the Path header, reverses the order of the fields, saves the resulting Path header and associates it with the UE. The P-CSCF then removes the Path header from the 200 OK response. The P-CSCF then forwards acknowledgement from the I-CSCF to the UE indicating that Registration was successful.

Table 6.2-22: 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
```

```
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

6.3 Registration signalling: reregistration - user currently registered

For the purpose of the reregistration signalling flow shown in figure 6.3-1, the subscriber is considered to be roaming. The HSS information indicates that the subscriber is registered and authenticated, and that the S-CSCF has been allocated to this subscriber. In this signalling flow, the home network does not have network configuration hiding active. This flow also shows the authentication of the private user identity.

This signalling flow assumes:

1. That the same PDP Context allocated during the initial registration scenario is still used for reregistration. For the case when the UE does not still have an active PDP context then PDP context procedures from subclause 16.2 is completed first.

Editor's Note: If the same PDP-Context is not available, is it guaranteed that the UE will get back the same IP address at this point? If this is not possible, would there be a problem with the binding in the P-CSCF (user_public1@home1.net and [5555::aaa:bbb:ccc:ddd])?

2. The DHCP procedure employed for P-CSCF discovery is not needed.

3. The S-CSCF selection procedure invoked by the I-CSCF is not needed.

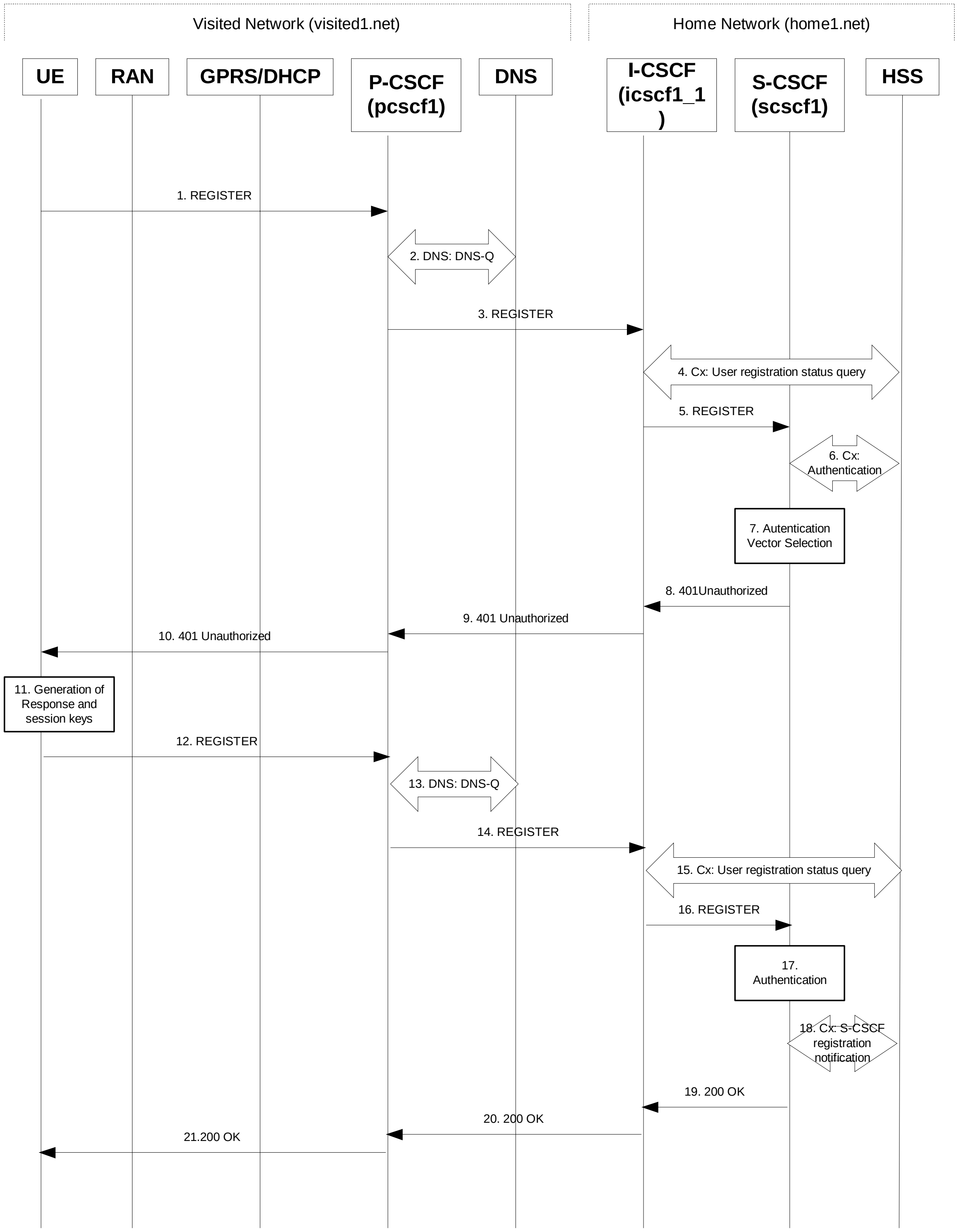


Figure 6.3-1: Reregistration when UE roaming

1. **REGISTER request (UE to P-CSCF) - see example in table 6.3-1**

   The registration expires in the UE. The UE reregisters by sending a new REGISTER request. This request is sent to the same P-CSCF with which the UE initially registered. The P-CSCF maintains the same binding between the public user address (user1_public1@home1.net) and the host (terminal) address ([5555::aaa:bbb:ccc:ddd]) which it established during the original registration.

Table 6.3-1: REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: eap eap-p=base64(user1_private1@home1.net)
CSeq: 3 REGISTER
Expires: 7200
Content-Length: 0
```

The header field usage is the same as for the initial registration scenario:

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates public user identity being registered. This is the identity by which other parties know this subscriber.

Contact: This indicates the point-of-presence for the subscriber – the IP address of the UE. This is the temporary identifier for the subscriber that is being registered. Subsequent requests destined for this subscriber will be sent to this address. This information is stored in the P-CSCF and the S-CSCF.

Authorization: It carries authentication information. The private user identity (user1_private1@home1.net) is carried in the user ID field of the extensible authentication protocol (EAP).

NOTE 1: The actual Authorization header value may look like this as it is in base64 form:
Authorization: eap eap-p=QWxhZGRpbjpvcGVuIHNlc2FtZQ==

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Upon receiving this request the P-CSCF will detect that it already has a registration record for this UE and will reset it's SIP registration timer for this UE to the Expires time in this request.

2. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs ~~a~~ the DNS quer~~y~~ies to locate the I-CSCF in the home network. The look up in the DNS is based on the ~~address~~ domain name specified in the Request URI. The DNS provides the P-CSCF with ~~an~~ the address of the I-CSCF in the home network. The P-CSCF must not use the I-CSCF address cached as a result of the previous registration.

3. **REGISTER request (P-CSCF to I-CSCF) - see example in table 6.3-3**

This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 6.3-3 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
```

```
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

Require:/Proxy-Require: These headers are included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating "path". Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

4. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. Because the user has registered, the HSS returns the I-CSCF with the S-CSCF address for the subscriber.

For detailed message flows see 3GPP TS 29.228.

For the parameters in the REGISTER request (flow 3) which need to be sent to HSS, see table 6.2-5a.

Table 6.3-4a provides the parameters in the REGISTER request (flow 5), which are obtained from the information sent back from the HSS.

Table 6.3-4a Cx: User registration status query procedure (HSS to I-CSCF)

Message source & destination	Cx Information element name	Mapping to SIP header in REGISTER	Description
HSS to I-CSCF	S-CSCF name	Request-URI:	This information indicates the serving CSCF’s name of that user

5. **REGISTER request (I-CSCF to S-CSCF) - see example in table 6.3-5**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected. The Request-URI is changed to the address of the S-CSCF.

Table 6.3-5: REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming_Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

Upon receiving this request the S-CSCF will detect that it already has a registration record for this UE and will reset it’s SIP registration timer for this UE to the Expires time in this request.

6. Cx: Authentication procedure

On receiving a REGISTER request from a registered user, the S-CSCF requires at least one authentication vector to be used in the challenge to the user. If a valid AV is not available, then the S-CSCF requests at least one AV from the HSS.

For detailed message flows see 3GPP TS 29.228.

Table 6.3-6a provides the parameters in the REGISTER request (flow 5) which need to been sent to HSS.

Table 6.3-6a Cx: S-CSCF authentication information procedure (S-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
S-CSCF to HSS	Public User Identify	To:	Identity which is used to communicate with other users
	Private User Identity	Authorization:	The Private User Identity is encoded according to the Authorization protocol.
	S-CSCF name	Request-URI:	This information indicates the serving CSCF's name of that user

7. Authentication vector selection

The S-CSCF selects an authentication vector for use in the authentication challenge. For detailed description of the authentication vector, see 3GPP TS 33.203.

NOTE 2: The authentication vector may be of the form as in 3GPP TS 33.203 (if IMS AKA is the selected authentication scheme):

- AV = $RAND_n||AUTN_n||XRES_n||CK_n||IK_n$ where:
  - RAND: random number used to generate the XRES, CK, IK, and part of the AUTN. It is also used to generate the RES at the UE.
  - AUTN: Authentication token (including MAC and SQN).
  - XRES:Expected (correct) result from the UE.
  - CK: Cipher key (optional).
  - IK: Integrity key.

8. 401 Unauthorized response (S-CSCF to I-CSCF) - see example in table 6.3-8

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.3-8: 401 Unauthorized response (S-CSCF to I-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49111
WWW-Authenticate: eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)
CSeq: 1 REGISTER
Expires: 7200
Content-Length: 0
```

NOTE 3: The actual WWW-Authenticate header value may look like this as it is in base64 form:
WWW-Authenticate: eap eap-p=QWxh4ZGRpb2jpvcGVuNlctZQ==

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

9. **401 Unauthorized response (I-CSCF to P-CSCF) - see example in table 6.3-9**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.3-9: 401 Unauthorized response (I-CSCF to P-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Contact:
Call-ID:
WWW-Authenticate:
CSeq:
Expires:
Content-Length:
```

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS

10. **401 Unauthorized response (P-CSCF to UE) - see example in table 6.3-10**

The P-CSCF removes any keys received in the 401 Unauthorized response and forwards the rest of the response to the UE.

Table 6.3-10: 401 Unauthorized response (P-CSCF to UE)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Contact:
Call-ID:
WWW-Authenticate: eap eap-p=base64(user1_private1.home1.net, RAND, AUTN)
CSeq:
Expires:
Content-Length:
```

11. **Generation of response and session keys at UE**

Upon receiving the Unauthorised response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in a REGISTER request.

12. **REGISTER request (UE to P-CSCF) - see example in table 6.3-12**

Table 6.3-12: REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49112
Authorization: eap eap-p=base64(user1_private1@home1.net, RES)
CSeq: 4 REGISTER
Expires: 7200
Content-Length: 0
```

Authorization: This carries the response to the authentication challenge received in step 10 along with the private user identity both encoded in base64 format.

13. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs ~~a~~ the DNS queriesy to locate the I-CSCF in the home network. The look up in the DNS is based on the ~~address~~ domain name specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify a numeric IP address, and the transport protocol and port are not indicated, the P-CSCF performs an NAPTR query for the domain specified in the Request-URI. ~~does not specify the transport protocol the, P-CSCF selects the UDP.~~

Table 6.13-3a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=registrar.home1.net, QCLASS=IN, QTYPE=NAPTR
```

The DNS records are retrieved according to RFC 3263 [13].

Table 6.13-3b DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=registrar.home1.net,  QCLASS=IN, QTYPE=NAPTR

registrar.home1.net         0 IN NAPTR 50   50 "s" "SIP+D2U"    ""  _sip._udp.registrar.home1.net
                            0 IN NAPTR 90   50 "s" "SIP+D2T"    ""  _sip._tcp.registrar.home1.net
                            0 IN NAPTR 100  50 "s" "SIPS+D2T"   ""  _sips._tcp.registrar.home1.net
```

Since the UDP is prefered, the P-CSCF finds the I-CSCF by a DNS SRV lookup according to RFC 2782 [4].

Table 6.3-13~~a~~c: DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 6.3-13d~~b~~: DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net        0 IN SRV 1 10 5060 icscf1_p.home1.net
                                            0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                 0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                 0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

14. **REGISTER request (P-CSCF to I-CSCF) - see example in table 6.2-14**

This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.

Table 6.3-14: REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

15. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. Because the user has registered, the HSS returns the I-CSCF with the S-CSCF address for the subscriber.

For detailed message flows see 3GPP TS 29.228.

For the parameters in the REGISTER request (flow 14) which need to be sent to HSS, see table 6.2-16a.

Table 6.3-15a provides the parameters in the REGISTER request (flow 16), which are obtained from the information sent back from the HSS

Table 6.3-15a: User registration status query response (*HSS to I-CSCF*)

Message source & destination	Cx Information element name	Mapping to SIP header in REGISTER	Description
HSS to I-CSCF	S-CSCF name	Request-URI:	This information indicates the serving CSCF's name of that user

16. **REGISTER request (I-CSCF to S-CSCF) - see example in table 6.3-16**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 6.3-16: REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

17. **Authentication**

Upon receiving the REGISTER request, carrying the authentication response, RES, the S-CSCF checks that the user's active, XRES matches the received RES. If the check is successful then the user has been authenticated and the public user identity is registered in the S-CSCF.

18. **Cx: S-CSCF registration notification procedure**

On registering a user the S-CSCF informs the HSS that the user has been re-registered at this instance.

For detailed message flows see 3GPP TS 29.228.

19. **200 OK response (S-CSCF to I-CSCF) - see example in table 6.3-19**

The S-CSCF sends acknowledgement to the I-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 6.3-19 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact: sip:[5555::aaa:bbb:ccc:ddd]
CSeq:
Date: Wed, 11 July 2001 08:49:37 GMT
Expires: 7200
Content-Length:
```

Path: The S-CSCF inserts its own name to the front of the list.

20. **200 OK response (I-CSCF to P-CSCF) - see example in table 6.3-20**

The I-CSCF forwards acknowledgement from the S-CSCF to the P-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 6.3-20: 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

21. **200 OK response (P-CSCF to UE) - see example in table 6.3-21**

The P-CSCF removes its address from the Path header, reverses the order of the fields, saves the resulting Path header and associates it with the UE. The P-CSCF then removes the Path header from the 200 OK response. The P-CSCF then forwards acknowledgement from the I-CSCF to the UE indicating that Registration was successful.

Table 6.3-21: 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

6.9.3 Registration failure – user authentication failure

This clause (see figure 6.9.3-1) shows the signalling flow with user authentication failure at step 19 of subclause 6.2 "Signalling flows for REGISTER" and a final failure of the authentication at step 30.

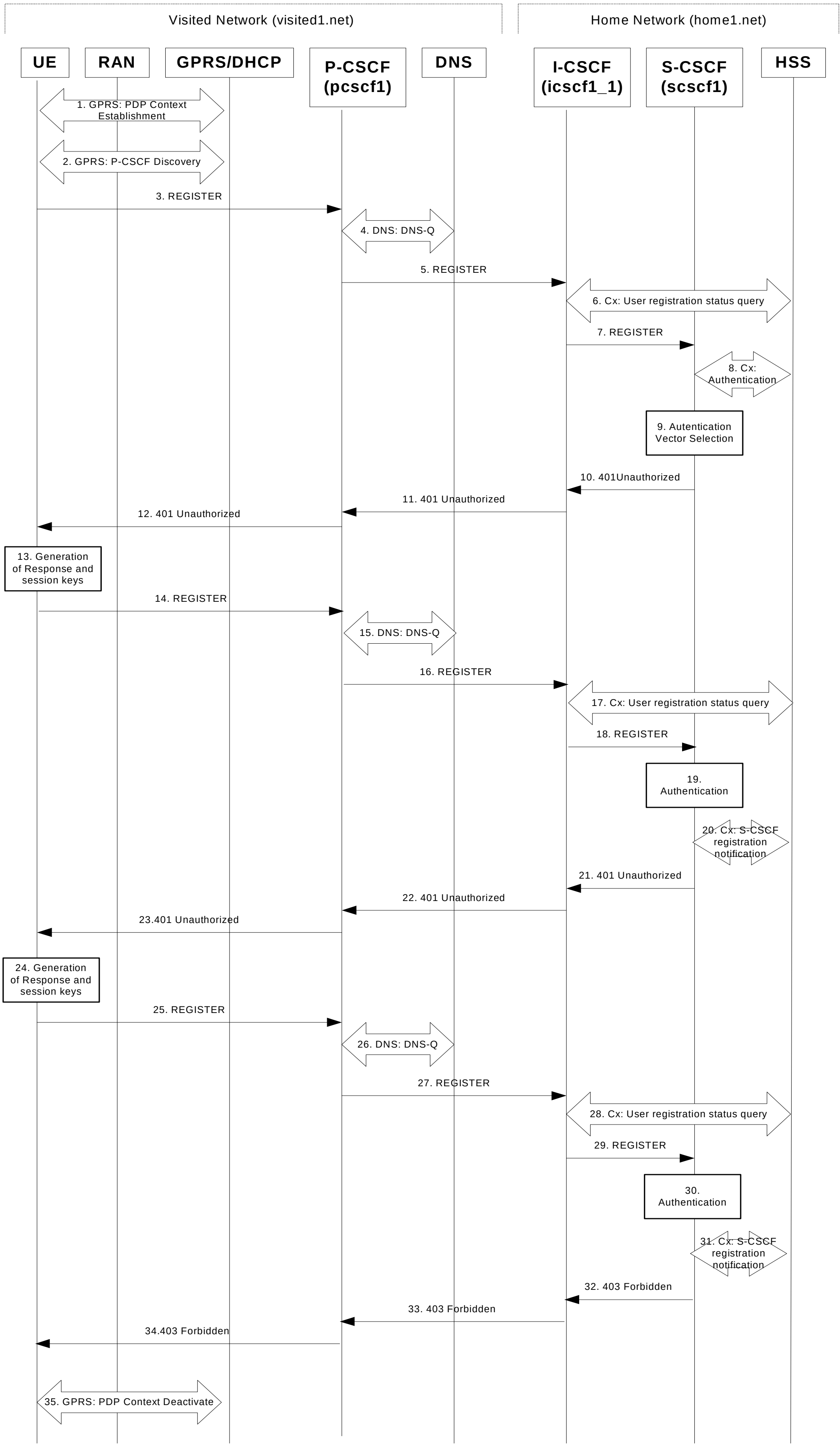


Figure 6.9.3-1: User Authentication Failure

Steps 1 through 18 are the same as the signalling flow in subclause 6.2.

19. **Authentication: User authentication fails**

Upon receiving the REGISTER request carrying the authentication response, RES, the S-CSCF checks that the user's active, XRES matches the received RES. If the check is unsuccessful then this authentication challenge fails and the public user identity is not yet registered in the S-CSCF.

At this point the S-CSCF has the option of repeating a number of authentication challenges as given in step 19 through 29. For the purposes of this flow, only one repetition is shown.

20. **Cx. SCGF registration notification**

The S-CSCF selects new authentication vectors as specified in step 9, either from the list already within the S-CSCF, or by requesting new vectors from the HSS.

21. **401 Unauthorized response (S-CSCF to I-CSCF) - see example in table 6.9.3-21**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.9.3-21: 401 Unauthorized response (S-CSCF to I-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Call-ID: apb03a0s09dkjdfglkj49111
WWW-Authenticate: eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)
CSeq: 2 REGISTER
Content-Length: 0
```

NOTE: The actual WWW-Authenticate header value may look like this as it is in base64 form:
WWW-Authenticate: eap eap-p=QWxh4ZGRpb2jpvcGVuNlctZQ==

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

22. **401 Unauthorized response(I-CSCF to P-CSCF) - see example in table 6.9.3-22**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.9.3-22: 401 Unauthorized response (I-CSCF to P-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate:
CSeq:
Content-Length:
```

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

23. **401 Unauthorized response (P-CSCF to UE) - see example in table 6.9.3-23**

The P-CSCF removes any keys received in the 401 Unauthorized response and forwards the rest of the response to the UE.

Table 6.9.3-23: 401 Unauthorized response (P-CSCF to UE)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate: eap eap-p=base64(user1_private1.home1.net, RAND, AUTN)
CSeq:
Content-Length:
```

24. **Generation of response and session keys at UE**

Upon receiving the Unauthorised response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in the REGISTER request.

25. **REGISTER request (UE to P-CSCF) - see example in table 6.9.3-25**

Table 6.9.3-25: REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49112
Authorization: eap eap-p=base64(user1_private1@home1.net, RES)
CSeq: 3 REGISTER
Expires: 7200
Content-Length: 0
```

Authorization: This carries the response to the authentication challenge received in step 12 along with the private user identity both encoded in base64 format.

26. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs ~~a~~ the DNS quer~~y~~ies to locate the I-CSCF in the home network. The look up in the DNS is based on the ~~address~~ domain name specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify a numeric IP address, and the transport protocol and port are not indicated, the P-CSCF performs an NAPTR query for the domain specified in the Request-URI. ~~does not specify the transport protocol the, P-CSCF selects the UDP.~~

Table 6.9.3-26a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=registrar.home1.net, QCLASS=IN, QTYPE=NAPTR
```

The DNS records are retrieved according to RFC 3263 [13].

Table 6.9.3-26b DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=registrar.home1.net,  QCLASS=IN, QTYPE=NAPTR

registrar.home1.net         0 IN NAPTR 50   50 "s" "SIP+D2U"    ""  _sip._udp.registrar.home1.net
                            0 IN NAPTR 90   50 "s" "SIP+D2T"    ""  _sip._tcp.registrar.home1.net
                            0 IN NAPTR 100  50 "s" "SIPS+D2T"   ""  _sips._tcp.registrar.home1.net
```

Since the UDP is prefered, the P-CSCF finds the I-CSCF by a DNS SRV lookup according to RFC 2782 [4].

Table 6.9.3-26ca: DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 6.9.3-26~~b~~d: DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net        0 IN SRV 1 10 5060 icscf1_p.home1.net
                                     0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                 0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                 0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

27. **REGISTER request (P-CSCF to I-CSCF) - see example in table 6.9.3-27**

This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.

Table 6.9.3-27: REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

28. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF required capabilities and the I-CSCF uses this information to select a suitable S-CSCF.

For detailed message flows see 3GPP TS 29.228.

Table 6.9.3-28a provides the parameters in the REGISTER request (flow 5) which need to be sent to HSS.

Table 6.9.3-28a Cx: User registration status query procedure (I-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
I-CSCF to HSS	Private User Identity	Authorization:	The Private User Identity is encoded according to the Authorization protocol.
	Public User Identity	To:	Identity which is used to communicate with other users
	Visited Network Identifier	Roaming-Info: vnid	This information indicates the network identifier of the visited network

29. **REGISTER request (I-CSCF to S-CSCF) - see example in table 6.9.3-29**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 6.9.3-29: REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

30. **Authentication**

Upon receiving the REGISTER request carrying the authentication response, RES, the S-CSCF checks that the user's active, XRES matches the received RES. If the check is unsuccessful, and no more authentication challenges are to be made, then the authentication has failed and the public user identity is not registered in the S-CSCF.

31. Cx: S-CSCF registration notification procedure

Upon user authentication failure the S-CSCF informs the HSS that the user has not been registered at this instance. The HSS clears the S-CSCF name for that subscriber.

For detailed message flows see 3GPP TS 29.229.

Table 6.9.3-31 provides the parameters in the REGISTER request (flow 18) which need to be sent to HSS.

Table 6.9.3-31 Cx: S-CSCF registration notification procedure (S-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
S-CSCF to HSS	Public User Identify	To:	Identity which is used to communicate with other users
	Private User Identity	Authorization:	The Private User Identity is encoded according to the Authorization protocol. Unique identity in IMS which is used by network to authenticate this user
	S-CSCF name	Request-URI:	This information indicates the serving CSCF's name of that user

32. **403 Forbidden response (S-CSCF to I-CSCF) - see example in table 6.9.3-32**

The S-CSCF sends an 403 Forbidden response to the I-CSCF indicating that authentication failed. No security parameters are included in this message.

Table 6.9.3-32: 403 Forbidden (S-CSCF to I-CSCF)

```
SIP/2.0 403 Forbidden
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Call-ID: apb03a0s09dkjdfglkj49111
CSeq: 3 REGISTER
Content-Length: 0
```

33. **403 Forbidden response (I-CSCF to P-CSCF) - see example in table 6.9.3-33**

The I-CSCF forwards the 403 Forbidden response from the S-CSCF to the P-CSCF indicating that authentication was unsuccessful.

Table 6.9.3-33: 403 Forbidden response (I-CSCF to P-CSCF)

```
SIP/2.0 403 Forbidden
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

34. **403 Forbidden response (P-CSCF to UE) - see example in table 6.9.3-33**

The P-CSCF forwards the 403 Forbidden response to the UE.

Table 6.9.3-34: 403 Forbidden response (P-CSCF to UE)

```
SIP/2.0 403 Forbidden
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

35. **PDP Context Deactivate**

On receiving the 403 Forbidden response the UE ceases registration and authentication attempts. In this case, if the PDP context on which the SIP signalling was being conducted is not being used for other purposes, the UE deactivates the signalling PDP context.

16.2 Registration signalling: user not registered

Figure 16.2-1 shows the registration signalling flow for the scenario when the user is not registered. For the purpose of this signalling flow, the subscriber is considered to be roaming. This flow also shows the authentication of the private user identity. In this signalling flow, the home network has network configuration hiding active.

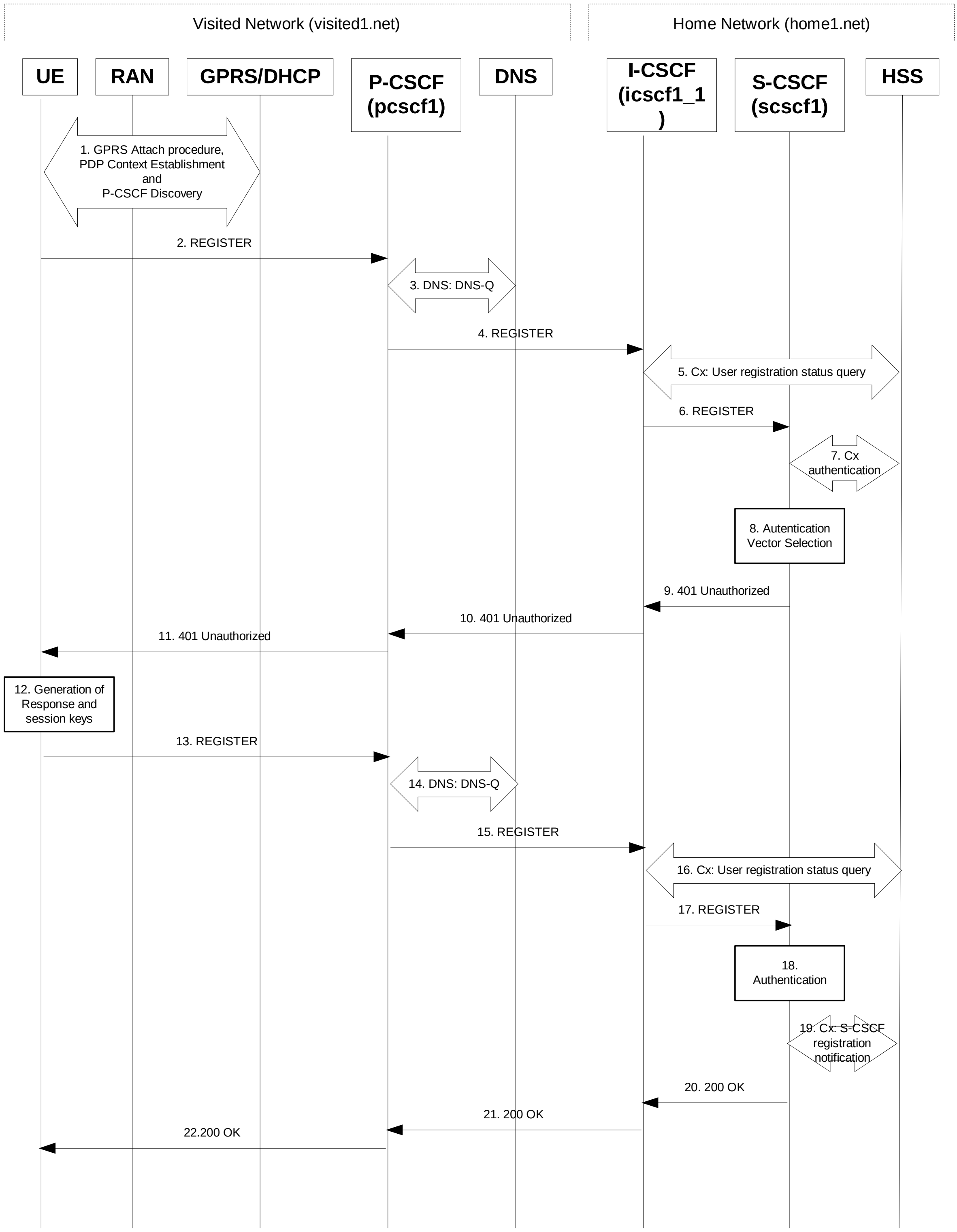


Figure 16.2-1: Registration when UE roaming

1. **GPRS Attach / PDP Context Establishment and P-CSCF Discovery (UE to GPRS)**

   This signalling flow is shown to indicate prerequisites for the registration signalling.

   See subclause 5.2 for details.

2. **REGISTER request (UE to P-CSCF) – see example in table 16.2-2**

The purpose of this request is to register the user's SIP URI with a S-CSCF in the home network. This request is routed to the P-CSCF because it is the only SIP server known to the UE. In the following SIP request, the Contact field contains the user's host address.

The P-CSCF will perform two actions, binding and forwarding. The binding is between the User's SIP address (user1_public1@home1.net) and the host (terminal) address ([5555::aaa:bbb:ccc:ddd]) which was acquired during PDP context activation process.

Editor's note: The security mode set-up procedure supports the negotiation of different protection mechanisms. This will involve the addition of a "security-setup" field to the SIP REGISTER request and the REGISTER response performing the authentication challenge containing the parameters:

list of Authentication (integrity} algorithms, and optionally list of encryption (confidentiality) algorithms

SA-ID that is used to uniquely identify the SA at the receiving side.

Key length: the length of encryption and authentication (integrity) keys is 128 bits.

The exact format and use for the security mode setup is being worked through IETF and is FFS

Table 16.2-2 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: eap eap-p=base64(user1_private1@home1.net)
CSeq: 1 REGISTER
Expires: 7200
Content-Length: 0
```

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Via: IPv6 PDP address of the SIP session allocated during the PDP Context Activation process.

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates the public user identity being registered. This is the identity by which other parties know this subscriber. It may be obtained from the USIM.

Contact: This indicates the point-of-presence for the subscriber – the IP address of the UE. This is the temporary point of contact for the subscriber that is being registered. Subsequent requests destined for this subscriber will be sent to this address. This information is stored in the P-CSCF and S-CSCF.

Editor's note: It is for further study whether this information is stored in the HSS and the S-CSCF for the subscriber in order to support multiple registrations.

Authorization: It carries authentication information. The private user identity (user1_private1@home1.net) is carried in the user ID field of the extensible authentication protocol (EAP).

Upon receiving this request the P-CSCF will set it's SIP registration timer for this UE to the Expires time in this request.

3. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs the~~a~~ DNS queries~~y~~ to locate the I-CSCF in the home network. The look up in the DNS is based on the ~~address~~ domain name specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify a numeric IP address, and the transport protocol and port are not indicated, the P-CSCF performs an NAPTR query for the domain specified in the Request-URI. ~~does not specify the transport protocol the, P-CSCF selects the UDP.~~

Table 16.2-3a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=registrar.home1.net, QCLASS=IN, QTYPE=NAPTR
```

The DNS records are retrieved according to RFC 3263 [13].

Table 16.2-3b DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=registrar.home1.net,  QCLASS=IN, QTYPE=NAPTR

registrar.home1.net         0 IN NAPTR 50   50 "s" "SIP+D2U"    ""  _sip._udp.registrar.home1.net
                            0 IN NAPTR 90   50 "s" "SIP+D2T"    ""  _sip._tcp.registrar.home1.net
                            0 IN NAPTR 100  50 "s" "SIPS+D2T"   ""  _sips._tcp.registrar.home1.net
```

Since the UDP is prefered, the P-CSCF finds the I-CSCF by a DNS SRV lookup according to RFC 2782 [4].

Table 16.2-3~~a~~c DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=_sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 16.2-3~~b~~d DNS: DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=_sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net          0 IN SRV 1 10 5060 icscf1_p.home1.com
                                              0 IN SRV 1  0 5060 icscf7_p.home1.com

icscf1_p.home1.net                     0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                     0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

4. **REGISTER request (P-CSCF to I-CSCF) – see example in table 16.2-4**

The P-CSCF needs to be in the path for all mobile originated and mobile terminated requests for this user. To ensure this, the P-CSCF adds itself to the path for future requests.

The P-CSCF binds the public user identity under registration to the Contact header supplied by the user.

The P-CSCF adds also the Roaming-Info header (if not present). The P-CSCF adds the *vnid* parameter with the contents of the identifier of the P-CSCF network. This may be the visited network domain name or any other identifier that identifies the visited network at the home network.

This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 16.2-4 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

Require:/Proxy-Require: These headers are included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating "path". Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

5. **Cx: User registration status query procedure**

The I-CSCF makes a request for information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF required capabilities and the I-CSCF uses this information to select a suitable S-CSCF.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-5a provides the parameters in the REGISTER request (flow 4) which need to been sent to HSS.

6. **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.2-6**

I-CSCF adds a proper I-CSCF name to the Path header.

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected. The Request-URI is changed to the address of the S-CSCF.

Table 16.2-6 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
        pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
```

```
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

Upon receiving this request the S-CSCF will set it's SIP registration timer for this UE to the Expires time in this request.

7. **Cx: S-CSCF authentication procedure**

On receiving a REGISTER request from an unauthenticated user, the S-CSCF requires at least one authentication vector to be used in the challenge to the user. If a valid AV is not available, then the S-CSCF requests at least one AV from the HSS.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-7a provides the parameters in the REGISTER request (flow 6) which need to been sent to HSS.

8. **Authentication vector selection**

The S-CSCF selects an authentication vector for use in the authentication challenge. For detailed description of the authentication vector, see 3GPP TS 33.203.

NOTE 1: The authentication vector may be of the form 3GPP TS 33.203 (if IMS AKA is the selected authentication scheme):

$AV = RAND_n||AUTN_n||XRES_n||CK_n||IK_n$ where:

- RAND: random number used to generate the XRES, CK, IK, and part of the AUTN. It is also used to generate the RES at the UE.
- AUTN: Authentication token (including MAC and SQN).
- XRES: Expected (correct) result from the UE.
- CK: Cipher key (optional).
- IK: Integrity key.

9. **401 Unauthorized response (S-CSCF to I-CSCF) – see example in table 16.2-9**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 16.2-9: 401 Unauthorized response (S-CSCF to I-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To: <sip:user1_public1@home1.net>; tag=5ef4
Call-ID:
WWW-Authenticate: eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)
CSeq:
Content-Length:
```

NOTE 2: The actual WWW-Authenticate header value may look like this as it is in base64 form:

- WWW-Authenticate: eap eap-p=QWxh4ZGRpb2jpvcGVuNlctZQ==

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

10. **401 Unauthorized response (I-CSCF to P-CSCF) – see example in table 16.2-10**

    The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 16.2-10: 401 Unauthorized response (I-CSCF to P-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate:
CSeq:
Content-Length:
```

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

11. **401 Unauthorized response (P-CSCF to UE) – see example in table 16.2-11**

    The P-CSCF removes any keys received in the 401 Unauthorized response and forwards the rest of the response to the UE.

Table 16.2-11: 401 Unauthorized response (P-CSCF to UE)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate:
CSeq:
Content-Length:
```

12. **Generation of response and session keys at UE**

    Upon receiving the Unauthorized response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in the REGISTER request.

13. **REGISTER request (UE to P-CSCF) – see example in table 16.2-13**

Table 16.2-13 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49112
Authorization: eap eap-p=base64(user1_private1@home1.net, RES)
CSeq: 2 REGISTER
Expires: 7200
Content-Length: 0
```

Authorization: This carries the response to the authentication challenge received in step 11 along with the private user identity both encoded in base64 format.

14. **DNS: DNS-Q**

    Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs ~~a~~the DNS queries~~y~~ to locate the I-CSCF in the home network. The look up in the DNS is based on the ~~address~~ domain name specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify a numeric IP address, and the transport protocol and port are not indicated, the P-CSCF performs an NAPTR query for the domain specified in the Request-URI. ~~does not specify the transport protocol the, P-CSCF selects the UDP.~~

Table 16.2-14a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=registrar.home1.net, QCLASS=IN, QTYPE=NAPTR
```

The DNS records are retrieved according to RFC 3263 [13].

Table 16.2-14b DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=registrar.home1.net,  QCLASS=IN, QTYPE=NAPTR

registrar.home1.net         0 IN NAPTR 50   50 "s" "SIP+D2U"    ""  _sip._udp.registrar.home1.net
                            0 IN NAPTR 90   50 "s" "SIP+D2T"    ""  _sip._tcp.registrar.home1.net
                            0 IN NAPTR 100  50 "s" "SIPS+D2T"   ""  _sips._tcp.registrar.home1.net
```

Since the UDP is prefered, the P-CSCF finds the I-CSCF by a DNS SRV lookup according to RFC 2782 [4].

Table 16.2-14ac DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 16.2-14~~b~~d DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net           0 IN SRV 1 10 5060 icscf1_p.home1.net
                                               0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                 0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                 0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

15. **REGISTER request (P-CSCF to I-CSCF) – see example in table 16.2-15**

This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.

Table 16.2-15 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
```

```
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

16. **Cx: User registration status query procedure**

    The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF required capabilities and the I-CSCF uses this information to select a suitable S-CSCF.

    For detailed message flows see 3GPP TS 29.228.

    Table 6.2-16a provides the parameters in the REGISTER request (flow 15) which need to been sent to HSS.

17. **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.2-17**

    This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 16.2-17 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

18. **Authentication**

    Upon receiving the REGISTER request, carrying the authentication response, RES, the S-CSCF checks that the user's active XRES matches the received RES. If the check is successful then the user has been authenticated and the public user identity is registered in the S-CSCF.

19. **Cx: S-CSCF registration notification procedure**

    On registering a user the S-CSCF informs the HSS that the user has been registered at this instance. The HSS stores the S-CSCF name for that subscriber. For a positive response, the HSS will include the user profile in the response sent to the S-CSCF.

    For detailed message flows see 3GPP TS 29.228.

    Table 6.2-19a provides the parameters in the SIP REGISTER request (flow 17) which need to been sent to HSS.

20. **200 OK response (S-CSCF to I-CSCF) – see example in table 16.2-20**

The S-CSCF sends acknowledgement to the I-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.2-20 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net>, <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact: sip:[5555::aaa:bbb:ccc:ddd]
CSeq:
Date: Wed, 11 July 2001 08:49:37 GMT
Expires: 7200
Content-Length:
```

Path: The S-CSCF inserts its own name to the front of the list.

21. **200 OK response (I-CSCF to P-CSCF) – see example in table 16.2-21**

The I-CSCF translates the S-CSCF name in the Path header. The I-CSCF forwards acknowledgement from the S-CSCF to the P-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.2-21 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:token(scscf1.home1.net)>, <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

22. **200 OK response (P-CSCF to UE) – see example in table 16.2-22**

The P-CSCF removes its address from the Path header, reverses the order of the fields, saves the resulting Path header and associates it with the UE. The P-CSCF then removes the Path header from the 200 OK response. The P-CSCF then forwards acknowledgement from the I-CSCF to the UE indicating that Registration was successful.

Table 16.2-22 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

16.3 Registration signalling: reregistration – user currently registered

For the purpose of the reregistration signalling flow shown in figure 16.3-1, the subscriber is considered to be roaming. This flow also shows the authentication of the private user identity. In this signalling flow, the home network has network configuration hiding active.

This signalling flow assumes:

1. That the same PDP Context allocated during the initial registration scenario is still used for reregistration. For the case when the UE does not still have an active PDP context then PDP context procedures from subclause 16.2 is completed first.

Editor's Note: If the same PDP-Context is not available, is it guaranteed that the UE will get back the same IP address at this point? If this is not possible, would there be a problem with the binding in the P-CSCF (user_public1@home1.net and [5555::aaa:bbb:ccc:ddd])?2. The DHCP procedure employed for P-CSCF discovery is not needed.

2. The S-CSCF selection procedure invoked by the I-CSCF is not needed.

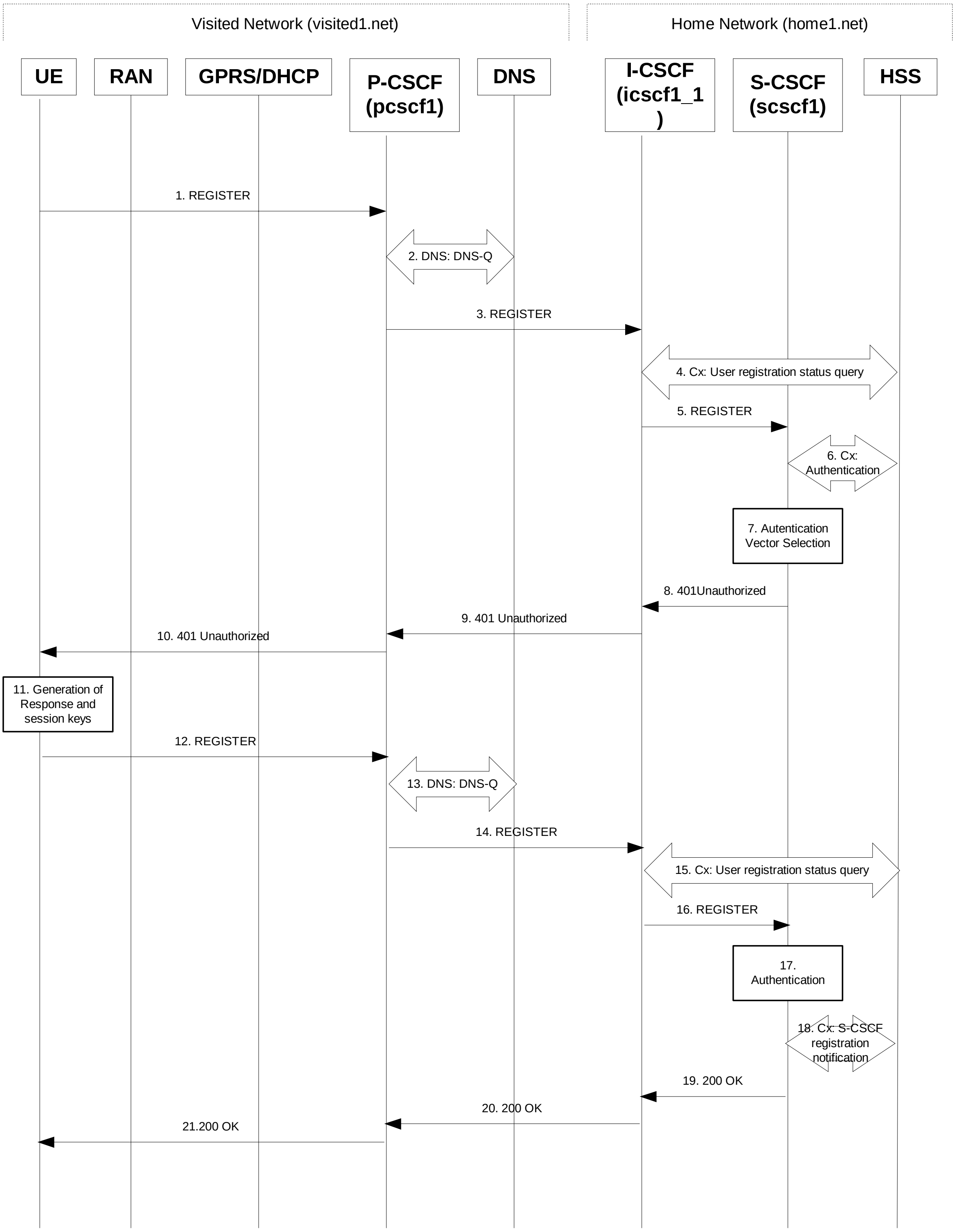


Figure 16.3-1: Reregistration when UE roaming

1. **REGISTER request (UE to P-CSCF) – see example in table 16.3-1**

   The registration expires in the UE. The UE reregisters by sending a new REGISTER request. This request is sent to the same P-CSCF with which the UE initially registered. The P-CSCF maintains the same binding between the User's SIP public address (user1_public1@home1.net) and the host (terminal) address ([5555::aaa:bbb:ccc:ddd]) which it established during the original registration.

Table 16.3-1 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: eap eap-p=base64(user1_private1@home1.net)
CSeq: 3 REGISTER
Expires: 7200
Content-Length: 0
```

The header field usage is the same as for the initial registration scenario:

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates public user identity being registered. This is the identity by which other parties know this subscriber.

Contact: This indicates the point-of-presence for the subscriber – the IP address of the UE. This is the temporary identifier for the subscriber that is being registered. Subsequent requests destined for this subscriber will be sent to this address. This information is stored in the P-CSCF.

Editor's note: It is for further study whether this information is stored in the HSS and the S-CSCF for the subscriber in order to support multiple registrations.

Authorization: It carries authentication information. The private user identity (user1_private1@home1.net) is carried in the user ID field of the extensible authentication protocol (EAP).

NOTE 1: The actual Authorization header value may look like this as it is in base64 form:

- Authorization: eap eap-p=QWxhZGRpbjpvcGVuIHNlc2FtZQ==

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Upon receiving this request the P-CSCF will detect that it already has a registration record for this UE and will reset it's SIP registration timer for this UE to the Expires time in this request.

2. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs the~~a~~ DNS queries~~y~~ to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI. The DNS provides the P-CSCF with an address of the I-CSCF in the home network. The P-CSCF must not use the I-CSCF address cached as a result of the previous registration.

3. **REGISTER request (P-CSCF to I-CSCF) – see example in table 16.3-3**

This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 16.3-3 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:Call-ID:
Authorization: eap eap-p=base64(user1_private1@home1.net)
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

Require:/Proxy-Require: These headers are included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating "path". Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

4. **Cx: User registration status query procedure**

   The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. Because the user has registered, the HSS returns the I-CSCF with the S-CSCF address for the subscriber

   For detailed message flows see 3GPP TS 29.228.

   For the parameters in the REGISTER request (flow 3), which are sent to the HSS, see table 6.2-5a.

   Table 6.3-4a provides the parameters in the SIP REGISTER request (flow 5), which are obtained from the information sent back from the HSS.

5. **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.3-5**

   This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected. The Request-URI is changed to the address of the S-CSCF.

   I-CSCF adds a proper I-CSCF name to the Path header.

Table 16.3-5 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Authorization: eap eap-p=base64(user1_private1@home1.net)
Call-ID:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

Upon receiving this request the S-CSCF will detect that it already has a registration record for this UE and will reset it's SIP registration timer for this UE to the Expires time in this request.

6. **Cx: Authentication procedure**

On receiving a REGISTER request from a registered user, the S-CSCF requires at least one authentication vector to be used in the challenge to the user. If a valid AV is not available, then the S-CSCF requests at least one AV from the HSS.

For detailed message flows see 3GPP TS 29.228.

Table 6.3-6a provides the parameters in the REGISTER request (flow 5), which are sent to the HSS.

7. **Authentication vector selection**

The S-CSCF selects an authentication vector for use in the authentication challenge. For detailed description of the authentication vector, see 3GPP TS 33.203.

NOTE 2: The authentication vector may be of the form 3GPP TS 33.203 (if IMS AKA is the selected authentication scheme):

AV = RANDn||AUTNn||XRESn||CKn||IKn where:

- RAND: random number used to generate the XRES, CK, IK, and part of the AUTN. It is also used to generate the RES at the UE.
- AUTN: Authentication token (including MAC and SQN).
- XRES: Expected (correct) result from the UE.
- CK: Cipher key (optional).
- IK: Integrity key.

8. **401 Unauthorized response (S-CSCF to I-CSCF) – see example in table 16.3-8**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 16.3-8: 401 Unauthorized response (S-CSCF to I-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate: eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)
CSeq:
Content-Length:
```

NOTE 3: The actual WWW-Authenticate header value may look like this as it is in base64 form:

- WWW-Authenticate: eap eap-p=QWxh4ZGRpb2jpvcGVuNlctZQ==

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

9. **401 Unauthorized response (I-CSCF to P-CSCF) – see example in table 16.3-9**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 16.3-9: 401 Unauthorized response (I-CSCF to P-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate: eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)
CSeq:
Content-Length:
```

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

10. **401 Unauthorized response (P-CSCF to UE) – see example in table 16.3-10**

The P-CSCF removes any keys received in the 401 Unauthorized response and forwards the rest of the response to the UE.

Table 16.3-10: 401 Unauthorized response (P-CSCF to UE)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate:
CSeq:
Content-Length:
```

11. **Generation of response and session keys at UE**

Upon receiving the Unauthorised response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in the REGISTER request.

12. **REGISTER request (UE to P-CSCF) – see example in table 16.3-12**

Table 16.3-12 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49112
Authorization: eap eap-p=base64(user1_private1@home1.net, RES)
CSeq: 4 REGISTER
Expires: 7200
Content-Length: 0
```

Authorization: This carries the response to the authentication challenge received in step 10 along with the private user identity both encoded in base64 format.

13. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs ~~a~~the DNS queries~~y~~ to locate the I-CSCF in the home network. The look up in the DNS is based on the ~~address~~ domain name specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify a numeric IP address, and the transport protocol and port are not indicated, the P-CSCF performs an NAPTR query for the domain specified in the Request-URI. ~~does not specify the transport protocol the, P-CSCF selects the UDP.~~

Table 16.2-13a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=registrar.home1.net, QCLASS=IN, QTYPE=NAPTR
```

The DNS records are retrieved according to RFC 3263 [13].

Table 16.2-13b DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=registrar.home1.net,  QCLASS=IN, QTYPE=NAPTR

registrar.home1.net         0 IN NAPTR 50   50 "s" "SIP+D2U"    ""  _sip._udp.registrar.home1.net
                            0 IN NAPTR 90   50 "s" "SIP+D2T"    ""  _sip._tcp.registrar.home1.net
                            0 IN NAPTR 100  50 "s" "SIPS+D2T"   ""  _sips._tcp.registrar.home1.net
```

Since the UDP is prefered, the P-CSCF finds the I-CSCF by a DNS SRV lookup according to RFC 2782 [4].

Table 16.3-13~~a~~c DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC2782 [4].

Table 16.3-13~~b~~d DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net           0 IN SRV 1 10 5060 icscf1_p.home1.net
                                        0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                 0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                 0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

14. **REGISTER request (P-CSCF to I-CSCF) – see example in table 16.3-14**

This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.

Table 16.3-14 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
```

```
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

15. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. Because the user has registered, the HSS returns the I-CSCF with the S-CSCF address for the subscriber.

For detailed message flows see 3GPP TS 29.228.

For the parameters in the REGISTER request (flow 14), which are sent to the HSS, see table 6.2-16a.

Table 6.3-15a provides the parameters in the REGISTER request (flow 16), which are obtained from the information sent back from the HSS.

16. **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.3-16**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 16.3-16 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

17. **Authentication**

Upon receiving the REGISTER request, carrying the authentication response, RES, the S-CSCF checks that the user's active XRES matches the received RES. If the check is successful then the user has been authenticated and the public user identity is registered in the S-CSCF.

18. **Cx: S-CSCF registration notification procedure**

On registering a user the S-CSCF informs the HSS that the user has been registered at this instance. The HSS stores the S-CSCF name for that subscriber. For a positive response, the HSS will include the user profile in the response sent to the S-CSCF.

For detailed message flows see 3GPP TS 29.228.

For the parameters in the REGISTER request (flow 16), which are sent to HSS, see table 6.2-19a.

19. **200 OK response (S-CSCF to I-CSCF) – see example in table 16.3-19**

The S-CSCF sends acknowledgement to the I-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.3-19 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net>, <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact: sip:[5555::aaa:bbb:ccc:ddd]
CSeq:
Date: Wed, 11 July 2001 08:49:37 GMT
Expires: 7200
Content-Length:
```

Path: The S-CSCF inserts its own name to the front of the list.

20. **200 OK response (I-CSCF to P-CSCF) – see example in table 16.3-20**

The I-CSCF translates the S-CSCF name in the Path header. The I-CSCF forwards acknowledgement from the S-CSCF to the P-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.3-20 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:token(scscf1.home1.net)>, <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

21. **200 OK response (P-CSCF to UE) – see example in table 16.3-21**

The P-CSCF removes its address from the Path header, reverses the order of the fields, saves the resulting Path header and associates it with the UE. The P-CSCF then removes the Path header from the 200 OK response. The P-CSCF then forwards acknowledgement from the I-CSCF to the UE indicating that Registration was successful.

Table 16.3-21 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

3GPP TSG-CN1 Meeting #23 **Tdoc N1-020904~~765~~**
Fort Lauderdale, Florida, USA 08. - 12. April 2002

CR-Form-v5

CHANGE REQUEST

⌘	24.228	CR	002	⌘ rev	1	⌘	Current version:	5.0.0	⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [X] Radio Access Network [ ] Core Network [X]

Title:	⌘	Update of the authorization flows
Source:	⌘	Ericsson
Work item code:	⌘	IMS-CCR
Date:	⌘	11-Apr-02
Category:	⌘	**F**
Release:	⌘	REL-5

Use one of the following categories:
F (correction)
A (corresponds to a correction in an earlier release)
B (addition of feature),
C (functional modification of feature)
D (editorial modification)
Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:
2 (GSM Phase 2)
R96 (Release 1996)
R97 (Release 1997)
R98 (Release 1998)
R99 (Release 1999)
REL-4 (Release 4)
REL-5 (Release 5)

Reason for change:	⌘	The authorization flows in 24.228 are out of date. The latest working assumption in stage 2 is that Digest AKA is the authentication protocol, instead of EAP AKA. This CR also introduces the transport of IK and CK from the S-CSCF to the P-CSCF. The P-CSCF also indicates to the S-CSCF whether the message was received integrity protected or not.
Summary of change:	⌘	Replacement of the EAP AKA authentication by Digest AKA. General cleanup. Addition of the IK and CK directives. Addition of the Integrity-protected directives
Consequences if not approved:	⌘	TS not in line with the stage 2 description

Clauses affected:	⌘	6.1, 6.2, 6.3, 6.9.3, 16.2, 16.3, 16.4 and 16.9.1
Other specs affected:	⌘	[X] Other core specifications ⌘ 24.229 [ ] Test specifications [ ] O&M Specifications
Other comments:	⌘	

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

********** First proposed change ****************************

6 Signalling flows for REGISTER (non hiding)

6.1 Introduction

In IMS Authentication is performed at registration time. The following sections show examples of SIP registration and UMTS AKA authentication. It is possible for the home to require other types of authentication.

In the example below, ~~Extensible Authentication Protocol (EAP)~~ Digest AKA is used within SIP headers to carry the information related to the authentication-challenge and response.

********** Next proposed change ****************************

6.2 Registration signalling: user not registered

Figure 6.2-1 shows the registration signalling flow for the scenario when the user is not registered. For the purpose of this registration signalling flow, the subscriber is considered to be roaming. This flow also shows the authentication of the private user identity. In this signalling flow, the home network does not have network configuration hiding active.

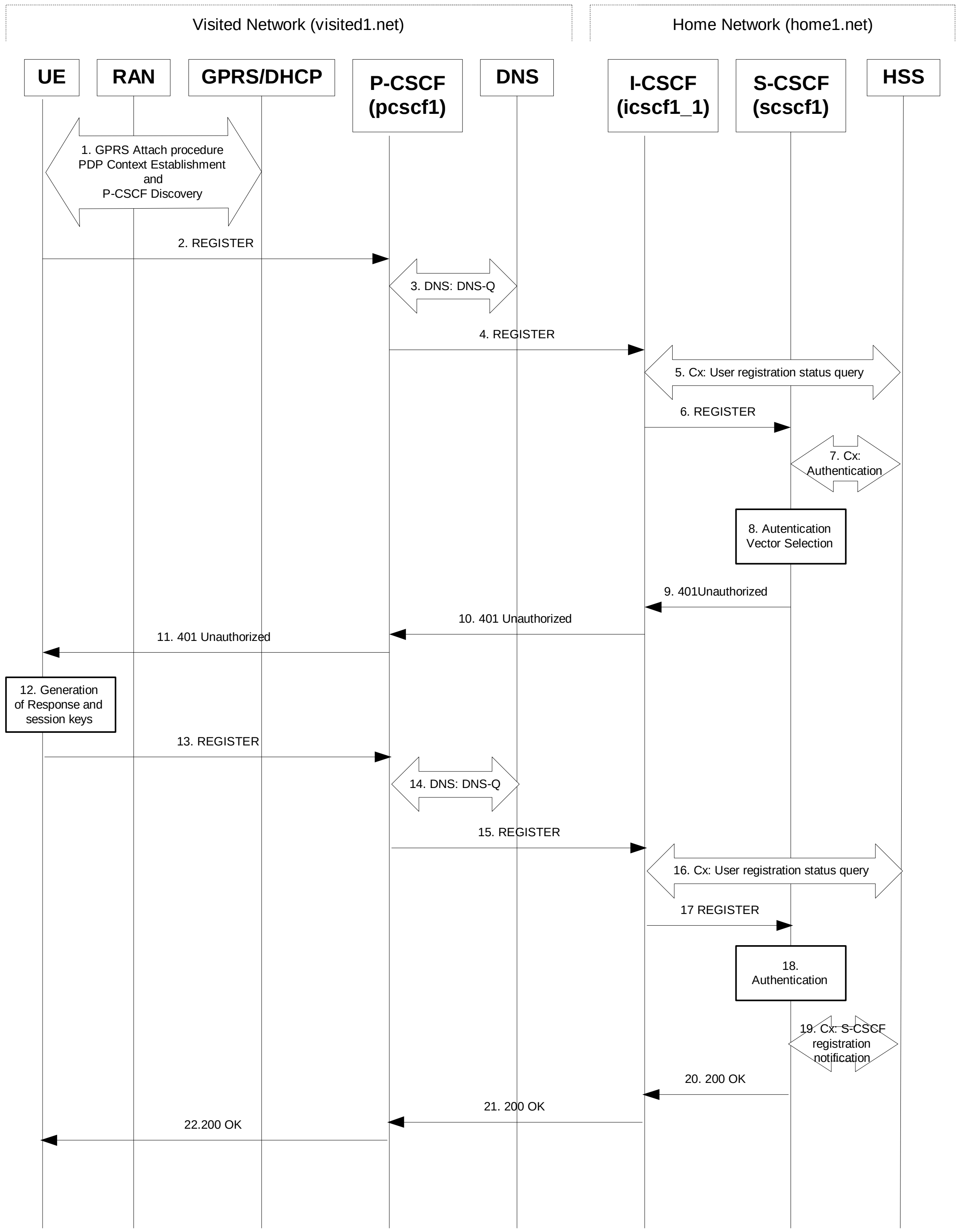


Figure 6.2-1: Registration signalling: user not registered

1. **GPRS Attach / PDP Context Establishment and P-CSCF Discovery (UE to GPRS)**

   This signalling flow is shown to indicate prerequisites for the registration signalling.

   See subclause 5.2 for details.

2. **REGISTER request (UE to P-CSCF) – see example in table 6.2-2**

The purpose of this request is to register the user's SIP URI with a S-CSCF in the home network. This request is routed to the P-CSCF because it is the only SIP server known to the UE. In the following SIP request, the Contact field contains the user's host address.

The P-CSCF will perform two actions, binding and forwarding. The binding is between the User's SIP address (user1_public1@home1.net) and the host (terminal) address ([5555::aaa:bbb:ccc:ddd]) which was acquired during PDP context activation process.

~~[Editor's note: The security mode set-up procedure supports the negotiation of different protection mechanisms. This will involve the addition of a "security-setup" field to the SIP REGISTER request and the REGISTER response performing the authentication challenge containing the parameters:~~

~~-list of Authentication (integrity} algorithms, and optionally list of encryption (confidentiality) algorithms~~

~~-SA-ID that is used to uniquely identify the SA at the receiving side.~~

~~-Key length: the length of encryption and authentication (integrity) keys is 128 bits.~~

~~The exact format and use for the security mode setup is being worked through IETF and is FFS]~~

Table 6.2-2: REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: eap eap-p=base64(user1_private1@home1.net)Digest
             username="user1_private@home1.net", realm="registrar.home1.net", nonce="",
             uri="sip:registrar.home1.net", response=""
CSeq: 1 REGISTER
Expires: 7200
Content-Length: 0
```

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Via: IPv6 address of the SIP session allocated during the PDP Context Activation process.

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates the public user identity being registered. This is the identity by which other parties know this subscriber. It may be obtained from the USIM.

Contact: This indicates the point-of-presence for the subscriber - the IP address of the UE. This is the temporary point of contact for the subscriber that is being registered. Subsequent requests destined for this subscriber will be sent to this address. This information is stored in the P-CSCF and S-CSCF.

Authorization: It carries authentication information. The private user identity (user1_private~~1~~@home1.net) is carried in the~~ user ID~~username field of the ~~extensible authentication protocol (EAP)~~Digest AKA protocol. The uri- parameter (directive) -contains the same value as the Request-URI. The realm parameter (directive) contains the network name where the username is ~~valid~~authenticated. The Request-URI and the realm parameter (directive) value are obtained from the same field in the USIM and therefore, are identical. In this example, it is assumed that a new ~~SIM~~UICC card was just inserted into the terminal, and there is no other cached information to send. Therefore, nonce and response parameters (directives) are empty.

~~NOTE: The actual Authorization header value may look like this as it is in base64 form:~~
~~Authorization: eap eap-p=QWxhZGRpbjpvcGVuIHNlc2FtZQ==~~

Upon receiving this request the P-CSCF will set it's SIP registration timer for this UE to the Expires time in this request.

3. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify the transport protocol, the P-CSCF selects the UDP.

Table 6.2-3a: DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=_sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 6.2-3b: DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=_sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net        0 IN SRV 1 10 5060 icscf1_p.home1.net
                                        0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                 0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                 0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

4. **REGISTER request (P-CSCF to I-CSCF) - see example in table 6.2-4**

The P-CSCF needs to be in the path for all mobile originated and mobile terminated requests for this user. To ensure this, the P-CSCF adds itself to the Path header value for future requests.

The P-CSCF binds the public user identity under registration to the Contact header supplied by the user.

The P-CSCF adds also the Roaming-Info header (if not present). The P-CSCF adds the *vnid* parameter with the contents of the identifier of the P-CSCF network. This may be the visited network domain name or any other identifier that identifies the visited network at the home network.

This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 6.2-4: REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
nonce="", uri="sip:registrar.home1.net", response="", integrity-protected="no"
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

Require:/Proxy-Require: These headers are included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating "path". Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

5. **Cx: User registration status query procedure**

The I-CSCF makes a request for information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF required capabilities and the I-CSCF uses this information to select a suitable S-CSCF.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-5a provides the parameters in the REGISTER request (flow 4) which are sent to the HSS.

Table 6.2-5a Cx: User registration status query procedure (I-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
I-CSCF to HSS	Private User Identity	Authorization:	The Private User Identity is encoded in the username field according to the Authorization protocol.
	Public User Identity	To:	Identity which is used to communicate with other users
	Visited Network Identifier	Roaming Info: vnid	This information indicates the network identifier of the visited network

6. **REGISTER request (I-CSCF to S-CSCF) – see example in table 6.2-6**

I-CSCF does not modify the Path header.

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 6.2-6: REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

Upon receiving this request the S-CSCF may set its SIP registration timer for this UE to the Expires time in this request or the S-CSCF may assign another registration timer for this registration

7. **Cx: Authentication procedure**

On receiving a REGISTER request from an unauthenticated user, the S-CSCF requires at least one authentication vector to be used in the challenge to the user. If a valid AV is not available, then the S-CSCF requests at least one AV from the HSS.

The S-CSCF indicates to the HSS that it has been assigned to serve this user.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-7a provides the parameters in the REGISTER request (flow 6) which are sent to the HSS.

Table 6.2-7a Cx: S-CSCF authentication information procedure (S-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
S-CSCF to HSS	Public User Identify	To:	Identity which is used to communicate with other users
	Private User Identity	Authorization:	The Private User Identity is encoded in the username field according to the Authorization protocol.
	S-CSCF Name	Request-URI:	This information element contains the name of the S-CSCF. The presence of this IE indicates that the user has not been authenticated yet by the S-CSCF

8. **Authentication vector selection**

The S-CSCF selects an authentication vector for use in the authentication challenge. For detailed description of the authentication vector, see 3GPP TS 33.203.

NOTE 1: The authentication vector may be of the form as in 3GPP TS 33.203 (if IMS AKA is the selected authentication scheme):

- AV = $RAND_n||AUTN_n||XRES_n||CK_n||IK_n$ where:
  - RAND: random number used to generate the XRES, CK, IK, and part of the AUTN. It is also used to generate the RES at the UE.
  - AUTN: Authentication token (including MAC and SQN).
  - XRES: Expected (correct) result from the UE.
  - CK: Cipher key (optional).
  - IK: Integrity key.

9. **401 Unauthorized response (S-CSCF to I-CSCF) - see example in table 6.2-9**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.2-9: 401 Unauthorized response (S-CSCF to I-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Call-ID: apb03a0s09dkjdfglkj49111
WWW-Authenticate: eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)Digest
                realm="registrar.home1.net", nonce=base64(RAND + AUTN + server specific data),
                algorithm=AKAv1-MD5, ik="00112233445566778899aabbccddeeff",
                ck="ffeeddccbbaa11223344556677889900"
CSeq: 1 REGISTER
Content-Length: 0
```

~~NOTE 2: The actual WWW-Authenticate header value may look like this as it is in base64 form: WWW-Authenticate: eap eap-p=QWxh4ZGRpb2jpvcGVuNlctZQ==~~

WWW-Authenticate: The S-CSCF challenges the user. The nonce includes the quoted string, base64 encoded value of the concatenation of the AKA RAND, AKA AUTN and server specific data. The S-CSCF appends also the Integrity Key (IK) and the Cyphering key (CK).

NOTE 2:— The actual nonce value in the WWW-Authenticate header field is encoded in base64, and it may look like:
nonce="A34Cm+Fva37UYWpGNB34JP"

~~Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.~~

10. **401 Unauthorized response (I-CSCF to P-CSCF) - see example in table 6.2-10**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.2-10: 401 Unauthorized response (I-CSCF to P-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate:
CSeq:
Content-Length:
```

~~Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.~~

11. **401 Unauthorized response (P-CSCF to UE) - see example in table 6.2-11**

The P-CSCF removes any keys received in the 401 Unauthorized response and forwards the rest of the response to the UE.

Table 6.2-11: 401 Unauthorized response (P-CSCF to UE)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate: Digest realm="registrar.home1.net", nonce=base64(RAND + AUTN + server
                 specific data), algorithm=AKAv1-MD5

eap eap-p=base64(user1_private1.home1.net, RAND, AUTN)
CSeq:
Content-Length:
```

WWW-Authenticate: The P-CSCF removes the ik and ck parameters (directives) from the header.

12. **Generation of response and session keys at UE**

Upon receiving the Unauthorised response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in the REGISTER request.

13. **REGISTER request (UE to P-CSCF) - see example in table 6.2-13**

Table 6.2-13 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49112
Authorization: eap eap-p=base64(user1_private1@home1.net, RES) Digest
              username="user1_private@home1.net", realm="registrar.home1.net",
              nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
              uri="sip:registrar.home1.net", response="6629fae49393a05397450978507c4ef1"
CSeq: 2 REGISTER
Expires: 7200
Content-Length: 0
```

Authorization: This carries the response to the authentication challenge received in step 11 along with the private user identity, the realm, the nonce, the URI and the algorithm ~~both encoded in base64 format~~.

14. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify the transport protocol the, P-CSCF selects the UDP.

Table 6.2-14a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 6.2-14b DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net        0 IN SRV 1 10 5060 icscf1_p.home1.net
                                        0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                 0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                 0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

15. **REGISTER request (P-CSCF to I-CSCF) - see example in table 6.2-15**

This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.

Table 6.2-15 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
uri="sip:registrar.home1.net", response="6629fae49393a05397450978507c4ef1", integrity-
protected="yes"
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

16. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF name which was previously selected in step 5 (Cx: User registration status query procedure).

For detailed message flows see 3GPP TS 29.228.

Table 6.2-16a provides the parameters in the REGISTER request (flow 15), which are sent to the HSS.

Table 6.2-16a Cx: User registration status query procedure (I-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description

I-CSCF to HSS	Private User Identity	Authorization:	The Private User Identity is encoded in the username field according to the Authorization protocol.
	Public User Identity	To:	Identity which is used to communicate with other users
	Visited Network Identifier	Roaming-Info: vnid	This information indicates the network identifier of the visited network

17. **REGISTER request (I-CSCF to S-CSCF) - see example in table 6.2-17**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF.

Table 6.2-17: REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

18. **Authentication**

Upon receiving the REGISTER request carrying the authentication response, RES, the S-CSCF checks that the user's active, XRES matches the received RES. If the check is successful then the user has been authenticated and the public user identity is registered in the S-CSCF.

19. **Cx: S-CSCF registration notification procedure**

On registering a user the S-CSCF informs the HSS that the user has been registered at this instance. Upon being requested by the S-CSCF , the HSS will also include the user profile in the response sent to the S-CSCF.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-19a provides the parameters in the REGISTER request (flow 17), which are sent to the HSS.

Table 6.2-19a Cx: S-CSCF registration notification procedure (S-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
S-CSCF to HSS	Public User Identify	To:	Identity which is used to communicate with other users
	Private User Identity	Authorization:	The Private User Identity is encoded in the username field according to the Authorization protocol. ~~Unique identity in IMS which is used by network to authenticate this user~~

	S-CSCF name	Request-URI:	This information indicates the serving CSCF's name of that user

20. **200 OK response (S-CSCF to I-CSCF) - see example in table 6.2-20**

The S-CSCF sends acknowledgement to the I-CSCF indicating that Registration was successful.

Table 6.2-20: 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact: sip:[5555::aaa:bbb:ccc:ddd]
CSeq:
Date: Wed, 11 July 2001 08:49:37 GMT
Expires: 7200
Content-Length:
```

Path: The S-CSCF inserts its own name to the front of the list.

21. **200 OK response (I-CSCF to P-CSCF) - see example in table 6.2-21**

The I-CSCF forwards acknowledgement from the S-CSCF to the P-CSCF indicating that Registration was successful.

Table 6.2-21: 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

22. **200 OK response (P-CSCF to UE) - see example in table 6.2-22**

The P-CSCF removes its address from the Path header, reverses the order of the fields, saves the resulting Path header and associates it with the UE. The P-CSCF then removes the Path header from the 200 OK response. The P-CSCF then forwards acknowledgement from the I-CSCF to the UE indicating that Registration was successful.

Table 6.2-22: 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

********** Next proposed change ******************************

6.3 Registration signalling: reregistration - user currently registered

For the purpose of the reregistration signalling flow shown in figure 6.3-1, the subscriber is considered to be roaming. The HSS information indicates that the subscriber is registered and authenticated, and that the S-CSCF has been allocated to this subscriber. In this signalling flow, the home network does not have network configuration hiding active. This flow also shows the authentication of the private user identity.

This signalling flow assumes:

1. That the same PDP Context allocated during the initial registration scenario is still used for reregistration. For the case when the UE does not still have an active PDP context then PDP context procedures from subclause 16.2 is completed first.

Editor's Note: If the same PDP-Context is not available, is it guaranteed that the UE will get back the same IP address at this point? If this is not possible, would there be a problem with the binding in the P-CSCF (user_public1@home1.net and [5555::aaa:bbb:ccc:ddd])?

2. The DHCP procedure employed for P-CSCF discovery is not needed.

3. The S-CSCF selection procedure invoked by the I-CSCF is not needed.

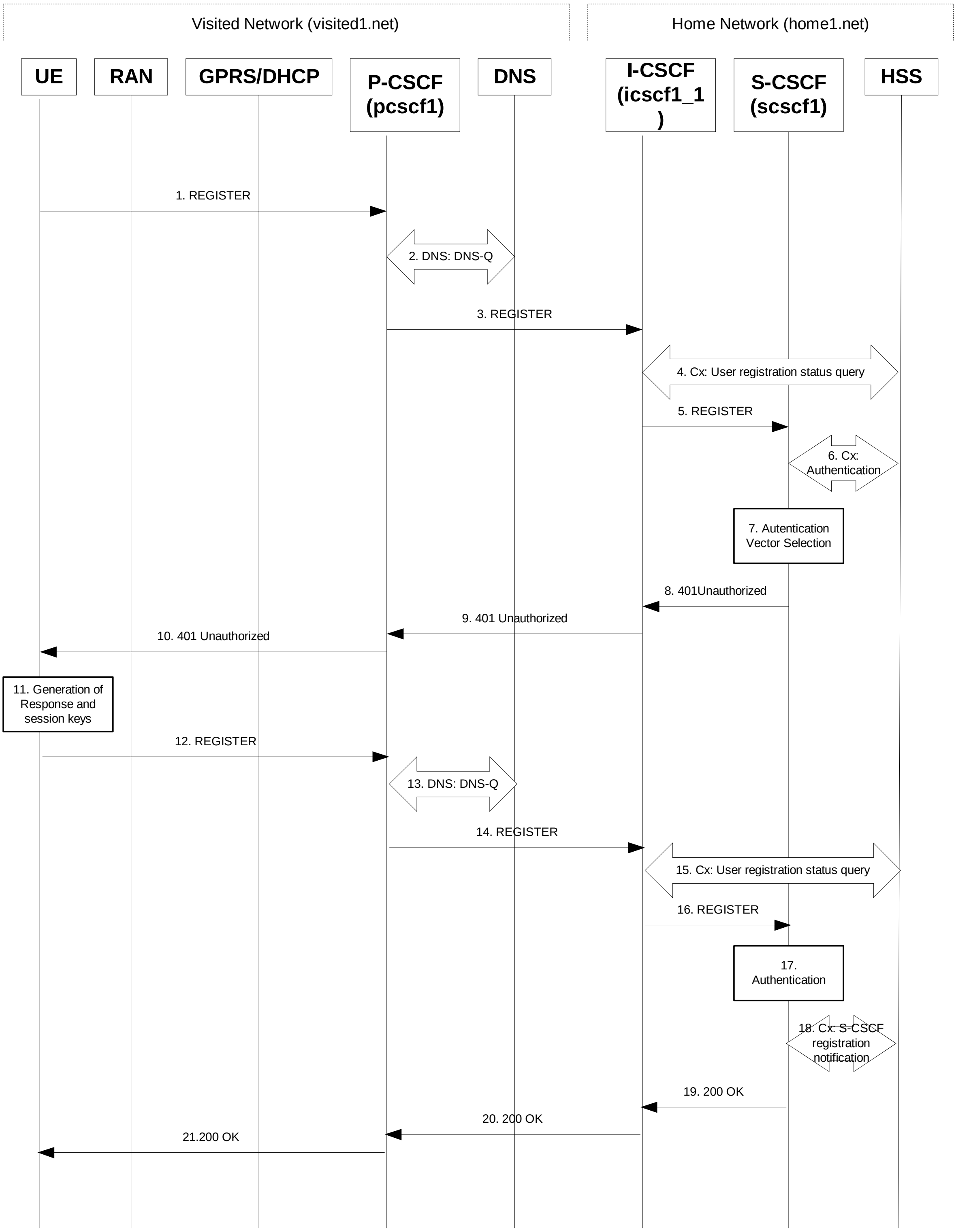


Figure 6.3-1: Reregistration when UE roaming

1. **REGISTER request (UE to P-CSCF) - see example in table 6.3-1**

   The registration expires in the UE. The UE reregisters by sending a new REGISTER request. This request is sent to the same P-CSCF with which the UE initially registered. The P-CSCF maintains the same binding between the public user address (user1_public1@home1.net) and the host (terminal) address ([5555::aaa:bbb:ccc:ddd]) which it established during the original registration.

Table 6.3-1: REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: eap eap-p=base64(user1_private1@home1.net)Digest
               username="user1_private@home1.net", realm="registrar.home1.net",
               nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
               uri="sip:registrar.home1.net", response="6629fae49393a05397450978507c4ef1"
CSeq: 3 REGISTER
Expires: 7200
Content-Length: 0
```

The header field usage is the same as for the initial registration scenario:

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates public user identity being registered. This is the identity by which other parties know this subscriber.

Contact: This indicates the point-of-presence for the subscriber – the IP address of the UE. This is the temporary identifier for the subscriber that is being registered. Subsequent requests destined for this subscriber will be sent to this address. This information is stored in the P-CSCF and the S-CSCF.

Authorization: It carries authentication information. The private user identity (user1_private~~1~~@home1.net) is carried in the ~~user ID~~username field of the ~~extensible authentication protocol (EAP)~~ Digest AKA protocol. As this is a re-registration process, the cached information (realm, nonce, algorithm, uri, response) is also sent.

NOTE 1: The actual nonce value in the WWW-Authenticate header field is encoded in base64, and it may look like:

nonce="A34Cm+Fva37UYWpGNB34JP"

~~NOTE 1: The actual Authorization header value may look like this as it is in base64 form:~~
~~Authorization: eap eap-p=QWxhZGRpbjpvcGVuIHNlc2FtZQ==~~

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Upon receiving this request the P-CSCF will detect that it already has a registration record for this UE and will reset it's SIP registration timer for this UE to the Expires time in this request.

2. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI. The DNS provides the P-CSCF with an address of the I-CSCF in the home network. The P-CSCF must not use the I-CSCF address cached as a result of the previous registration.

3. **REGISTER request (P-CSCF to I-CSCF) - see example in table 6.3-3**

This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 6.3-3 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
```

```
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
uri="sip:registrar.home1.net", response="6629fae49393a05397450978507c4ef1", integrity-
protected="yes"
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

Require:/Proxy-Require: These headers are included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating "path". Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

4. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. Because the user has registered, the HSS returns the I-CSCF with the S-CSCF address for the subscriber.

For detailed message flows see 3GPP TS 29.228.

For the parameters in the REGISTER request (flow 3) which need to be sent to HSS, see table 6.2-5a.

Table 6.3-4a provides the parameters in the REGISTER request (flow 5), which are obtained from the information sent back from the HSS.

Table 6.3-4a Cx: User registration status query procedure (HSS to I-CSCF)

Message source & destination	Cx Information element name	Mapping to SIP header in REGISTER	Description
HSS to I-CSCF	S-CSCF name	Request-URI:	This information indicates the serving CSCF's name of that user

5. **REGISTER request (I-CSCF to S-CSCF) - see example in table 6.3-5**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected. The Request-URI is changed to the address of the S-CSCF.

Table 6.3-5: REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming_Info:
From:
To:
Contact:
Call-ID:
Authorization:
```

```
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

Upon receiving this request the S-CSCF will detect that it already has a registration record for this UE and will reset it's SIP registration timer for this UE to the Expires time in this request.

6. Cx: Authentication procedure

On receiving a REGISTER request from a registered user, the S-CSCF requires at least one authentication vector to be used in the challenge to the user. If a valid AV is not available, then the S-CSCF requests at least one AV from the HSS.

For detailed message flows see 3GPP TS 29.228.

Table 6.3-6a provides the parameters in the REGISTER request (flow 5) which need to been sent to HSS.

Table 6.3-6a Cx: S-CSCF authentication information procedure (S-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
S-CSCF to HSS	Public User Identify	To:	Identity which is used to communicate with other users
	Private User Identity	Authorization:	The Private User Identity is encoded in the username field according to the Authorization protocol.
	S-CSCF name	Request-URI:	This information indicates the serving CSCF's name of that user

7. **Authentication vector selection**

The S-CSCF selects an authentication vector for use in the authentication challenge. For detailed description of the authentication vector, see 3GPP TS 33.203.

NOTE 2: The authentication vector may be of the form as in 3GPP TS 33.203 (if IMS AKA is the selected authentication scheme):

- AV = $RAND_n||AUTN_n||XRES_n||CK_n||IK_n$ where:
  - RAND: random number used to generate the XRES, CK, IK, and part of the AUTN. It is also used to generate the RES at the UE.
  - AUTN: Authentication token (including MAC and SQN).
  - XRES:Expected (correct) result from the UE.
  - CK: Cipher key (optional).
  - IK: Integrity key.

8. **401 Unauthorized response (S-CSCF to I-CSCF) - see example in table 6.3-8**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.3-8: 401 Unauthorized response (S-CSCF to I-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49111
WWW-Authenticate: Digest realm="registrar.home1.net", nonce=base64(RAND + AUTN + server
                specific data), algorithm=AKAv1-MD5, ik="00112233445566778899aabbccddeeff",
                ck="ffeeddccbbaa11223344556677889900"
eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)
CSeq: 1 REGISTER
Expires: 7200
Content-Length: 0
```

~~NOTE 3: The actual WWW-Authenticate header value may look like this as it is in base64 form: WWW-Authenticate: eap eap-p=QWxh4ZGRpb2jpvcGVuNlctZQ==~~

WWW-Authenticate: The S-CSCF challenges the user. The new nonce includes the quoted string, base64 encoded value of the concatenation of the AKA RAND, AKA AUTN and server specific data. The S-CSCF appends also the Integrity Key (IK) and the Cyphering key (CK).

NOTE 3: The actual nonce value in the WWW-Authenticate header field is encoded in base64, and it may look like:

nonce="AY+3fUYo021Qi1Mnv3C6qAzEp4502"

~~Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.~~

9. **401 Unauthorized response (I-CSCF to P-CSCF) - see example in table 6.3-9**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.3-9: 401 Unauthorized response (I-CSCF to P-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Contact:
Call-ID:
WWW-Authenticate:
CSeq:
Expires:
Content-Length:
```

~~Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS~~

10. **401 Unauthorized response (P-CSCF to UE) - see example in table 6.3-10**

The P-CSCF removes any keys received in the 401 Unauthorized response and forwards the rest of the response to the UE.

Table 6.3-10: 401 Unauthorized response (P-CSCF to UE)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Contact:
Call-ID:
WWW-Authenticate: eap eap-p=base64(user1_private1.home1.net, RAND, AUTN)Digest
                realm="registrar.home1.net", nonce=base64(RAND + AUTN + server specific data),
                algorithm=AKAv1-MD5
```

```
CSeq:
Expires:
Content-Length:
```

WWW-Authenticate: The P-CSCF removes the ik and ck parameters (directive) from the header.

11. **Generation of response and session keys at UE**

Upon receiving the Unauthorised response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in a REGISTER request.

12. **REGISTER request (UE to P-CSCF) - see example in table 6.3-12**

Table 6.3-12: REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49112
Authorization: eap eap-p=base64(user1_private1@home1.net, RES)Digest
             username="user1_private@home1.net", realm="registrar.home1.net",
             nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
             uri="sip:registrar.home1.net", response="0a1b04c89e54f09ab45e84d30e29f83a"
CSeq: 4 REGISTER
Expires: 7200
Content-Length: 0
```

Authorization: This carries the response to the authentication challenge received in step 10 along with the private user identity, the realm, the nonce, the URI and the algorithm ~~both encoded in base64 format~~.

13. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify the transport protocol the, P-CSCF selects the UDP.

Table 6.3-13a: DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 6.3-13b: DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net        0 IN SRV 1 10 5060 icscf1_p.home1.net
                                        0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                 0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                 0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

14. **REGISTER request (P-CSCF to I-CSCF) - see example in table 6.2-14**

This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.

Table 6.3-14: REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
uri="sip:registrar.home1.net", response="0a1b04c89e54f09ab45e84d30e29f83a", integrity-
protected="yes"
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

15. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. Because the user has registered, the HSS returns the I-CSCF with the S-CSCF address for the subscriber.

For detailed message flows see 3GPP TS 29.228.

For the parameters in the REGISTER request (flow 14) which need to be sent to HSS, see table 6.2-16a.

Table 6.3-15a provides the parameters in the REGISTER request (flow 16), which are obtained from the information sent back from the HSS

Table 6.3-15a: User registration status query response (*HSS to I-CSCF*)

Message source & destination	Cx Information element name	Mapping to SIP header in REGISTER	Description
HSS to I-CSCF	S-CSCF name	Request-URI:	This information indicates the serving CSCF's name of that user

16. **REGISTER request (I-CSCF to S-CSCF) - see example in table 6.3-16**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 6.3-16: REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

17. **Authentication**

Upon receiving the REGISTER request, carrying the authentication response, RES, the S-CSCF checks that the user's active, XRES matches the received RES. If the check is successful then the user has been authenticated and the public user identity is registered in the S-CSCF.

18. **Cx: S-CSCF registration notification procedure**

On registering a user the S-CSCF informs the HSS that the user has been re-registered at this instance.

For detailed message flows see 3GPP TS 29.228.

19. **200 OK response (S-CSCF to I-CSCF) - see example in table 6.3-19**

The S-CSCF sends acknowledgement to the I-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 6.3-19 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact: sip:[5555::aaa:bbb:ccc:ddd]
CSeq:
Date: Wed, 11 July 2001 08:49:37 GMT
Expires: 7200
Content-Length:
```

Path: The S-CSCF inserts its own name to the front of the list.

20. **200 OK response (I-CSCF to P-CSCF) - see example in table 6.3-20**

The I-CSCF forwards acknowledgement from the S-CSCF to the P-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 6.3-20: 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact:
```

```
CSeq:
Date:
Expires:
Content-Length:
```

21. **200 OK response (P-CSCF to UE) - see example in table 6.3-21**

    The P-CSCF removes its address from the Path header, reverses the order of the fields, saves the resulting Path header and associates it with the UE. The P-CSCF then removes the Path header from the 200 OK response. The P-CSCF then forwards acknowledgement from the I-CSCF to the UE indicating that Registration was successful.

Table 6.3-21: 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

6.9.3 Registration failure – user authentication failure

******** Next proposed change ***************************

This clause (see figure 6.9.3-1) shows the signalling flow with user authentication failure at step 19 of subclause 6.2 "Signalling flows for REGISTER" and a final failure of the authentication at step 30.

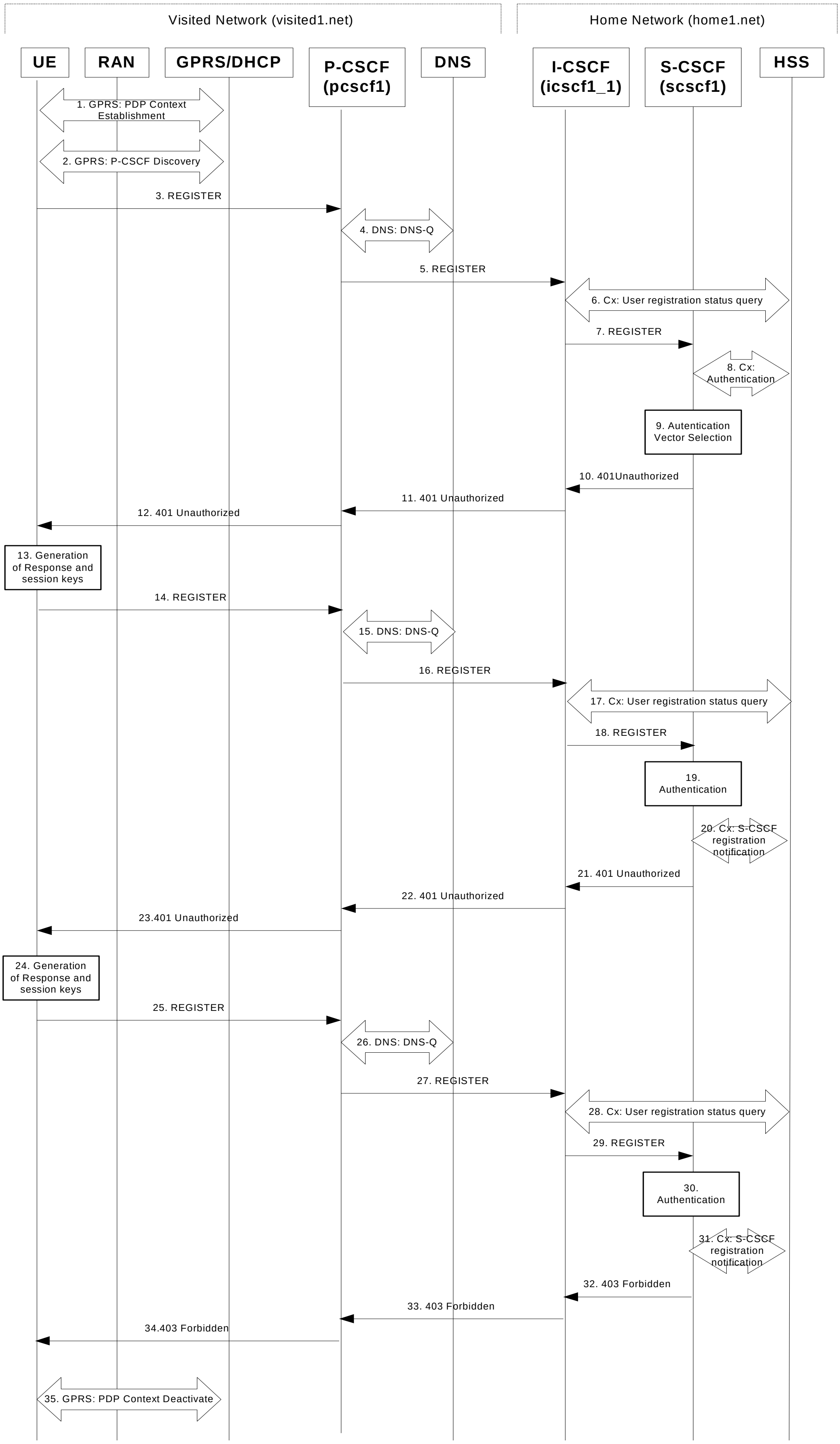


Figure 6.9.3-1: User Authentication Failure

Steps 1 through 18 are the same as the signalling flow in subclause 6.2.

19. **Authentication: User authentication fails**

Upon receiving the REGISTER request carrying the authentication response, RES, the S-CSCF checks that the user's active, XRES matches the received RES. If the check is unsuccessful then this authentication challenge fails and the public user identity is not yet registered in the S-CSCF.

At this point the S-CSCF has the option of repeating a number of authentication challenges as given in step 19 through 29. For the purposes of this flow, only one repetition is shown.

20. **Cx. SCGF registration notification**

The S-CSCF selects new authentication vectors as specified in step 9, either from the list already within the S-CSCF, or by requesting new vectors from the HSS.

21. **401 Unauthorized response (S-CSCF to I-CSCF) - see example in table 6.9.3-21**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.9.3-21: 401 Unauthorized response (S-CSCF to I-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Call-ID: apb03a0s09dkjdfglkj49111
WWW-Authenticate: ~~eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)~~Digest
                realm="registrar.home1.net", nonce=base64(RAND + AUTN + server specific data),
                algorithm=AKAv1-MD5, ik="00112233445566778899aabbccddeeff",
                ck="ffeeddccbbaa11223344556677889900"
CSeq: 2 REGISTER
Content-Length: 0
```

~~NOTE: The actual WWW-Authenticate header value may look like this as it is in base64 form:~~
~~WWW-Authenticate: eap eap-p=QWxh4ZGRpb2jpvcGVuNlctZQ==~~

NOTE: —The actual nonce value in the WWW-Authenticate header field is encoded in base64, and it may look like:

——nonce="AY+3fUYo021Qi1Mnv3C6qAzEp4502"

~~Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.~~

22. **401 Unauthorized response(I-CSCF to P-CSCF) - see example in table 6.9.3-22**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.9.3-22: 401 Unauthorized response (I-CSCF to P-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate:
CSeq:
Content-Length:
```

~~Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.~~

23. **401 Unauthorized response (P-CSCF to UE) - see example in table 6.9.3-23**

The P-CSCF removes any keys received in the 401 Unauthorized response and forwards the rest of the response to the UE.

Table 6.9.3-23: 401 Unauthorized response (P-CSCF to UE)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate: Digest realm="registrar.home1.net", nonce=base64(RAND + AUTN + server
                 specific data), algorithm=AKAv1-MD5~~eap eap-p=base64(user1_private1.home1.net,
                 RAND, AUTN)~~
CSeq:
Content-Length:
```

WWW-Authenticate: The P-CSCF removes the ik and ck parameters (directives) from the header.

24. **Generation of response and session keys at UE**

Upon receiving the Unauthorised response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in the REGISTER request.

25. **REGISTER request (UE to P-CSCF) - see example in table 6.9.3-25**

Table 6.9.3-25: REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49112
Authorization: ~~eap eap-p=base64(user1_private1@home1.net, RES)~~Digest
              username="user1_private@home1.net", realm="registrar.home1.net",
              nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
              uri="sip:registrar.home1.net", response="0a1b04c89e54f09ab45e84d30e29f83a"
CSeq: 3 REGISTER
Expires: 7200
Content-Length: 0
```

Authorization: This carries the response to the authentication challenge received in step 12 along with the private user identity, the realm, the nonce, the URI and the algorithm. ~~both encoded in base64 format.~~

26. DNS: DNS-Q

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify the transport protocol the, P-CSCF selects the UDP.

Table 6.9.3-26a: DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 6.9.3-26b: DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net        0 IN SRV 1 10 5060 icscf1_p.home1.net
                                        0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                 0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                 0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

27. **REGISTER request (P-CSCF to I-CSCF) - see example in table 6.9.3-27**

This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.

Table 6.9.3-27: REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
uri="sip:registrar.home1.net", response="0a1b04c89e54f09ab45e84d30e29f83a", integrity-
protected="yes"
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

28. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF required capabilities and the I-CSCF uses this information to select a suitable S-CSCF.

For detailed message flows see 3GPP TS 29.228.

Table 6.9.3-28a provides the parameters in the REGISTER request (flow 5) which need to be sent to HSS.

Table 6.9.3-28a Cx: User registration status query procedure (I-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description

I-CSCF to HSS	Private User Identity	Authorization:	The Private User Identity is encoded in the username field according to the Authorization protocol.
	Public User Identity	To:	Identity which is used to communicate with other users
	Visited Network Identifier	Roaming-Info: vnid	This information indicates the network identifier of the visited network

29. **REGISTER request (I-CSCF to S-CSCF) - see example in table 6.9.3-29**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 6.9.3-29: REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

30. **Authentication**

Upon receiving the REGISTER request carrying the authentication response, RES, the S-CSCF checks that the user's active, XRES matches the received RES. If the check is unsuccessful, and no more authentication challenges are to be made, then the authentication has failed and the public user identity is not registered in the S-CSCF.

31. Cx: S-CSCF registration notification procedure

Upon user authentication failure the S-CSCF informs the HSS that the user has not been registered at this instance. The HSS clears the S-CSCF name for that subscriber.

For detailed message flows see 3GPP TS 29.229.

Table 6.9.3-31 provides the parameters in the REGISTER request (flow 18) which need to be sent to HSS.

Table 6.9.3-31 Cx: S-CSCF registration notification procedure (S-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
S-CSCF to HSS	Public User Identify	To:	Identity which is used to communicate with other users
	Private User Identity	Authorization:	The Private User Identity is encoded in the username field according to the Authorization protocol. ~~Unique identity in IMS which is used by network to authenticate this user~~

	S-CSCF name	Request-URI:	This information indicates the serving CSCF's name of that user

32. **403 Forbidden response (S-CSCF to I-CSCF) - see example in table 6.9.3-32**

The S-CSCF sends an 403 Forbidden response to the I-CSCF indicating that authentication failed. No security parameters are included in this message.

Table 6.9.3-32: 403 Forbidden (S-CSCF to I-CSCF)

```
SIP/2.0 403 Forbidden
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Call-ID: apb03a0s09dkjdfglkj49111
CSeq: 3 REGISTER
Content-Length: 0
```

33. **403 Forbidden response (I-CSCF to P-CSCF) - see example in table 6.9.3-33**

The I-CSCF forwards the 403 Forbidden response from the S-CSCF to the P-CSCF indicating that authentication was unsuccessful.

Table 6.9.3-33: 403 Forbidden response (I-CSCF to P-CSCF)

```
SIP/2.0 403 Forbidden
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

34. **403 Forbidden response (P-CSCF to UE) - see example in table 6.9.3-33**

The P-CSCF forwards the 403 Forbidden response to the UE.

Table 6.9.3-34: 403 Forbidden response (P-CSCF to UE)

```
SIP/2.0 403 Forbidden
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

35. **PDP Context Deactivate**

On receiving the 403 Forbidden response the UE ceases registration and authentication attempts. In this case, if the PDP context on which the SIP signalling was being conducted is not being used for other purposes, the UE deactivates the signalling PDP context.

********** Next proposed change ******************************

16.2 Registration signalling: user not registered

Figure 16.2-1 shows the registration signalling flow for the scenario when the user is not registered. For the purpose of this signalling flow, the subscriber is considered to be roaming. This flow also shows the authentication of the private user identity. In this signalling flow, the home network has network configuration hiding active.

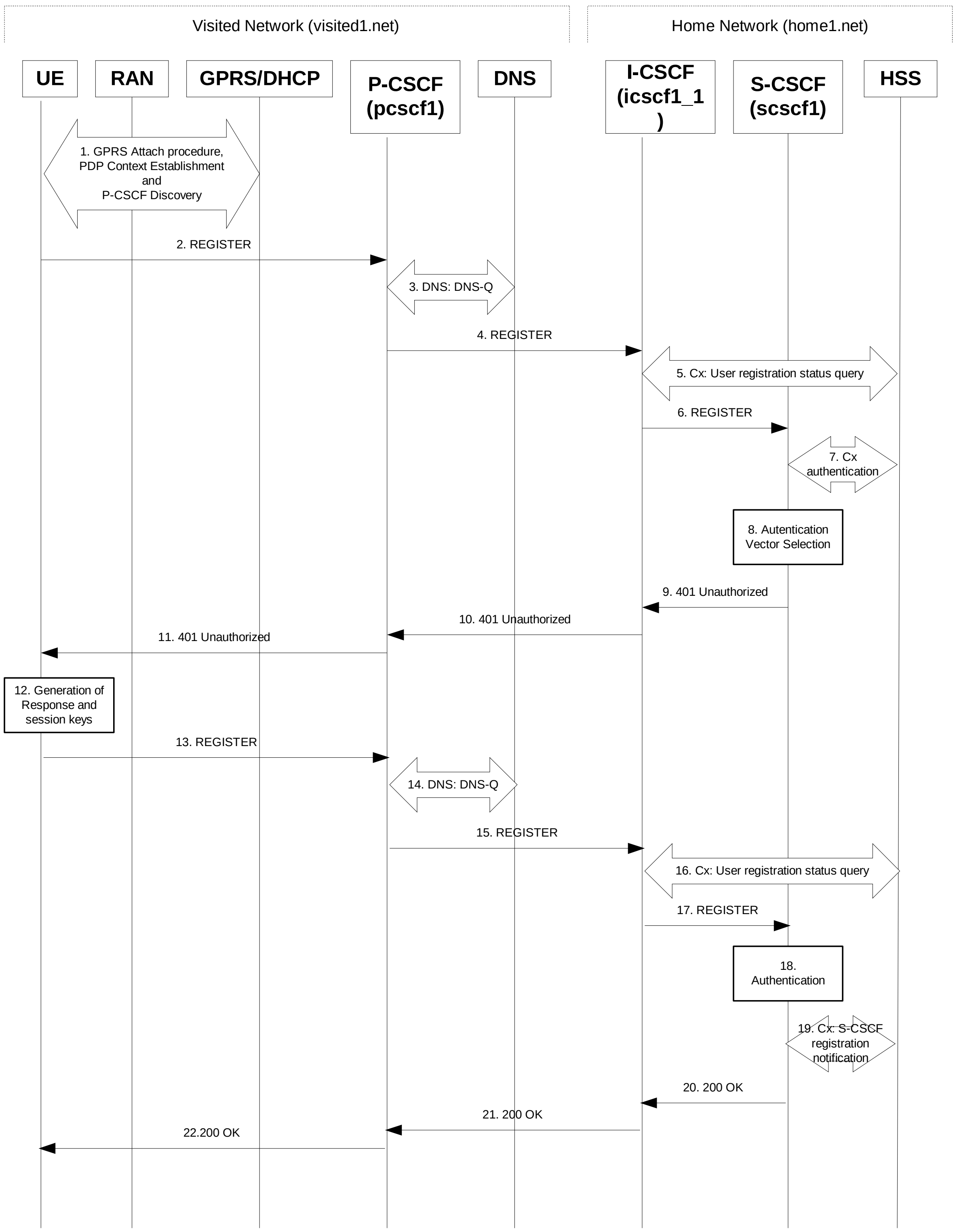


Figure 16.2-1: Registration when UE roaming

1. **GPRS Attach / PDP Context Establishment and P-CSCF Discovery (UE to GPRS)**

   This signalling flow is shown to indicate prerequisites for the registration signalling.

   See subclause 5.2 for details.

2. **REGISTER request (UE to P-CSCF) – see example in table 16.2-2**

The purpose of this request is to register the user's SIP URI with a S-CSCF in the home network. This request is routed to the P-CSCF because it is the only SIP server known to the UE. In the following SIP request, the Contact field contains the user's host address.

The P-CSCF will perform two actions, binding and forwarding. The binding is between the User's SIP address (user1_public1@home1.net) and the host (terminal) address ([5555::aaa:bbb:ccc:ddd]) which was acquired during PDP context activation process.

~~Editor's note: The security mode set-up procedure supports the negotiation of different protection mechanisms. This will involve the addition of a "security-setup" field to the SIP REGISTER request and the REGISTER response performing the authentication challenge containing the parameters:~~

~~-list of Authentication (integrity) algorithms, and optionally list of encryption (confidentiality) algorithms~~

~~-SA-ID that is used to uniquely identify the SA at the receiving side.~~

~~-Key length: the length of encryption and authentication (integrity) keys is 128 bits.~~

~~The exact format and use for the security mode setup is being worked through IETF and is FFS~~

Table 16.2-2 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: eap eap-p=base64(user1_private1@home1.net)Digest username="user1_private@home1.net",
             realm="registrar.home1.net", nonce="", uri="sip:registrar.home1.net", response=""
CSeq: 1 REGISTER
Expires: 7200
Content-Length: 0
```

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Via: IPv6 PDP address of the SIP session allocated during the PDP Context Activation process.

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates the public user identity being registered. This is the identity by which other parties know this subscriber. It may be obtained from the USIM.

Contact: This indicates the point-of-presence for the subscriber – the IP address of the UE. This is the temporary point of contact for the subscriber that is being registered. Subsequent requests destined for this subscriber will be sent to this address. This information is stored in the P-CSCF and S-CSCF.

Editor's note: It is for further study whether this information is stored in the HSS and the S-CSCF for the subscriber in order to support multiple registrations.

Authorization: It carries authentication information. The private user identity (user1_private~~1~~@home1.net) is carried in the ~~user ID~~ usernamed field of the ~~extensible authentication protocol (EAP)~~Digest AKA protocol. The uri parameter (directive) -contains the same value as the Request-URI. The realm parameter (directive) contains the network name where the username is ~~valid~~authenticated. The Request-URI and the realm parameter (directive) value are obtained from the same field in the USIM, and therefore, are identical~~.~~. In this example, it is assumed that a new ~~SIM~~UICC card was just inserted into the terminal, and there is no other cached information to send. Therefore, nonce and response parameters (directives) are empty.

Upon receiving this request the P-CSCF will set it's SIP registration timer for this UE to the Expires time in this request.

3. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify the transport protocol the, P-CSCF selects the UDP.

Table 16.2-3a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=_sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 16.2-3b DNS: DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=_sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net          0 IN SRV 1 10 5060 icscf1_p.home1.com
                                       0 IN SRV 1  0 5060 icscf7_p.home1.com

icscf1_p.home1.net                     0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                     0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

4. **REGISTER request (P-CSCF to I-CSCF) – see example in table 16.2-4**

The P-CSCF needs to be in the path for all mobile originated and mobile terminated requests for this user. To ensure this, the P-CSCF adds itself to the path for future requests.

The P-CSCF binds the public user identity under registration to the Contact header supplied by the user.

The P-CSCF adds also the Roaming-Info header (if not present). The P-CSCF adds the *vnid* parameter with the contents of the identifier of the P-CSCF network. This may be the visited network domain name or any other identifier that identifies the visited network at the home network.

This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 16.2-4 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net", nonce="",
uri="sip:registrar.home1.net", response="", integrity-protected="no"
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

Require:/Proxy-Require: These headers are included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating "path". Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

5. **Cx: User registration status query procedure**

   The I-CSCF makes a request for information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF required capabilities and the I-CSCF uses this information to select a suitable S-CSCF.

   For detailed message flows see 3GPP TS 29.228.

   Table 6.2-5a provides the parameters in the REGISTER request (flow 4) which need to been sent to HSS.

6. **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.2-6**

   I-CSCF adds a proper I-CSCF name to the Path header.

   This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected. The Request-URI is changed to the address of the S-CSCF.

Table 16.2-6 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
        pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

Upon receiving this request the S-CSCF will set it's SIP registration timer for this UE to the Expires time in this request.

7. **Cx: S-CSCF authentication procedure**

On receiving a REGISTER request from an unauthenticated user, the S-CSCF requires at least one authentication vector to be used in the challenge to the user. If a valid AV is not available, then the S-CSCF requests at least one AV from the HSS.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-7a provides the parameters in the REGISTER request (flow 6) which need to been sent to HSS.

8. **Authentication vector selection**

The S-CSCF selects an authentication vector for use in the authentication challenge. For detailed description of the authentication vector, see 3GPP TS 33.203.

NOTE 1: The authentication vector may be of the form 3GPP TS 33.203 (if IMS AKA is the selected authentication scheme):

$AV = RAND_n||AUTN_n||XRES_n||CK_n||IK_n$ where:

- RAND: random number used to generate the XRES, CK, IK, and part of the AUTN. It is also used to generate the RES at the UE.
- AUTN: Authentication token (including MAC and SQN).
- XRES: Expected (correct) result from the UE.
- CK: Cipher key (optional).
- IK: Integrity key.

9. **401 Unauthorized response (S-CSCF to I-CSCF) – see example in table 16.2-9**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 16.2-9: 401 Unauthorized response (S-CSCF to I-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To: <sip:user1_public1@home1.net>; tag=5ef4
Call-ID:
WWW-Authenticate: eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)Digest
                realm="registrar.home1.net", nonce=base64(RAND + AUTN + server specific data),
                algorithm=AKAv1-MD5, ik="00112233445566778899aabbccddeeff",
                ck="ffeeddccbbaa11223344556677889900"
CSeq:
Content-Length:
```

~~NOTE 2: The actual WWW-Authenticate header value may look like this as it is in base64 form:~~

~~- WWW-Authenticate: eap eap-p=QWxh4ZGRpb2jpvcGVuNlctZQ==~~

WWW-Authenticate: The S-CSCF challenges the user. The nonce includes the quoted string, base64 encoded value of the concatenation of the AKA RAND, AKA AUTN and server specific data. The S-CSCF appends also the Integrity Key (IK) and the Cyphering key (CK).

NOTE: —The actual nonce value in the WWW-Authenticate header field is encoded in base64, and it may look like:

——nonce="A34Cm+Fva37UYWpGNB34JP"

~~Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.~~

10. **401 Unauthorized response (I-CSCF to P-CSCF) – see example in table 16.2-10**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 16.2-10: 401 Unauthorized response (I-CSCF to P-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate:
CSeq:
Content-Length:
```

~~Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.~~

11. **401 Unauthorized response (P-CSCF to UE) – see example in table 16.2-11**

The P-CSCF removes any keys received in the 401 Unauthorized response and forwards the rest of the response to the UE.

Table 16.2-11: 401 Unauthorized response (P-CSCF to UE)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate: Digest realm="registrar.home1.net", nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5
CSeq:
Content-Length:
```

WWW-Authenticate: The P-CSCF removes the ik and ck parameters (directives) from the header.

12. **Generation of response and session keys at UE**

Upon receiving the Unauthorized response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in the REGISTER request.

13. **REGISTER request (UE to P-CSCF) – see example in table 16.2-13**

Table 16.2-13 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49112
Authorization: eap eap-p=base64(user1_private1@home1.net, RES)Digest
             username="user1_private@home1.net", realm="registrar.home1.net", nonce=base64(RAND +
             AUTN + server specific data), algorithm=AKAv1-MD5, uri="sip:registrar.home1.net",
             response="6629fae49393a05397450978507c4ef1"
CSeq: 2 REGISTER
Expires: 7200
Content-Length: 0
```

Authorization: This carries the response to the authentication challenge received in step 11 along with the private user identity , the realm, the nonce, the URI and the algorithm~~both encoded in base64 format~~.

14. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify the transport protocol the, P-CSCF selects the UDP.

Table 16.2-14a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 16.2-14b DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net           0 IN SRV 1 10 5060 icscf1_p.home1.net
                                        0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                 0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                 0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

15. **REGISTER request (P-CSCF to I-CSCF) – see example in table 16.2-15**

This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.

Table 16.2-15 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
uri="sip:registrar.home1.net", response="6629fae49393a05397450978507c4ef1", integrity-
protected="yes"
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

16. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF required capabilities and the I-CSCF uses this information to select a suitable S-CSCF.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-16a provides the parameters in the REGISTER request (flow 15) which need to been sent to HSS.

17. **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.2-17**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 16.2-17 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

18. **Authentication**

Upon receiving the REGISTER request, carrying the authentication response, RES, the S-CSCF checks that the user's active XRES matches the received RES. If the check is successful then the user has been authenticated and the public user identity is registered in the S-CSCF.

19. **Cx: S-CSCF registration notification procedure**

On registering a user the S-CSCF informs the HSS that the user has been registered at this instance. The HSS stores the S-CSCF name for that subscriber. For a positive response, the HSS will include the user profile in the response sent to the S-CSCF.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-19a provides the parameters in the SIP REGISTER request (flow 17) which need to been sent to HSS.

20. **200 OK response (S-CSCF to I-CSCF) – see example in table 16.2-20**

The S-CSCF sends acknowledgement to the I-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.2-20 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net>, <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
```

```
Contact: sip:[5555::aaa:bbb:ccc:ddd]
CSeq:
Date: Wed, 11 July 2001 08:49:37 GMT
Expires: 7200
Content-Length:
```

Path: The S-CSCF inserts its own name to the front of the list.

21. **200 OK response (I-CSCF to P-CSCF) – see example in table 16.2-21**

    The I-CSCF translates the S-CSCF name in the Path header. The I-CSCF forwards acknowledgement from the S-CSCF to the P-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.2-21 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:token(scscf1.home1.net)>, <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

22. **200 OK response (P-CSCF to UE) – see example in table 16.2-22**

    The P-CSCF removes its address from the Path header, reverses the order of the fields, saves the resulting Path header and associates it with the UE. The P-CSCF then removes the Path header from the 200 OK response. The P-CSCF then forwards acknowledgement from the I-CSCF to the UE indicating that Registration was successful.

Table 16.2-22 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

********** Next proposed change ******************************

16.3 Registration signalling: reregistration – user currently registered

For the purpose of the reregistration signalling flow shown in figure 16.3-1, the subscriber is considered to be roaming. This flow also shows the authentication of the private user identity. In this signalling flow, the home network has network configuration hiding active.

This signalling flow assumes:

1. That the same PDP Context allocated during the initial registration scenario is still used for reregistration. For the case when the UE does not still have an active PDP context then PDP context procedures from subclause 16.2 is completed first.

Editor’s Note: If the same PDP-Context is not available, is it guaranteed that the UE will get back the same IP address at this point? If this is not possible, would there be a problem with the binding in the P-CSCF (user_public1@home1.net and [5555::aaa:bbb:ccc:ddd])?2. The DHCP procedure employed for P-CSCF discovery is not needed.

2. The S-CSCF selection procedure invoked by the I-CSCF is not needed.

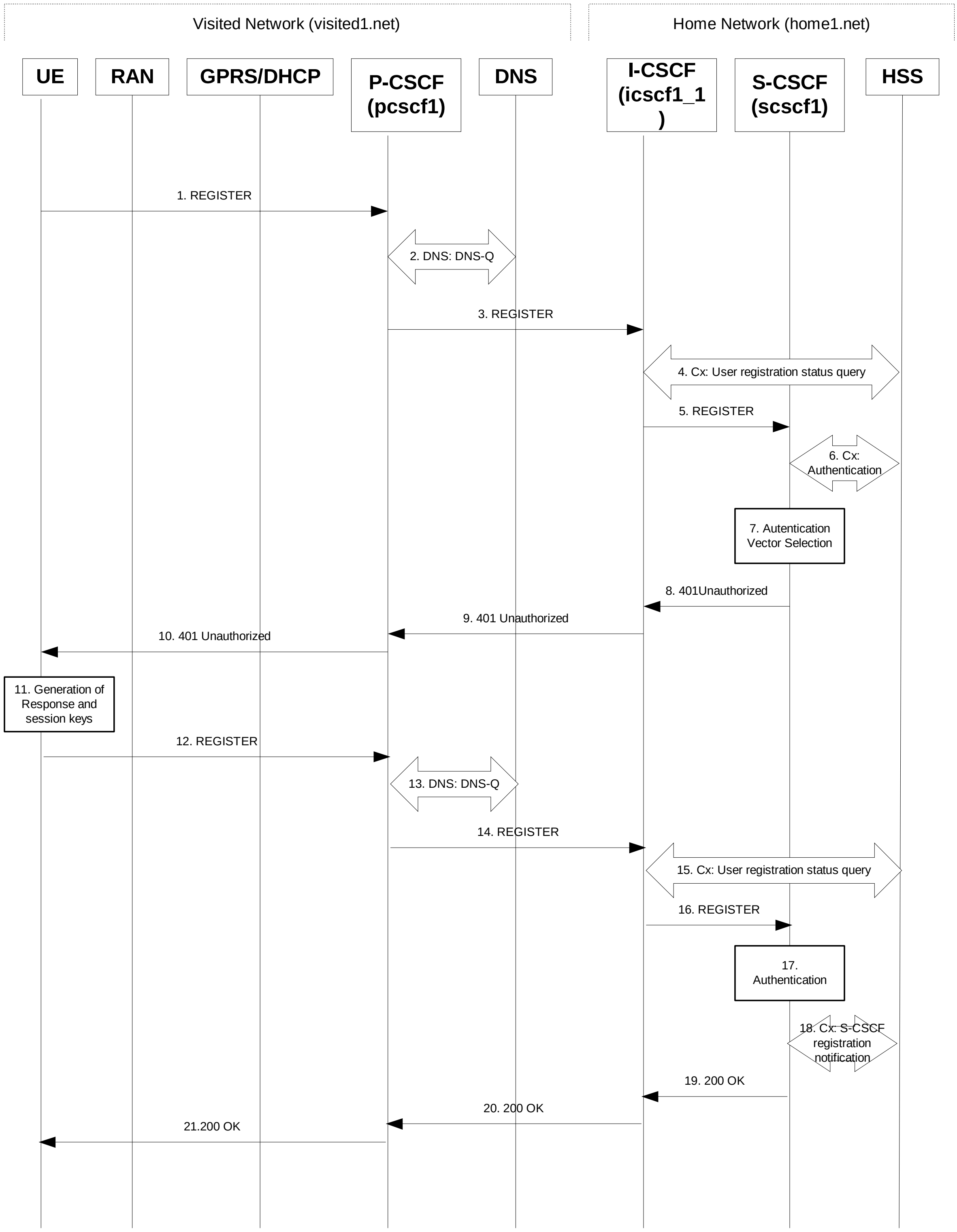


Figure 16.3-1: Reregistration when UE roaming

1. **REGISTER request (UE to P-CSCF) – see example in table 16.3-1**

   The registration expires in the UE. The UE reregisters by sending a new REGISTER request. This request is sent to the same P-CSCF with which the UE initially registered. The P-CSCF maintains the same binding between the User's SIP public address (user1_public1@home1.net) and the host (terminal) address ([5555::aaa:bbb:ccc:ddd]) which it established during the original registration.

Table 16.3-1 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: eap eap-p=base64(user1_private1@home1.net)Digest username="user1_private@home1.net",
             realm="registrar.home1.net", nonce=base64(RAND + AUTN + server specific data),
             algorithm=AKAv1-MD5, uri="sip:registrar.home1.net",
             response="6629fae49393a05397450978507c4ef1"
CSeq: 3 REGISTER
Expires: 7200
Content-Length: 0
```

The header field usage is the same as for the initial registration scenario:

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates public user identity being registered. This is the identity by which other parties know this subscriber.

Contact: This indicates the point-of-presence for the subscriber – the IP address of the UE. This is the temporary identifier for the subscriber that is being registered. Subsequent requests destined for this subscriber will be sent to this address. This information is stored in the P-CSCF.

Editor's note: It is for further study whether this information is stored in the HSS and the S-CSCF for the subscriber in order to support multiple registrations.

Authorization: It carries authentication information. The private user identity (user1_private~~1~~@home1.net) is carried in the ~~user ID~~username field of the Digest AKA protocol. As this is a re-registration process, the cached information (realm, nonce, algorithm, uri, response) is also sent.~~extensible authentication protocol (EAP).~~

NOTE 1: —The actual nonce value in the WWW-Authenticate header field is encoded in base64, and it may look like:

—nonce="A34Cm+Fva37UYWpGNB34JP"

~~NOTE 1: The actual Authorization header value may look like this as it is in base64 form:~~

~~- Authorization: eap eap-p=QWxhZGRpbjpvcGVuIHNlc2FtZQ==~~

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Upon receiving this request the P-CSCF will detect that it already has a registration record for this UE and will reset it's SIP registration timer for this UE to the Expires time in this request.

2. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI. The DNS provides the P-CSCF with an address of the I-CSCF in the home network. The P-CSCF must not use the I-CSCF address cached as a result of the previous registration.

3. **REGISTER request (P-CSCF to I-CSCF) – see example in table 16.3-3**

This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 16.3-3 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:Call-ID:
Authorization: eap eap-p=base64(user1_private1@home1.net)Digest username="user1_private@home1.net", realm="registrar.home1.net", nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5, uri="sip:registrar.home1.net", response="6629fae49393a05397450978507c4ef1", integrity-protected="yes"
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

Require:/Proxy-Require: These headers are included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating "path". Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

4. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. Because the user has registered, the HSS returns the I-CSCF with the S-CSCF address for the subscriber

For detailed message flows see 3GPP TS 29.228.

For the parameters in the REGISTER request (flow 3), which are sent to the HSS, see table 6.2-5a.

Table 6.3-4a provides the parameters in the SIP REGISTER request (flow 5), which are obtained from the information sent back from the HSS.

5. **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.3-5**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected. The Request-URI is changed to the address of the S-CSCF.

I-CSCF adds a proper I-CSCF name to the Path header.

Table 16.3-5 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Authorization: eap eap-p=base64(user1_private1@home1.net)
Call-ID:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

Upon receiving this request the S-CSCF will detect that it already has a registration record for this UE and will reset it's SIP registration timer for this UE to the Expires time in this request.

6. **Cx: Authentication procedure**

On receiving a REGISTER request from a registered user, the S-CSCF requires at least one authentication vector to be used in the challenge to the user. If a valid AV is not available, then the S-CSCF requests at least one AV from the HSS.

For detailed message flows see 3GPP TS 29.228.

Table 6.3-6a provides the parameters in the REGISTER request (flow 5), which are sent to the HSS.

7. **Authentication vector selection**

The S-CSCF selects an authentication vector for use in the authentication challenge. For detailed description of the authentication vector, see 3GPP TS 33.203.

NOTE 2: The authentication vector may be of the form 3GPP TS 33.203 (if IMS AKA is the selected authentication scheme):

AV = RANDn||AUTNn||XRESn||CKn||IKn where:

- RAND: random number used to generate the XRES, CK, IK, and part of the AUTN. It is also used to generate the RES at the UE.
- AUTN: Authentication token (including MAC and SQN).
- XRES: Expected (correct) result from the UE.
- CK: Cipher key (optional).
- IK: Integrity key.

8. **401 Unauthorized response (S-CSCF to I-CSCF) – see example in table 16.3-8**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 16.3-8: 401 Unauthorized response (S-CSCF to I-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate: eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)Digest
                realm="registrar.home1.net", nonce=base64(RAND + AUTN + server specific data),
                algorithm=AKAv1-MD5, ik="00112233445566778899aabbccddeeff",
                ck="ffeeddccbbaa11223344556677889900"
CSeq:
Content-Length:
```

~~NOTE 3: The actual WWW-Authenticate header value may look like this as it is in base64 form:~~

- ~~WWW-Authenticate: eap eap-p=QWxh4ZGRpb2jpvcGVuNlctZQ==~~

WWW-Authenticate: The S-CSCF challenges the user. The new nonce includes the quoted string, base64 encoded value of the concatenation of the AKA RAND, AKA AUTN and server specific data. The S-CSCF appends also the Integrity Key (IK) and the Cyphering key (CK).

NOTE 3: —The actual nonce value in the WWW-Authenticate header field is encoded in base64, and it may look like:

————nonce="AY+3fUYo021Qi1Mnv3C6qAzEp4502"

~~Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.~~

9. **401 Unauthorized response (I-CSCF to P-CSCF) – see example in table 16.3-9**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 16.3-9: 401 Unauthorized response (I-CSCF to P-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate: eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)
CSeq:
Content-Length:
```

~~Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.~~

10. **401 Unauthorized response (P-CSCF to UE) – see example in table 16.3-10**

The P-CSCF removes any keys received in the 401 Unauthorized response and forwards the rest of the response to the UE.

Table 16.3-10: 401 Unauthorized response (P-CSCF to UE)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate: Digest realm="registrar.home1.net", nonce=base64(RAND + AUTN + server specific
                data), algorithm=AKAv1-MD5
CSeq:
Content-Length:
```

WWW-Authenticate: The P-CSCF removes the ik and ck parameters (directives) from the header.

11. **Generation of response and session keys at UE**

Upon receiving the Unauthorised response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in the REGISTER request.

12. **REGISTER request (UE to P-CSCF) – see example in table 16.3-12**

Table 16.3-12 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49112
```

```
Authorization: eap eap-p=base64(user1_private1@home1.net, RES)Digest
             username="user1_private@home1.net", realm="registrar.home1.net", nonce=base64(RAND +
             AUTN + server specific data), algorithm=AKAv1-MD5, uri="sip:registrar.home1.net",
             response="0a1b04c89e54f09ab45e84d30e29f83a"
CSeq: 4 REGISTER
Expires: 7200
Content-Length: 0
```

Authorization: This carries the response to the authentication challenge received in step 10 along with the private user identity, the realm, the nonce, the URI and the algorithm ~~both encoded in base64 format~~.

13. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify the transport protocol the, P-CSCF selects the UDP.

Table 16.3-13a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC2782 [4].

Table 16.3-13b DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net           0 IN SRV 1 10 5060 icscf1_p.home1.net
                                        0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                 0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                 0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

14. **REGISTER request (P-CSCF to I-CSCF) – see example in table 16.3-14**

This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.

Table 16.3-14 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
```

```
Call-ID:
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
uri="sip:registrar.home1.net", response="0a1b04c89e54f09ab45e84d30e29f83a", integrity-
protected="yes"
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

15. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. Because the user has registered, the HSS returns the I-CSCF with the S-CSCF address for the subscriber.

For detailed message flows see 3GPP TS 29.228.

For the parameters in the REGISTER request (flow 14), which are sent to the HSS, see table 6.2-16a.

Table 6.3-15a provides the parameters in the REGISTER request (flow 16), which are obtained from the information sent back from the HSS.

16. **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.3-16**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 16.3-16 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

17. **Authentication**

Upon receiving the REGISTER request, carrying the authentication response, RES, the S-CSCF checks that the user's active XRES matches the received RES. If the check is successful then the user has been authenticated and the public user identity is registered in the S-CSCF.

18. **Cx: S-CSCF registration notification procedure**

On registering a user the S-CSCF informs the HSS that the user has been registered at this instance. The HSS stores the S-CSCF name for that subscriber. For a positive response, the HSS will include the user profile in the response sent to the S-CSCF.

For detailed message flows see 3GPP TS 29.228.

For the parameters in the REGISTER request (flow 16), which are sent to HSS, see table 6.2-19a.

19. **200 OK response (S-CSCF to I-CSCF) – see example in table 16.3-19**

The S-CSCF sends acknowledgement to the I-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.3-19 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net>, <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact: sip:[5555::aaa:bbb:ccc:ddd]
CSeq:
Date: Wed, 11 July 2001 08:49:37 GMT
Expires: 7200
Content-Length:
```

Path: The S-CSCF inserts its own name to the front of the list.

20. **200 OK response (I-CSCF to P-CSCF) – see example in table 16.3-20**

The I-CSCF translates the S-CSCF name in the Path header. The I-CSCF forwards acknowledgement from the S-CSCF to the P-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.3-20 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:token(scscf1.home1.net)>, <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

21. **200 OK response (P-CSCF to UE) – see example in table 16.3-21**

The P-CSCF removes its address from the Path header, reverses the order of the fields, saves the resulting Path header and associates it with the UE. The P-CSCF then removes the Path header from the 200 OK response. The P-CSCF then forwards acknowledgement from the I-CSCF to the UE indicating that Registration was successful.

Table 16.3-21 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

********** Next proposed change ******************************

16.4 Registration signalling: mobile initiated deregistration

Figure 16.4-1 shows a signalling flow for mobile initiated deregistration. For the purposes of this deregistration signalling flow, the subscriber is considered to be roaming. In this signalling flow, the home network has configuration hiding active.

This signalling flow assumes:

1. That the same PDP Context allocated during the initial registration scenario is still used for deregistration. For the case when the UE does not still have an active PDP context then PDP context procedures from subclause 16.2 must first be completed.

Editor's Note: If the same PDP-Context is not available, is it guaranteed that the UE will get back the same IP address at this point? If this is not possible, would there be a problem with the binding in the P-CSCF (user_public1@home1.net and [5555::aaa:bbb:ccc:ddd])?

2. The procedure employed for P-CSCF discovery is not needed.

3. The S-CSCF selection procedure invoked by the I-CSCF is not needed.

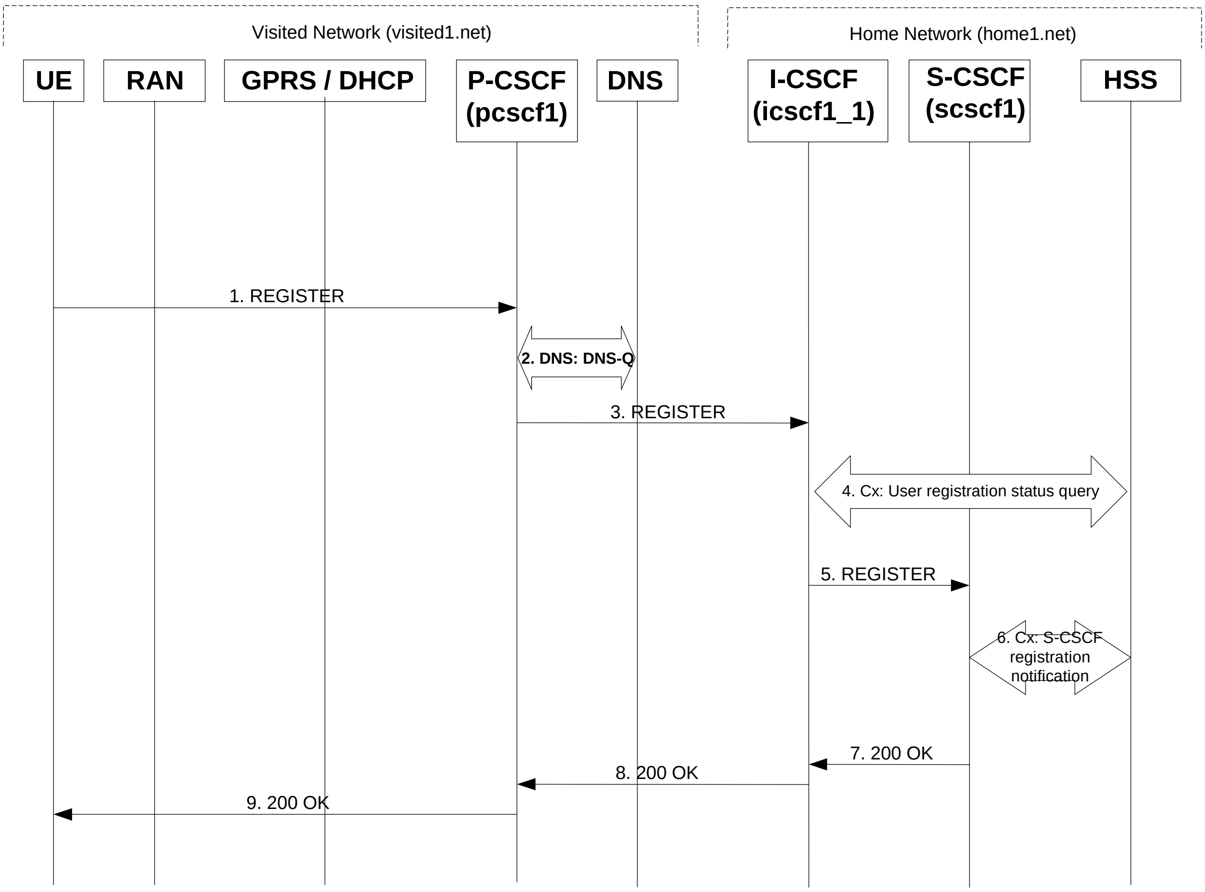


Figure 16.4-1: Registration signalling: mobile initiated deregistration

1. **REGISTER request (UE to P-CSCF) – see example in table 16.4-1**

   The UE intends to de-register itself. It does so by sending a new REGISTER request. This request looks similar as in reregister case, but the Expires header contains zero. This request is sent to the same P-CSCF with which the UE initially registered.

Table 16.4-1 REGISTER (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49111
```

```
Authorization: ~~eap eap-p=AQAAEwFqYXJpQGFya2tvLmNvbQ==~~Digest username="user1_private@home1.net",
             realm="registrar.home1.net", nonce=base64(RAND + AUTN + server specific data),
             algorithm=AKAv1-MD5, uri="sip:registrar.home1.net",
             response="6629fae49393a05397450978507c4ef1"
CSeq: 7 REGISTER
Expires: 0
Content-Length: 0
```

The header field usage is the same as for the initial registration scenario:

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates public user identity. This is the identity by which other parties know this subscriber.

Contact: This indicates the point-of-presence for the subscriber – the IP address of the UE. This is the temporary identifier for the subscriber that is being de-registered.

Authorization: It carries authentication information. The private user identity is carried in the ~~user ID~~usernamed field of the ~~authentication~~ Digest AKA protocol. The deregistration process also includes the cached information (realm, nonce, algorithm, uri, response).

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Expires: The 0 value indicates the registration is being cancelled.

Upon receiving this request the P-CSCF will reset the SIP registration timer for this UE to 0.

2. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI. The DNS provides the P-CSCF with an address of the I-CSCF in the home network. The P-CSCF must not use the I-CSCF address cached as a result of the previous registration.

3. **REGISTER request (P-CSCF to I-CSCF) – see example in table 16.4-3**

This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 16.4-3 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
uri="sip:registrar.home1.net", response="6629fae49393a05397450978507c4ef1", integrity-
protected="yes"
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

Require:/Proxy-Require: These headers are included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating "path". Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

4. **Cx: User registration status query procedure**

   The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. Because the user has registered, the HSS returns the I-CSCF with the S-CSCF address for the subscriber

   For detailed message flows see 3GPP TS 29.228.

   For the parameters in the SIP REGISTER request (flow 3) which are sent to the HSS, see table 6.2-5a.

   Table 6.3-4a provides the parameters in the SIP REGISTER request (flow 5) which are obtained from the information sent back from the HSS.

5. **REGISTER (I-CSCF to S-CSCF) – see example in table 16.4-5**

   I-CSCF adds a proper I-CSCF name to the Path header.

   This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected. The Request-URI is changed to the address of the S-CSCF.

Table 16.4-5 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:icscf1_p.home1.net> <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

   Upon receiving this request the S-CSCF will reset the SIP registration timer for this UE to 0.

6. **Cx: S-CSCF registration notification procedure**

   The S-CSCF shall notify the HSS to clear its location information for that subscriber. The HSS deletes the S-CSCF name for that subscriber. The HSS sends a response to the S-CSCF to acknowledge the clearing of location information.

   For detailed message flows see 3GPP TS 29.228.

   For the parameters in the SIP REGISTER request (flow 5), which are sent to the HSS, see table 6.2-7a.

7. **200 OK (S-CSCF to I-CSCF) – see example in table 16.4-7**

   The S-CSCF sends acknowledgement to the I-CSCF indicating that deregistration was successful. This request will traverse the path that the REGISTER request took as described in the Via list. The S-CSCF clears its information for that subscriber.

Table 16.4-7 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net>, <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
```

```
From:
To: <sip:user1_public1@home1.net>
Call-ID: apb03a0s09dkjdfglkj49111
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
CSeq: 3 REGISTER
Date: Wed, 11 July 2001 08:49:37 GMT
Expires: 0
Content-Length: 0
```

Path: The S-CSCF inserts its own name to the front of the list.

8. **200 OK (I-CSCF to P-CSCF) – see example in table 16.4-8**

   The I-CSCF forwards acknowledgement from the S-CSCF to the P-CSCF indicating that deregistration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.4-8 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:token(scscf1.home1.net)>, <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

9. **200 OK (P-CSCF to UE) – see example in table 16.4-9**

   The P-CSCF forwards the acknowledgement from the I-CSCF to the UE indicating that deregistration was successful. The P-CSCF clears its information for that subscriber after sending the acknowledgement to the UE.

Table 16.4-9 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

********** Next proposed change ******************************

16.9.1 Reregistration – failure of reregistration

This signalling flow (see figure 16.9.1-1) is a continuation of the signalling flow in subclause 16.3 after reception of signalling flow 4. This signalling flow shows the recovery after a failure of the S-CSCF that had been assigned to the subscriber in a previous registration.

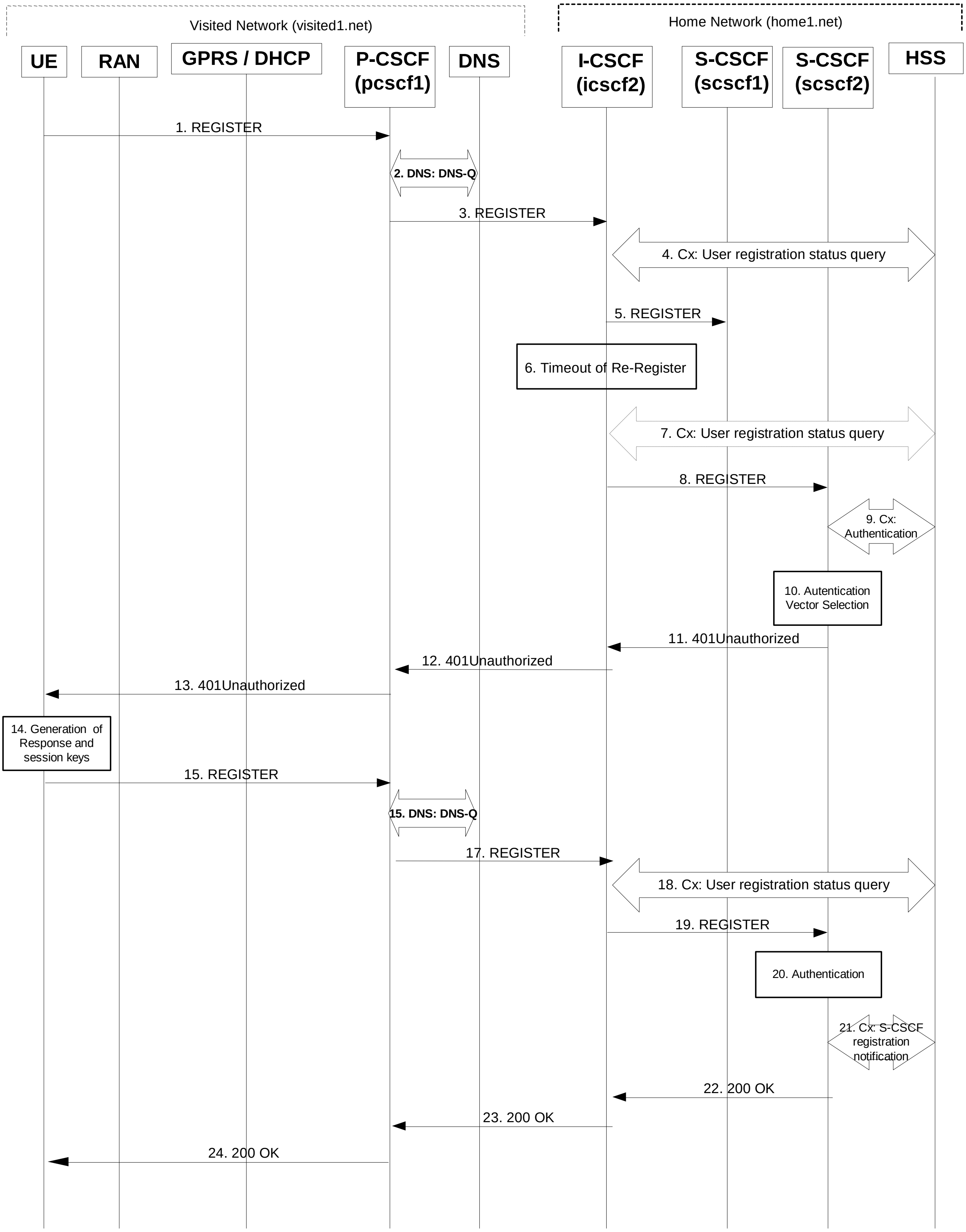


Figure 16.9.1-1: Failure of previous S-CSCF during reregistration

Steps 1 through 4 are the same as the signalling flow in subclause 16.3.

5 **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.9.1-5**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected. The Request-URI is changed to the address of the S-CSCF.

I-CSCF adds a proper I-CSCF name to the Path header.

Table 16.9.1-5 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: eap eap-p=AQAAEwFqYXJpQGFya2tvLmNvbQ==Digest username="user1_private@home1.net",
             realm="registrar.home1.net", nonce=base64(RAND + AUTN + server specific data),
             algorithm=AKAv1-MD5, uri="sip:registar.home1.net",
             response="0a1b04c89e54f09ab45e84d30e29f83a", integrity-protected="yes"
CSeq: 10 REGISTER
Expires: 7200
Content-Length: 0
```

6 **Timeout of reregister**

The I-CSCF times out, waiting for the response from the S-CSCF.

Editor’s Note: The value of the timer in this particular instance is FFS. Clearly the value of the timers in the P-CSCF and UE waiting for the response must be considered when choosing this value.

7 **Cx: User registration status query (Optional)**

The I-CSCF informs the HSS that the S-CSCF for the subscriber is unreachable and requests information related to the required S-CSCF capabilities from the HSS, The HSS sends the capability information required for S-CSCF selection. The I-CSCF uses this information to select a suitable S-CSCF.

This step is optional. Depending on implementation, sufficient information may be available to the I-CSCF from Step 4, to allow the I-CSCF select an alternate S-CSCF. Alternative mechanisms (for example a CSCF management plane) would be used to enable the HSS learn of S-CSCF failure. In addition, the HSS will learn about the assignment of a new S-CSCF in Step 9.

8 **REGISTER (I-CSCF to S-CSCF) – see example in table 16.9.1-8**

This signalling flow forwards the REGISTER request from the I-CSCF to the newly selected S-CSCF. The Request-URI is changed to the address of the new S-CSCF.

Table 16.9.1-8 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf2.home1.net SIP/2.0
Via:
Via:
Via:
Path:
Path:
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
```

```
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

The next ten steps (9 to18) are the same as in the normal reregistration case (steps 6 to 12 in subclause 16.3).

19. **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.9.1-9**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 16.9.1-9 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf2.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

The remaining steps (20-25) are the same as in the normal reregistration case (steps 17-22 in subclause 16.3)

3GPP TSG-CN1 SIP Ad Hoc Meeting | ***Tdoc N1-021061~~0933~~***
Madrid, Spain 23-25 April 2002

CR-Form-v5

CHANGE REQUEST

⌘	**24.228**	**CR**	**004**	⌘ **rev**	**3**	⌘	Current version:	**5.0.0**	⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [ ] Radio Access Network [ ] Core Network [X]

Title: ⌘	MO, S-S, MT #1a reference flow update		
Source: ⌘	Nokia		
Work item code: ⌘	IMS-CCR	***Date:*** ⌘	18-04~~11-04~~~~25-03~~-2002
Category: ⌘	**F**	***Release:*** ⌘	REL-5
	Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change: ⌘	Provide a complete reference update flow for 24.228
Summary of change: ⌘	Update based on latest IETF RFCs and I-Ds, correction of mistakes
Consequences if not approved: ⌘	24.228 call flows are not standard compliant

Clauses affected: ⌘	2, 7.2.2.1, 7.3.2.1, 7.4.2.1		
Other specs affected: ⌘	[X] Other core specifications	⌘	24.229
	[ ] Test specifications		
	[ ] O&M Specifications		

Other comments: ⌘ Revision 2: Require: 100rel added to 180 Ringing
The updated flow contains the following major changes:
- Reference RFC 3261 and privacy-04 added
- Loose routing adopted (change of Request-URI, Route header fields)
- UPDATE method + Manyfolks-05 adopted (change of the figures, SDP, Require, Supported header fields, place of the Resource Reservation~~-Approval of QoS commit~~ boxes, Content-disposition header field removed)
- Max-Forwards header field added to every request
- Branch parameters deleted from Route and Record-Route header fields
~~- To and From header fields updated to anonymous@localhost~~
- Storage information tables at P-CSCF/S-CSCF in MO/MT flows updated
- Anonymity header fields deleted (privacy-04)
- RPID-Privacy header field added (privacy-04)
- Media-Authorization header field changed to P-Media-Authorization (call-auth-04)
~~- 'Authorize QoS Resource' deleted~~
- 'Service Control' changed to 'Evaluation of initial filter criterias' for INVITE,

	deleted for 180 Ringing, 200 OK of INVITE~~deleted except for INVITE~~ - editorial corrections mistakes update of the description text update of the header descriptions SDP update (missing parameters added) inconsistency between MO/S-S/MT flows corrected (output of MO = input of S-S; output of S-S = input of MT)

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 23.228: "IP multimedia subsystem; Stage 2".

[3] IETF ~~2543bis~~RFC 3261: “SIP: Session Initiation Protocol”~~ (ietf-sip-rfc2543bis-05.txt)~~

[4] IETF RFC 2782: "A DNS RR for specifying the location of services (DNS SRV)".

[5] IETF RFC 2806: "URLs for Telephone Calls".

[6] IETF RFC 2916: "E.164 number and DNS".

[7] 3GPP TS 33.203: "Access security for IP based services".

[8] 3GPP TS 23.060: "General Packet Radio Service (GPRS) Service description; Stage 2".

[9] 3GPP TS 29.207: "End to end Quality of Service (QoS); stage 3".

[10] 3GPP TS 29.060: "General Packet Radio Service (GPRS); GPRS Tunnelling Protocol (GTP) across the Gn and Gp Interface".

[11] 3GPP TS 29.228: "IP Multimedia (IM) Subsystem Cx Interface; Signalling flows and message contents".

[12] 3GPP TS 24.008: "Mobile radio interface layer 3 specification; Core Network Protocols; Stage 3".

[13] IETF Privacy draft: “SIP Extensions for Network-Asserted Caller Identity and Privacy within Trusted Networks” (draft-ietf-sip-privacy-04.txt)

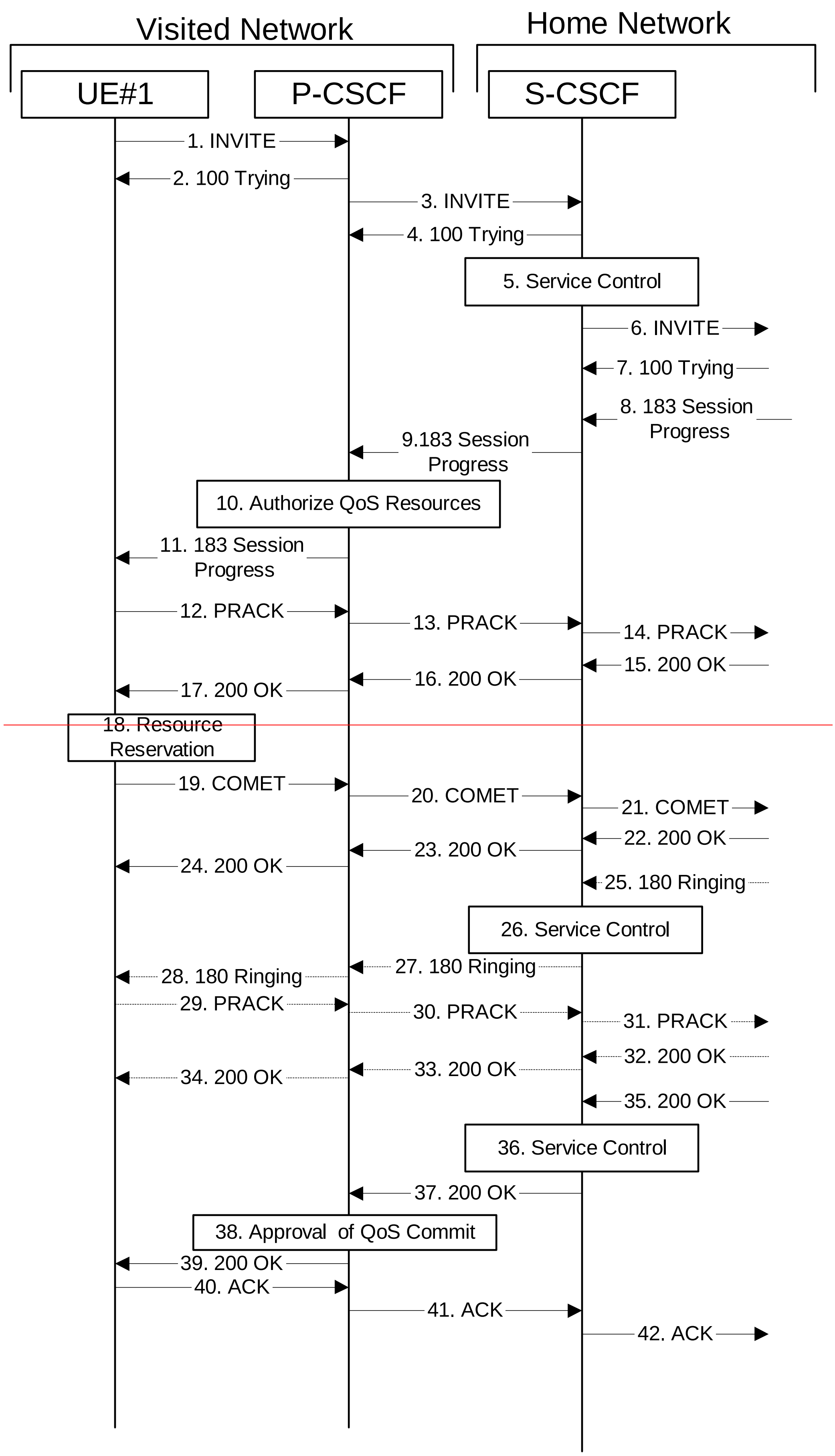
~~Editors Note: This reference to 2543 will need to be updated to reference the assigned RFC number, once the draft achieves RFC status within the IETF.~~

7.2.2 MO#1a

7.2.2.1 (MO#1a) Mobile origination, roaming (S-S#1a, MT#1a assumed)

Figure 7.2.2.1-1 shows an origination procedure which applies to roaming subscribers when the home network operator does not desire to keep its internal configuration hidden from the visited network. The UE is located in a visited network, and determines the P-CSCF via the CSCF discovery procedure. During registration, the home network allocates a S-CSCF. The home network provides the S-CSCF name/address as the entry point from the visited network.

When registration is complete, P-CSCF knows the name/address of the S-CSCF.


Visited Network
Home Network
UE#1
P-CSCF
S-CSCF
1. INVITE
2. 100 Trying
3. INVITE
4. 100 Trying
5. Service Control
6. INVITE
7. 100 Trying
8. 183 Session Progress
9.183 Session Progress
10. Authorize QoS Resources
11. 183 Session Progress
12. PRACK
13. PRACK
14. PRACK
15. 200 OK
16. 200 OK
17. 200 OK
18. Resource Reservation
19. COMET
20. COMET
21. COMET
22. 200 OK
23. 200 OK
24. 200 OK
25. 180 Ringing
26. Service Control
27. 180 Ringing
28. 180 Ringing
29. PRACK
30. PRACK
31. PRACK
32. 200 OK
33. 200 OK
34. 200 OK
35. 200 OK
36. Service Control
37. 200 OK
38. Approval of QoS Commit
39. 200 OK
40. ACK
41. ACK
42. ACK

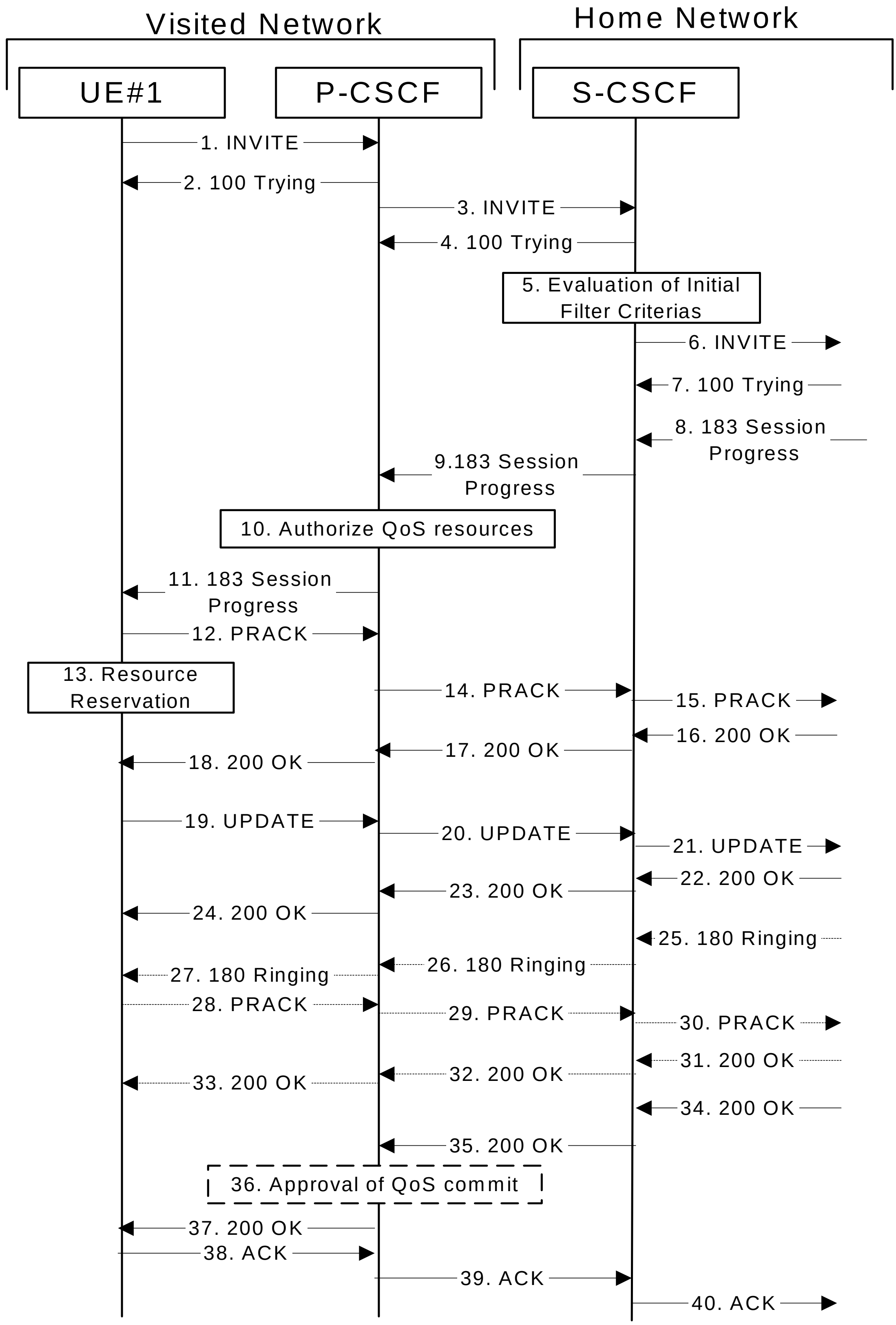


Figure 7.2.2.1-1: MO#1a

Procedure MO#1a is as follows:

1. **INVITE (UE to P-CSCF) - see example in table 7.2.2.1-1**

UE#1 determines the complete set of codecs that it is capable of supporting for this session. It builds a SDP containing bandwidth requirements and characteristics of each, and assigns local port numbers for each possible media flow. Multiple media flows may be offered, and for each media flow (m= line in SDP), there may be multiple codec choices offered.

For this example, assume UE#1 is capable of sending two simultaneous video streams, either H261 or MPV format, and two simultaneous audio streams, either AMR, G726-32, PCMU, or G728.

UE sends the INVITE request, containing an initial SDP, to the P-CSCF determined via the CSCF discovery mechanism. The initial SDP may represent one or more media for a multimedia session.

Editor's Note: Need to insure the codec negotiation procedures are compatible with the procedures brought into release 4 for CS domain services (BICC).

Table 7.2.2.1-1: INVITE (UE to P-CSCF)

```
INVITE sip:+1-212-555-2222@home1.net;user=phone SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
~~Supported: 100rel~~
~~Require: precondition, update, 100rel~~
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>~~;privacy=off~~
RPID-Privacy: privacy=off;party=calling
~~Anonymity: Off~~
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
seq=72))@localhost>; tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 127 INVITE
~~Max-Forwards: 70~~
Require: precondition
Supported: 100rel
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 3400 RTP/AVP 98 99
b=AS:54.6
~~a=qos:mandatory sendrecv~~
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:98 H261
a=rtpmap:99:MPV
m=video 3402 RTP/AVP 98 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:98 H261
a=rtpmap:99:MPV
~~a=qos:mandatory sendrecv~~
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
~~a=qos:mandatory sendrecv~~
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
```

```
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
a=qos:mandatory sendrecv
```

Request-URI: contains the keyed number from the user. This is specified by the UE as sip:<keyed number>@home1.net. This is in accordance to standard IETF procedures for specifying dialled digits.

Via: contains the IP address or FQDN of the originating UE.

Remote-Party-ID: contains the originator's public user identity. The Display name is optional.

From:/To:/Call-ID: follow the recommendations of draft-ietf-sip-privacy-~~01~~ [13], even though anonymity is not being requested for this session.

Cseq: is a random starting number.

Contact: is a~~the~~ SIP URL that contains the IP address or FQDN of the originating UE.

SDP The SDP contains a set of codecs supported by UE#1 and desired by the user at UE#1 for this session.

Upon receiving the INVITE, the P-CSCF stores the following information about this session, for use in possible error recovery actions - see example in table 7.2.2.1-1b.

Table 7.2.2.1-1b: Storage of information at P-CSCF

```
Request-URI: sip:+1-212-555-2222@home1.net;user=phone
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
 seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
Cseq(2dest): 127 INVITE
Cseq(2orig): none
ContactRouteContact(2origlocal): sip:[5555::aaa:bbb:ccc:ddd]
```

2. **100 Trying (P-CSCF to UE) - see example in table 7.2.2.1-2**

P-CSCF responds to the INVITE request (1) with a 100 Trying provisional response.

Table 7.2.2.1-2: 100 Trying (P-CSCF to UE)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

3. **INVITE (P-CSCF to S-CSCF) - see example in table 7.2.2.1-3**

P-CSCF remembers (from the registration procedure) the request routing for this UE. This becomes ~~the~~ a Route header~~Request-URI~~ in the request. This next hop is the S-CSCF within the home network of UE#1.

P-CSCF adds itself to the Record-Route header and Via header.

P-CSCF~~#1~~ examines the media parameters, and removes any choices that the network operator decides based on local policy, not to allow on the network.

For this example, assume the network operator disallows H261 video encoding.

The INVITE request is forwarded to the S-CSCF.

Table 7.2.2.1-3: INVITE (P-CSCF to S-CSCF)

```
INVITE sip:+1-212-555-2222@home1.net;user=phone~~scscf1.home1.net~~ SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
~~Require:~~
Record-Route: sip:pcscf1.visited1.net;lr
Route: sip:scscf1.home1.net;lr~~ +1-212-555-2222@home2.net;user=phone~~
~~Supported: ~~
Remote-Party-ID:
RPID-Privacy:
~~Anonymity: ~~
From:
To:
Call-ID:
Cseq:
~~Max-Forwards: 69~~
Require:
Supported:
Contact:
Content-Type:
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 3400 RTP/AVP 99
b=AS:54.6
~~a=qos:mandatory sendrecv~~
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=video 3402 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
~~a=qos:mandatory sendrecv~~
a=rtpmap:99:MPV
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
~~a=qos:mandatory sendrecv ~~
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
~~a=qos:mandatory sendrecv ~~
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
```

~~**Request-URI:** is the first component in the remembered Path header from Registration.~~

Route: contains the ~~remaining~~ elements from the Path header from r~~R~~egistration~~, with the initial Request-URI (received from the UE) appended as the final component.~~

SDP The SDP contains the restricted set of codecs allowed by the network operator. The "m=" lines for the video media streams no longer list code 98 (H261).

Upon receiving the INVITE, the S-CSCF stores the following information about this session, for use in possible error recovery actions - see example in table 7.2.2.1-3b.

Table 7.2.2.1-3b: Storage of information at S-CSCF

```
Request-URI: sip:+1-212-555-2222@home1.net;user=phone
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
seq=72))@localhost>; tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
Cseq(2dest): 127 INVITE
Cseq(2orig): none
Route~~Contact~~(2orig): sip:~~%5b5555%3a%3aaaaa%3abbb%3accc%3addd%5d@~~pcscf1.visited1.net~~, 
sip:[5555::aaa:bbb:ccc:ddd]~~
Contact(orig): sip:[5555::aaa:bbb:ccc:ddd]
```

4. **100 Trying (S-CSCF to P-CSCF) - see example in table 7.2.2.1-4**

   S-CSCF responds to the INVITE request (3) with a 100 Trying provisional response.

Table 7.2.2.1-4: 100 Trying (S-CSCF to P-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

5. **~~Service Control~~Evaluation of initial filter criterias**

   S-CSCF validates the service profile of this subscriber~~,~~ and evaluates the initial filter criterias.~~performs any origination service control required for this subscriber. For this example, assume no Application Server involvement.~~

   ~~S-CSCF#1 examines the media parameters, and removes any choices that the subscriber does not have authority to request.~~

   ~~For this example, assume the subscriber is not allowed video.~~

6. **INVITE (MO#1 to S-S) - see example in table 7.2.2.1-6**

   S-CSCF examines the media parameters, and removes any choices that the subscriber does not have authority to request. For this example, assume the subscriber is not allowed video.

   S-CSCF forwards the INVITE request, as specified by the S-CSCF to S-CSCF procedures.

~~Editor's Note: Need for additional headers to transport e.g. Billing-Correlation-Identifier is FFS.~~

Table 7.2.2.1-6: INVITE request (MO#1a to S-S)

```
INVITE sip:+1-212-555-2222@home2.net;user=phone SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
~~Require: ~~
Record-Route: sip:~~332b23.1@~~scscf1.home1.net;lr, sip:pcscf1.visited1.net;lr
~~Supported: ~~
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>;~~privacy=off;~~screen=yes
RPID-Privacy:
~~Anonymity: ~~
From:
To:
Call-ID:
Cseq:
~~Max-Forwards: 68~~
Require:
Supported:
Contact:
Content-Type:
Content-Length: (...)
```

```
v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
b=AS:54.6
a=qos:mandatory sendrecv
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=qos:mandatory sendrecv
a=rtpmap:99:MPV
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=qos:mandatory sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=qos:mandatory sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
```

SDP The SDP contains the restricted set of codecs allowed by the network operator. The "m=" lines for the video media streams show a port number zero, which removes them from the negotiation.

Request-URI: In the case where the ~~Route header~~ Request-URI of the incoming INVITE request to S-CSCF contains a TEL-URL [5], it has to be translated to a globally routable SIP-URL before applying it as Request-URI of the outgoing INVITE request. For this address translation the S-CSCF shall use the services of an ENUM-DNS protocol according to RFC 2916 [6], or any other suitable translation database. Database aspects of ENUM are outside the scope of this specification.

7. **100 Trying (S-S to MO#1a) - see example in table 7.2.2.1-7 (related to table 7.2.2.1-6)**

S-CSCF receives a 100 Trying provisional response, as specified by the S-CSCF to S-CSCF procedures.

Table 7.2.2.1-7: 100 Trying (S-S to MO#1a)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

8. **183 Session Progress (S-S to MO#1a) - see example in table 7.2.2.1-8 (related to table 7.2.2.1-6)**

The media stream capabilities of the destination are returned along the signalling path, in a 183 Session Progress provisional response (to 6), per the S-CSCF to S-CSCF procedures.

Table 7.2.2.1-8: 183 Session Progress (S-S to MO#1a)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:361k21.1@pcscf2.visited2.net;lr, sip:764z87.1@scscf2.home2.net;lr,
sip:332b23.1@scscf1.home1.net;lr, sip:240f34.1@pcscf1.visited1.net;lr
Remote-Party-ID: "John Smith" <tel:+1-212-555-2222>;privacy=off;screen=yes
RPID-Privacy: privacy=off;party=called
Anonymity: Off
Require: 100rel
From:
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost; tag=314159
Call-ID:
CSeq:
Require: 100rel
Contact: sip:[5555::eee:fff:aaa:bbb]
RSeq: 9021
Content-Disposition: precondition
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97 96
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=conf:qos remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
a=qos:mandatory sendrecv confirm
m=audio 0 RTP/AVP 97 96 0 15
```

Upon receiving the 183 Session Progress, the S-CSCF stores the following information about this session, for use in providing enhanced services or in possible error recovery actions – see example in table 7.2.2.1-8b.

Table 7.2.2.1-8b: Storage of information at S-CSCF

```
Request-URI: sip:+1-212-555-2222@home1.net;user=phone
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
seq=72))@localhost>; tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost; tag=314159From:
"Anonymous" <sip:anonymous@localhost>; tag=171828
To: sip:anonymous@localhost; tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
CSeq(2dest): 127 INVITE
CSeq(2orig): none
Route(2dest): sip:scscf2.home2.net,sip:pcscf2.visited2.net, sip:[5555::eee:fff:aaa:bbb]
Route(2orig): sip:pcscf1.visited1.net, sip:[5555::aaa:bbb:ccc:ddd]
Contact(dest): sip:[5555::eee:fff:aaa:bbb]
Contact(orig): sip:[5555::aaa:bbb:ccc:ddd]
```

9. **183 Session Progress (S-CSCF to P-CSCF) - see example in table 7.2.2.1-9**

S-CSCF forwards the 183 Session Progress response to P-CSCF.

Table 7.2.2.1-9: 183 Session Progress (S-~~SCSF~~CSCF to P-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP
[5555::aaa:bbb:ccc:ddd]
Record-Route:
Remote-Party-ID:
```

```
RPID-Privacy:
Anonymity:
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Disposition:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
a=
m=
```

Upon receiving the 183 Session Progress, the P-CSCSF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE. The saved value of the information for this session is - see example in table 7.2.2.1-9b.

Table 7.2.2.1-9b: Storage of information at P-CSCF

```
Request-URI: sip:+1-212-555-2222@home1.net;user=phone
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
seq=72))@localhost>; tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
Cseq(2dest): 127 INVITE
CSeq(2orig): none
Route(2dest): sip:scscf1.home1.net, sip:scscf2.home2.net, pcscf2.visited2.net
ContactRoute(2origlocal): sip:[5555::aaa:bbb:ccc:ddd]
Route(2dest): sip:332b23.1@scscf1.home1.net, sip:764z87.1@scscf2.home2.net, 
 pcscf2.visited2.net, sip:[5555::eee:fff:aaa:bbb]
Contact(dest): sip:[5555::eee:fff:aaa:bbb]
Contact(orig): sip:[5555::aaa:bbb:ccc:ddd]
```

10. **Authorize QoS Resources**

P-CSCF authorizes the resources necessary for this session. The approval of QoS commitment either happens at this stage or after 200 OK of INVITE (35) based on operator local policy.

11. **183 Session Progress (P-CSCF to UE) – see example in table 7.2.2.1-11**

P-CSCF forwards the 183 Session Progress response to the originating endpoint.

Table 7.2.2.1-11: 183 Session Progress (P-CSCF to UE)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Media-Authorization: 0020000100100101706366312e78797a2e6e6574000c02013942563330373200
Remote-Party-ID:
RPID-Privacy:
Anonymity:
Require: 
P-Media-Authorization:0020000100100101706366312e78797a2e6e6574000c02013942563330373200
From:
To:
Call-ID:
CSeq:
Require: 
Contact:
RSeq:
Content-Disposition: 
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
a=
m=
```

~~P-CSCF removes the Record-Route and Via headers, calculates the proper Route header to add to future requests, and saves that information without passing it to the UE. The saved value of the Route header is:~~

```
Route: sip:332b23.1@scscf1.home1.net, sip:764z87.1@scscf2.home2.net,
    sip:pcscf2.visited2.net
```

~~Media-~~P-Media-Authorization: a P-CSCF generated authorization token. This particular example shows a Policy-Element generated by "pcf1.xyz.net" with credentials "9BV3072". "00" at the end of the authorization token is required to pad to a multiple of 4 bytes.

12. **PRACK (UE to P-CSCF) - see example in table 7.2.2.1-12**

UE#1 determines which media flows should be used for this session, and which codecs should be used for each of those media flows. If there was any change in media flows, or if there was more than one choice of codec for a media flow, then UE#1 ~~must~~ includes an new SDP offer in the PRACK message sent to UE#2.

For this example, assume UE#1 chooses AMR as the codec to use for the single audio stream.

UE includes this information in the PRACK request to P-CSCF.

~~Editor's Note: The use of three-message codec negotiation (one round-trip to determine common capabilities, then originator picks the ones to use) is allowed by RFC2543, but will apparently not be supported by 2543bis. This inconsistency needs to be resolved.~~

Table 7.2.2.1-12: PRACK (UE to P-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
~~Require: precondition, 100rel, update~~
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 128 PRACK
Require: precondition~~Max-forwards: 70~~
Rack: 9021 127 INVITE
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 3456 RTP/AVP 97
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
~~a=qos:mandatory sendrecv~~
m=audio 0 RTP/AVP 97 96 0 15
```

Request-URI: takes the value of the Contact header of the received 183 Session Progress response.

Via: takes the value of either the IP address or~~f~~ FQDN of the originating UE.

From:/To:/Call-ID: copied from the 183 Session Progress response so that they include any tag parameter.

Cseq: takes a higher value than that in the previous request.

~~The final selection of the media stream from the set of those supported by the terminating endpoint, given in the received 183 Session Progress response (14), is made by the originating UE and included in the SDP.~~

1~~2~~3. **Resource Reservation**

After determining the final media streams in step #11, UE initiates the reservation procedures for the resources needed for this session.

1~~3~~4. **PRACK (P-CSCF to S-CSCF) – see example in table 7.2.2.1-14~~3~~**

P-CSCF adds the Route header corresponding to the session.

P-CSCF forwards the PRACK request to S-CSCF.

Table 7.2.2.1-14~~3~~: PRACK (P-CSCF to S-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb] ~~scscf1.home1.net ~~SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
~~Require:~~
Route: sip:scscf1.home1.net;lr, sip:~~764z87.1@~~scscf2.home2.net;lr,
sip:~~361k21.1@~~pcscf2.visited2.net;lr~~,sip:[5555::eee:fff:aaa:bbb]~~
From:
To:
Call-ID:
Cseq:
Require:
~~Max-Forwards: 69~~
Rack:
Content-Type:
Content-Length:
```

```
v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

~~**Request-URI:** taken from the first component of the saved Route header.~~

Route: saved from the Record-Route header of the 183 Session Progress response ~~(with first element moved to Request-URI) with the initial Request-URI (received from the UE) appended as the final component.~~

15~~4~~. **PRACK (MO#1a to S-S) – see example in table 7.2.2.1-15~~4~~**

S-CSCF forwards the PRACK request to the terminating endpoint, as per the S-CSCF to S-CSCF procedure.

Table 7.2.2.1-15~~4~~: PRACK (MO#1a to S-S)

```
PRACK sip:[5555::eee:fff:aaa:bbb] scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Require:
Route: sip:scscf2.home2.net;lr,
sip:361k21.1@pcscf2.visited2.net;lr,sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Require:
Max-Forwards: 68
Rack:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

~~**Request-URI:** the first component of the Route header. This will vary according to which S-CSCF to S-CSCF signalling flow is used.~~

16~~5~~. **200 OK (S-S to MO#1a) – see example in table 7.2.2.1-16~~5~~ (related to table 7.2.2.1-15~~4~~)**

The destination endpoint responds to the PRACK request (14) with a 200 OK response, per the S-CSCF to S-CSCF procedures.

Table 7.2.2.1-16~~5~~: 200 OK (S-S to MO#1a)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
~~Content-Length: 0~~
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=conf:qos remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
m=audio 0 RTP/AVP 97 96 0 15
```

17~~6~~. **200 OK (S-CSCF to P-CSCF) - see example in table 7.2.2.1-17~~6~~**

S-CSCF forwards the 200 OK response to P-CSCF.

Table 7.2.2.1-17~~6~~: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

18~~7~~. **200 OK (P-CSCF to UE) - see example in table 7.2.2.1-18~~7~~**

P-CSCF forwards the 200 OK response to UE.

Table 7.2.2.1-18~~7~~: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
```

```
From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

~~18. **Resource Reservation**~~

~~After determining the final media streams in step #11, UE initiates the reservation procedures for the resources needed for this session.~~

19. **~~COMET~~UPDATE (UE to P-CSCF) – see example in table 7.2.2.1-19**

When the resource reservation is completed, UE sends the ~~COMET~~UPDATE request to the terminating endpoint, via the signalling path established by the INVITE request. ~~The request is sent first to P-CSCF.~~

Table 7.2.2.1-19: ~~COMET~~UPDATE (UE to P-CSCF)

```
COMETUPDATE sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 129 COMETUPDATE
Max-Forwards: 70
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 3456 RTP/AVP 97
b=AS:25.4
a=curr:qos local sendrecv
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=qos:success sendonly
m=audio 0 RTP/AVP 97 96 0 15
```

Request-URI: takes the value of the Contact header of the received 183 Session Progress response.

Via: takes the value of either the IP address or FQDN of the originating UE.

From:/To:/Call-ID: copied from the 183 Session Progress response so that they include any tag parameters.

Cseq: takes a higher value than that in the previous request.

The SDP indicates that the resource reservation was successful in the local segment.

20. **~~COMET~~UPDATE (P-CSCF to S-CSCF) – see example in table 7.2.2.1-20**

P-CSCF adds the Route header corresponding to the session.

P-CSCF forwards the ~~COMET~~UPDATE request to S-CSCF.

Table 7.2.2.1-20: ~~COMET~~UPDATE (P-CSCF to S-CSCF)

```
COMETUPDATE sip:[5555::eee:fff:aaa:bbb]scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:764z87.1@scscf2.home2.net, 
sip:361k21.1@pcscf2.visited2.net,sip:[5555::eee:fff:aaa:bbb]Route: sip:scscf1.home1.net;lr, 
sip:scscf2.home2.net;lr, sip:pcscf2.visited2.net;lr
From:
To:
Call-ID:
Cseq:
Max-Forwards: 69
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

~~**Request-URI:** taken from the first component of the saved Route header.~~

Route: saved from the Record-Route header of the 183 Session Progress response. ~~(with first element moved to Request-URI) with the initial Request-URI (received from the UE) appended as the final component.~~

21. **~~COMET~~UPDATE (MO#1a to S-S) - see example in table 7.2.2.1-21**

S-CSCF forwards the ~~COMET~~UPDATE request to the terminating endpoint, as per the S-CSCF to S-CSCF procedure.

Table 7.2.2.1-21: ~~COMET~~UPDATE (MO#1a to S-S)

```
COMETUPDATE sip:[5555::eee:fff:aaa:bbb]scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP 
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: pcscf2.visited2.net,sip:[5555::eee:fff:aaa:bbb]Route: sip:scscf2.home2.net;lr, 
sip:pcscf2.visited2.net;lr
From:
To:
Call-ID:
Cseq:
Max-Forwards: 68
Content-Type:
Content-Length:

v=
o=
```

```
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

~~**Request-URI:** the first component of the Route header. This will vary according to which S-CSCF to S-CSCF signalling flow is used.~~

22. **200 OK (S-S to MO#1a) – see example in table 7.2.2.1-22 (related to table 7.2.2.1-21)**

The destination endpoint responds to the ~~COMET~~UPDATE request (21) with a 200 OK, per the S-CSCF to S-CSCF procedures.

Table 7.2.2.1-22: 200 OK (S-S to MO#1a)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97
b=AS:25.4
a=curr:qos local sendrecv
a=curr:qos remote sendrecv
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
m=audio 0 RTP/AVP 97 96 0 15
```

The SDP indicates that the resource reservation was successful both in the local and the remote segment.

23. **200 OK (S-CSCF to P-CSCF) - see example in table 7.2.2.1-23**

S-CSCF forwards the 200 OK response to P-CSCF.

Table 7.2.2.1-23: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length:

v=
o=
```

```
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

~~23. **Approval of QoS Commit**~~

~~The P-CSCF approves the commitment of the QoS resources.~~

24. **200 OK (P-CSCF to UE) – see example in table 7.2.2.1-24**

P-CSCF forwards the 200 OK response to UE.

Table 7.2.2.1-24: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

25. **180 Ringing (S-S to MO#1a) – see example in table 7.2.2.1-25 (related to table 7.2.2.1-6)**

The called UE may optionally perform alerting. If so, it signals this to the calling party by a 180 Ringing provisional response to (6). This response is sent to S-CSCF per the S-CSCF to S-CSCF procedure.

Table 7.2.2.1-25: 180 Ringing (S-S to MO#1a)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:361k21.1@pcscf2.visited2.net;lr, sip:764z87.1@scscf2.home2.net;lr,
sip:332b23.1@scscf1.home1.net;lr, sip:240f34.1@pcscf1.visited1.net;lr
Require: 100rel
From:
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost; tag=314159
Call-ID:
CSeq:
Require: 100rel
```

```
Contact: sip:[5555::eee:fff:aaa:bbb]
RSeq: 9022
Content-Length: 0
```

~~26. **Service Control**~~

~~The S-CSCF validates the service profile and performs any service control required for this subscriber.~~

2~~7~~6. **180 Ringing (S-CSCF to P-CSCF) – see example in table 7.2.2.1-2~~7~~6**

S-CSCF forwards the 180 Ringing response to P-CSCF.

Table 7.2.2.1-2~~7~~6: 180 Ringing (S-CSCF to P-CSCF)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Length:
```

2~~8~~7. **180 Ringing (P-CSCF to UE) - see example in table 7.1.1-27~~8~~**

P-CSCF removes the Record-Route headers.

P-CSCF forwards the 180 Ringing response to UE.

Table 7.2.2.1-2~~8~~7: 180 Ringing (P-CSCF to UE)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Length:
```

~~Editor's Note: Additional QoS interactions to handle one-way media at this point (e.g. for PSTN ringback and announcements) is for further study.~~

~~29~~28. **PRACK (UE to P-CSCF) – see example in table 7.2.2.1-28~~29~~**

UE indicates to the originating subscriber that the destination is ringing. It responds to the 180 Ringing provisional response (28) with a PRACK request.

Table 7.2.2.1-~~2~~28~~9~~: PRACK (UE to P-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 130 PRACK
Max-Forwards: 70
Rack: 9022 127 INVITE
Content-Length: 0
```

Request-URI: takes the value of the Contact header of the received 180 Ringing response.

Via: takes the value of either the IP address or FQDN of the originating UE.

From:/To:/Call-ID: copied from the 180 Ringing response so that they include any revised tag parameters.

Cseq: takes a higher value than in the previous request.

29~~30~~. **PRACK (P-CSCF to S-CSCF) – see example in table 7.2.2.1-29~~30~~**

P-CSCF adds the Route header corresponding to the session.

P-CSCF forwards the PRACK request to S-CSCF.

Table 7.2.2.1-29~~30~~: PRACK (P-CSCF to S-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb]~~scscf1.home1.net~~ SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
~~Route: sip:764z87.1@scscf2.home2.net, ~~
~~sip:361k21.1@pcscf2.visited2.net,sip:[5555::eee:fff:aaa:bbb]~~Route: sip:scscf1.home1.net;lr, 
sip:scscf2.home2.net;lr, sip:pcscf2.visited2.net;lr
From:
To:
Call-ID:
Cseq:
~~Max-Forwards: 69~~
Rack:
Content-Length:
```

3~~1~~0. **PRACK (MO#1a to S-S) - see example in table 7.2.2.1-30~~1~~**

S-CSCF forwards the PRACK request to the terminating endpoint, as per the S-CSCF to S-CSCF procedure.

Table 7.2.2.1-3~~1~~0: PRACK (MO#1a to S-S)

```
PRACK sip:[5555::eee:fff:aaa:bbb]~~scscf2.home2.net~~ SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scscf2.home2.net;lr, 
sip:~~361k21.1@~~pcscf2.visited2.net;lr~~,sip:[5555::eee:fff:aaa:bbb]~~
From:
To:
Call-ID:
Cseq:
~~Max-Forwards: 68~~
Rack:
Content-Length:
```

3~~2~~1. **200 OK (S-S to MO#1a) - see example in table 7.2.2.1-3~~2~~1 (related to table 7.2.2.1-3~~1~~0)**

The destination endpoint responds to the PRACK request (30~~1~~) with a 200 OK response.

Table 7.2.2.1-3~~2~~1: 200 OK (S-S to MO#1a)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

3~~3~~2. **200 OK (S-CSCF to P-CSCF) - see example in table 7.2.2.1-3~~3~~2**

S-CSCF forwards the 200 OK response to P-CSCF.

Table 7.2.2.1-3~~3~~2: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

3~~4~~3. **200 OK (P-CSCF to UE) – see example in table 7.2.2.1-33~~4~~**

P-CSCF forwards the 200 OK response to UE.

Table 7.2.2.1-3~~4~~3: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

3~~5~~4. **200 OK (S-S to MO#1a) – see example in table 7.2.2.1-3~~5~~4 (related to table 7.2.2.1-6)**

When the called party answers, the terminating endpoint sends a 200 OK final response to the INVITE request (6), as specified by the termination procedures and the S-CSCF to S-CSCF procedures, to S-CSCF.

Table 7.2.2.1-3~~5~~4: 200 OK (S-S to MO#1a)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:~~361k21.1@~~pcscf2.visited2.net;lr, sip:~~764z87.1@~~scscf2.home2.net;lr,
sip:~~332b23.1@~~scscf1.home1.net;lr, sip:~~240f34.1@~~pcscf1.visited1.net;lr~~,~~
From:
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost; tag=314159
Call-ID:
CSeq: 127 INVITE
Contact: sip:[5555::eee:fff:aaa:bbb]
~~Content-Type: application/sdp~~
Content-Length:0~~ (...)~~

~~v=0~~
~~o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd~~
~~s=-~~
~~c=IN IP6 5555::eee:fff:aaa:bbb~~
~~t=907165275 0~~
~~m=video 0 RTP/AVP 99~~
~~m=video 0 RTP/AVP 99~~
~~m=audio 6544 RTP/AVP 97~~
~~b=AS:25.4~~
~~a=rtpmap:97 AMR~~
~~a=fmtp:97 mode-set=0,2,5,7; maxframes=2~~
~~a=qos:success sendrecv~~
~~m=audio 0 RTP/AVP 97 96 0 15~~
```

~~Upon receiving the 200 OK, the S-CCSF stores the following information about this session, for use in providing enhanced services or in possible error recovery actions – see example in table 7.2.2.1-35b.~~

~~**Table 7.2.2.1-35b: Storage of information at S-CSCF**~~

```
~~Request-URI: sip:+1-212-555-2222@home1.net;user=phone~~
~~From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;~~
~~seq=72))@localhost>; tag=171828~~
~~To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost; tag=314159~~
~~sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost~~
~~Call-ID: cb03a0s09a2sdfglkj490333~~
~~CSeq(2dest): 127 INVITE~~
```

```
~~CSeq(2orig): none~~
~~Route(2dest):~~
~~sip:scscf2.home1.net,sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home1.net~~
~~Route(2orig): sip:%5b5555%3a%3aaaa%3abbb%3accc%3addd%5d@pcscf1.visited1.net~~
```

~~36. **Service Control**~~

~~S-CSCF performs whatever service control is appropriate for the completed session.~~

3~~7~~5. **200 OK (S-CSCF to P-CSCF) – see example in table 7.2.2.1-35~~7~~**

S-CSCF sends a 200 OK final response along the signalling path back to P-CSCF.

Table 7.2.2.1-3~~7~~5: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
From:
To:
Call-ID:
CSeq:
Contact:
~~Content-Types:~~
Content-Length:

~~v=~~
~~o=~~
~~s=~~
~~c=~~
~~t=~~
~~m=~~
~~m=~~
~~m=~~
~~b=~~
~~a=~~
~~a=~~
~~a=~~
~~m=~~
```

3~~8~~6. **Approval of QoS Commit**

The P-CSCF approves the commitment of the QoS resources if it was not approved already in step (10).

3~~9~~7~~6~~. **200 OK (P-CSCF to UE) – see example in table 7.2.2.1-3~~96~~7**

P-CSCF ~~indicates the resources reserved for this session should now be committed, and~~ forwards the 200 OK final response to the session originator. UE can start the media flow(s) for this session.

Table 7.2.2.1-3~~96~~7: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact:
~~Content-Types:~~
Content-Length:

~~v=~~
~~o=~~
~~s=~~
~~c=~~
~~t=~~
~~m=~~
~~m=~~
~~m=~~
~~b=~~
~~a=~~
~~a=~~
```

```
a=
m=
```

~~P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.~~

3~~7~~8~~40~~. ACK (UE to P-CSCF) – see example in table 7.2.2.1-~~37~~38~~40~~

UE starts the media flow for this session, and responds to the 200 OK (37) with an ACK request sent to P-CSCF.

Table 7.2.2.1-3~~7~~8~~40~~: ACK (UE to P-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 127 ACK
Max-Forwards: 70
Content-Length: 0
```

Cseq: is required to be the same value as Cseq contained in original INVITE request [3].

3~~8~~9~~41~~. ACK (P-CSCF to S-CSCF) – see example in table 7.2.2.1-3~~8~~9~~41~~

P-CSCF adds the Route header corresponding to the session.

P-CSCF forwards the ACK request to S-CSCF.

Table 7.2.2.1-38~~41~~: ACK (P-CSCF to S-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:scscf1.home1.net;lr, sip:764z87.1@scscf2.home2.net;lr,
sip:361k21.1@pcscf2.visited2.net;lr, sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Max-Forwards: 69
Content-Length:
```

~~**Request-URI:** the first component of the saved Route header.~~

Route: saved from the ~~200 OK~~ Record-Route header of the 183 Session Progress response. ~~(with first element moved to Request-URI) with the initial Request-URI (received from the UE) appended as the final component.~~

~~39~~40~~42~~. ACK (MO#1a to S-S) - see example in table 7.2.2.1-~~39~~40~~42~~

S-CSCF forwards the ACK request to the terminating endpoint, per the S-CSCF to S-CSCF procedure.

Table 7.2.2.1-~~39~~40~~42~~: ACK (MO#1a to S-S)

```
ACK sip:[5555::eee:fff:aaa:bbb]scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scscf2.home2.net;lr, sip:361k21.1@pcscf2.visited2.net;lr,
sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Max-Forwards: 68
```

```
Content-Length:
```

7.3.2 S-S#1a

7.3.2.1 (S-S#1a) Different network operators performing origination and termination (MO#1a, MT#1a assumed)

Figure 7.3.2.1-1 shows a S-CSCF handling session origination (S-CSCF#1), which performs an analysis of the destination address, and determines that it belongs to a subscriber of a different operator. The originating network operator does not desire to keep their configuration hidden, so it forwards the request to a well-known entry point in the destination operator's network, I-CSCF. I-CSCF queries the HSS for current location information, and finds the S-CSCF assigned to the subscriber (S-CSCF#2), and forwards the request to S-CSCF#2. The terminating network operator does not desire to keep their configuration hidden, so the I-CSCF does not insert itself into the signalling path for future exchanges. This example flow does not show Application Server involvement.

Origination sequences that share this common S-CSCF to S-CSCF procedure are:

MO#1a Mobile origination, roaming, without a THIG. The "Originating Network" of S-S#1a is therefore a visited network.

MO#1b Mobile origination, roaming, with a THIG in home network. The "Originating Network" of S-S#1a is therefore a visited network.

MO#2 Mobile origination, located in home service area. The "Originating Network" of S-S#1a is therefore the home network.

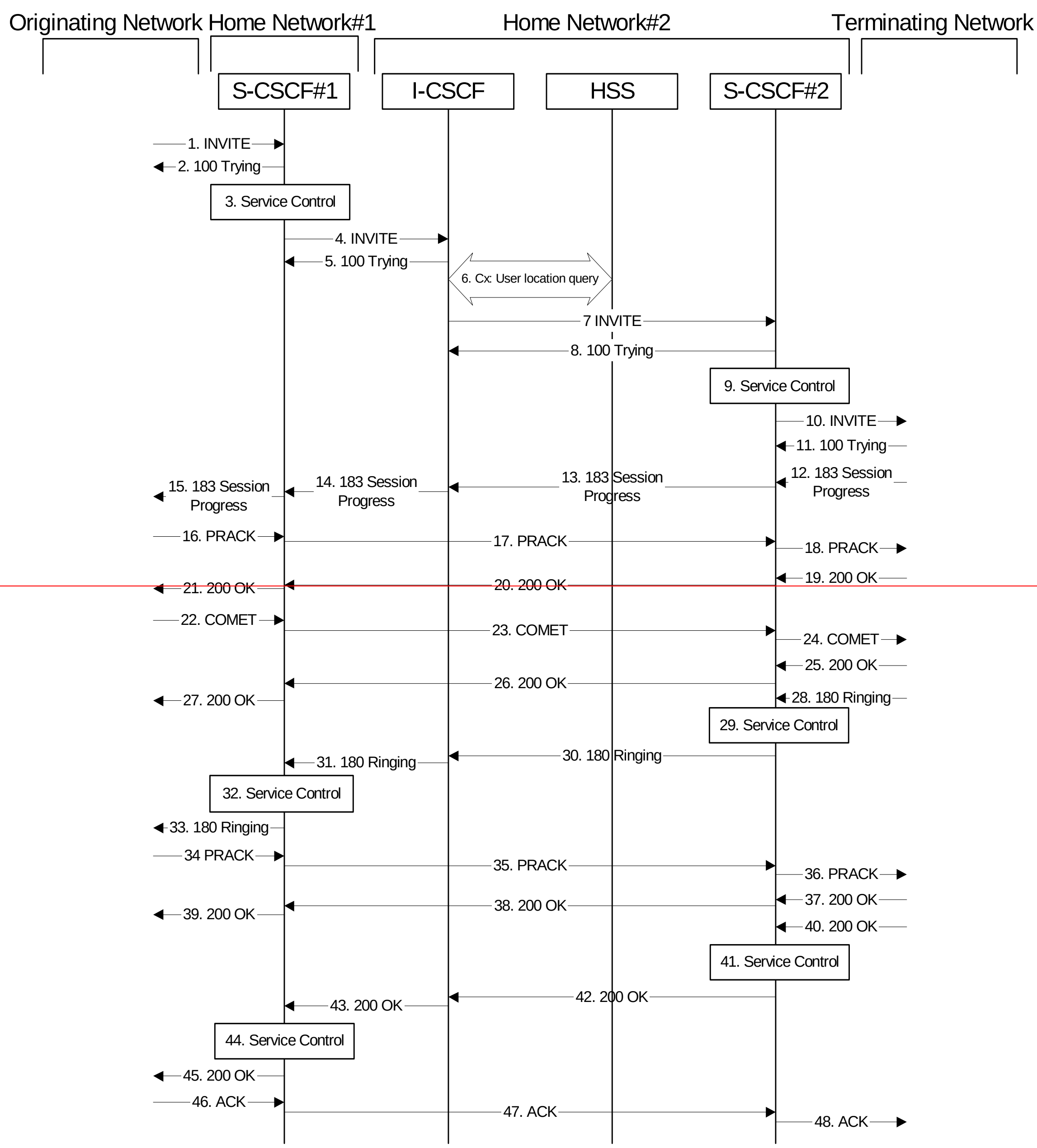
CS-O CS Networks origination. The "Originating Network" of S-S#1a is the home network. The element labelled S-CSCF#1 is the MGCF of the CS-O procedure.

Termination sequences that share this common S-CSCF to S-CSCF procedure are:

MT#1a Mobile termination, roaming, without a THIG. The "Terminating Network" of S-S#1a is a visited network.

MT#1b Mobile termination, roaming, with a THIG in home network. The "Terminating Network" of S-S#1a is a visited network.

MT#2 Mobile termination, located in home service area. The "Terminating Network" of S-S#1a is the home network.


Originating Network
Home Network#1
Home Network#2
Terminating Network
S-CSCF#1
I-CSCF
HSS
S-CSCF#2
1. INVITE
2. 100 Trying
3. Service Control
4. INVITE
5. 100 Trying
6. Cx: User location query
7 INVITE
8. 100 Trying
9. Service Control
10. INVITE
11. 100 Trying
12. 183 Session Progress
13. 183 Session Progress
14. 183 Session Progress
15. 183 Session Progress
16. PRACK
17. PRACK
18. PRACK
19. 200 OK
20. 200 OK
21. 200 OK
22. COMET
23. COMET
24. COMET
25. 200 OK
26. 200 OK
27. 200 OK
28. 180 Ringing
29. Service Control
30. 180 Ringing
31. 180 Ringing
32. Service Control
33. 180 Ringing
34 PRACK
35. PRACK
36. PRACK
37. 200 OK
38. 200 OK
39. 200 OK
40. 200 OK
41. Service Control
42. 200 OK
43. 200 OK
44. Service Control
45. 200 OK
46. ACK
47. ACK
48. ACK

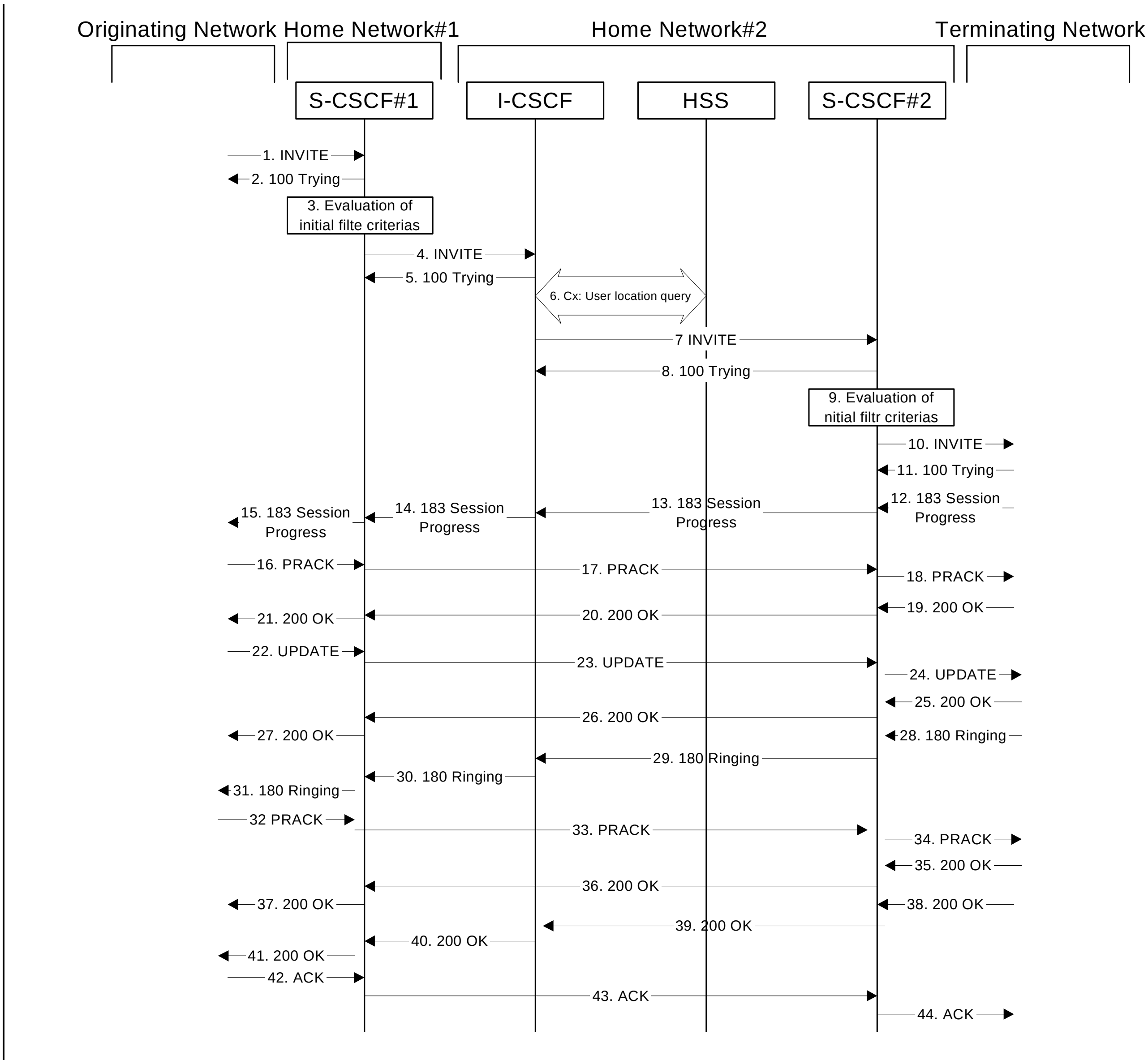


Figure 7.3.2.1-1: S-S#1a

Procedure S-S#1a is as follows:

1. **INVITE (MO to S-S#1a) – see example in table 7.3.2.1-1**

   The INVITE request is sent from the UE to S-CSCF#1 by the procedures of the originating signalling flow.

Table 7.3.2.1-1: INVITE (MO to S-S#1a)

```
INVITE sip:+1-212-555-2222@home1.net;user=phonescscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Require: precondition, update, 100rel
Record-Route: sip:240f34.1@pcscf1.visited1.net;lr
Route: sip:scscf1.home1.net;lr+1-212-555-2222@home1.net;user=phone
Supported: 100rel
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>;privacy=off
RPID-Privacy: privacy=off;party=calling
Anonymity: Off
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
    seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 127 INVITE
Require: precondition
Supported: 100rel
```

```
Max-Forwards: 69
Contact: [5555::aaa:bbb:ccc:ddd]
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 3400 RTP/AVP 99
b=AS:54.6
a=qos:mandatory sendrecv
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=video 3402 RTP/AVP 99
b=AS:54.6
a=qos:mandatory sendrecv
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
a=qos:mandatory sendrecv
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
a=qos:mandatory sendrecv
```

2. **100 Trying (S-S#1a to MO) – see example in table 7.3.2.1-2**

   S-CSCF#1 responds to the INVITE request (1) with a 100 Trying provisional response.

Table 7.3.2.1-2: 100 Trying (S-S#1a to MO)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

3. **~~Service Control~~Evaluation of initial filter criterias**

   S-CSCF#1 validates the service profile of this subscriber and evaluates the initial filter criterias. For this example, assume no Application Server involvement.

~~- S-CSCF#1 performs whatever service control logic is appropriate for this session attempt.~~

~~- S-CSCF#1 examines the media parameters, and removes any choices that the subscriber does not have authority to request.~~

~~- For this example, assume the subscriber is not allowed video.~~

4. **INVITE (S-CSCF to I-CSCF) – see example in table 7.3.2.1-4**

S-CSCF#1 performs an analysis of the destination address, and determines the network operator to whom the destination subscriber belongs. Since the originating operator does not desire to keep their internal configuration hidden, S-CSCF#1 forwards the INVITE request directly to to I-CSCF in the destination network.

S-CSCF examines the media parameters, and removes any choices that the subscriber does not have authority to request. For this example, assume the subscriber is not allowed video.

Table 7.3.2.1-4: INVITE (S-CSCF to I-CSCF)

```
INVITE sip:+1-212-555-2222@home2.net;user=phone SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1 SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
~~Require:~~
Record-Route: sip:~~332b23.1@~~scscf1.home1.net;lr, sip:~~240f34.1@~~pcscf1.visited1.net;lr
~~Supported:~~
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>;~~privacy=off;~~screen=yes
RPID-Privacy:
~~Anonymity:~~
From:
To:
Call-ID:
Cseq:
Require:
Supported:
~~Max-Forwards: 68~~
Contact:
Content-Type:
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
~~a=qos:mandatory sendrecv~~
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
~~a=qos:mandatory sendrecv~~
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
```

Request-URI: In the case where the ~~Route header~~ Request-URI of the incoming INVITE request to S-CSCF contains a TEL-URL [5], it has to be translated to a globally routable SIP-URL before applying it as Request-URI of the outgoing INVITE request. For this address translation the S-CSCF shall use the services of an ENUM-DNS protocol according to RFC 2916 [6], or any other suitable translation database. Database aspects of ENUM are outside the scope of this specification.

5. **100 Trying (I-CSCF to S-CSCF) – see example in table 7.3.2.1-5**

   I-CSCF responds to the INVITE request (4) by sending a 100 Trying provisional response to S-CSCF#1.

Table 7.3.2.1-5: 100 Trying (I-CSCF to S-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

6. **Cx: User Location Query procedure**

   The I-CSCF sends a query to the HSS to find out the S-CSCF of the called user. The HSS responds with the address of the current S-CSCF for the terminating subscriber.

   For detailed message flows see 3GPP TS 29.228 [11].

   Table 6.3.2-6a provides the parameters in the SIP INVITE request (flow 4), which are sent to the HSS.

Table 7.3.2.1-6a Cx: User registration status query procedure (I-CSCF to HSS)

Message source & destination	Cx: Information element name	Information source in SIP INVITE	Description
I-CSCF to HSS	User Public Identity	Request-URI:	This information element indicates the public user identity

Table 7.3.2.1-6b provides the parameters sent from the HSS that need to be mapped to SIP INVITE (flow 7) and sent to S-CSCF.

Table 7.3.2.1-6b Cx: User registration status query procedure (HSS to I-CSCF)

Message source & destination	Cx: Information element name	Mapping to SIP header in SIP INVITE	Description
HSS to I-CSCF	S-CSCF name	~~Request-URI:~~Route header field	This information indicates the serving CSCF's name of that user

7. **INVITE (I-CSCF to S-CSCF) – see example in table 7.3.2.1-7**

   I-CSCF forwards the INVITE request to the S-CSCF (S-CSCF#2) that will handle the session termination.

Table 7.3.2.1-7: INVITE (I-CSCF to S-CSCF)

```
INVITE sip:+1-212-555-2222@home2.net;user=phonescscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Require:
Route: sip:scscf2.home2.net +1-212-555-2222@home2.net;user=phone
Record-Route: sip:332b23.1@scscf1.home1.net;lr, sip:240f34.1@pcscf1.visited1.net;lr
```

```
Route: sip:scscf2.home2.net;lr
Supported: 
Remote-Party-ID:
RPID-Privacy:
Anonymity: 
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Max-Forwards: 67
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
a=
a=
```

NOTE: The I-CSCF does not add itself to the Record-Route header, as it has no need to remain in the signalling path once the session is established.

8. **100 Trying (S-CSCF to I-CSCF) – see example in table 7.3.2.1-8**

S-CSCF#2 responds to the INVITE request (7) with a 100 Trying provisional response.

Table 7.3.2.1-8: 100 Trying (S-CSCF to I-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

9. ~~Service Control~~Evaluation of initial filter criterias

~~S-CSCF#2 performs whatever service control logic is appropriate for this session attempt.~~ S-CSCF#2 validates the service profile of this subscriber and evaluates the initial filter criterias.

~~S-CSCF#2 examines the media parameters, and removes any choices that the destination subscriber does not have authority to request.~~

~~For this example, assume the destination subscriber is not allowed stereo, so only a single audio stream is permitted.~~

10. **INVITE (S-S#1a to MT) – see example in table 7.3.2.1-10**

S-CSCF#2 forwards the INVITE request, as determined by the termination procedure. S-CSCF#2 remembers (from the registration procedure) the UE Contact address and the next hop CSCF for this UE.

S-CSCF#2 examines the media parameters, and removes any choices that the destination subscriber does not have authority to request. For this example, assume the destination subscriber is not allowed stereo, so only a single audio stream is permitted.

Table 7.3.2.1-10: INVITE (S-S#1a to MT)

```
INVITE sip:[5555::eee:fff:aaa:bbb]pcscf2.visited2.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 66
Require:
Route: sip:pcscf2.visited2.netsip:+1-212-555-2222@home2.net;user=phone
Record-Route: sip:764z87.1@scscf2.home2.net;lr, sip:332b23.1@scscf1.home1.net;lr,
sip:pcscf1.visited1.net;lr
Route: sip:pcscf2.visited2.net;lr
Supported: 
Remote-Party-ID:
RPID-Privacy:
Anonymity: 
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Max-Forwards: 66
Contact:
P-Called-Party-ID: <sip:+1-212-555-2222@home2.net;user=phone>
Content-Type:
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd 
t=907165275 0
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR 
```

```
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 0 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=qos:mandatory sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 0 RTP/AVP 97 96 0 15
```

11. **100 Trying (MT to S-S#1a) – see example in table 7.3.2.1-11 (related to table 7.3.2.1-10)**

S-CSCF#2 receives a 100 Trying provisional response to the INVITE request (10), as specified by the termination procedures.

Table 7.3.2.1-11: 100 Trying (MT to S-S#1a)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP
    icscf2_sp.home2.net;branch=871y12.1556u87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

12. **183 Session Progress (MT to S-S#1a) – see example in table 7.3.2.1-12 (related to table 7.3.2.1-10)**

The media stream capabilities of the destination are returned along the signalling path, in a 183 Session Progress provisional response to the INVITE request (10), as per the termination procedure.

Table 7.3.2.1-12: 183 Session Progress (MT to S-S#1a)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:361k21.1@pcscf2.visited2.net;lr, sip:764z87.1@scscf2.home2.net;lr,
    sip:332b23.1@scscf1.home1.net;lr, sip:240f34.1@pcscf1.visited1.net;lr
Remote-Party-ID: "John Smith" <tel:+1-212-555-2222>;privacy=off
RPID-Privacy: privacy=off;party=called
Anonymity: Off
Require: 100rel
From:
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost; tag=314159
Call-ID:
CSeq:
Require: 100rel
Contact: sip:[5555::eee:fff:aaa:bbb]
RSeq: 9021
Content-Disposition: precondition
Content-Type: application/sdp
Content-Length: (…)

v=0
```

```
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97 96
b=AS:25.4 3
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=conf:qos remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
a=qos:mandatory sendrecv confirm
m=audio 0 RTP/AVP 97 96 0 15
```

13. **183 Session Progress (S-CSCF to I-CSCF) – see example in table 7.3.2.1-13**

S-CSCF#2 forwards the 183 Session Progress provisional response to I-CSCF.

Table 7.3.2.1-13: 183 Session Progress (S-CSCF to I-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
Remote-Party-ID: "John Smith" <tel:+1-212-555-2222>;privacy=off;screen=yes
RPID-Privacy:
Anonymity:
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Disposition:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
a=
m=
```

14. **183 Session Progress (I-CSCF to S-CSCF) – see example in table 7.3.2.1-14**

I-CSCF forwards the 183 Session Progress provisional response to S-CSCF#1.

Table 7.3.2.1-14: 183 Session Progress (I-CSCF to S-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
```

```
Remote-Party-ID:
RPID-Privacy:
Anonymity: 
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Disposition: 
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
a=
m=
```

15. **183 Session Progress (S-S#1a to MO) – see example in table 7.3.2.1-15**

S-CSCF#1 forwards the 183 Session Progress to the originator, as per the originating procedure.

Table 7.3.2.1-15: 183 Session Progress (S-S#1a to MO)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
Remote-Party-ID:
RPID-Privacy:
Anonymity: 
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Disposition: 
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
a=
m=
```

16. **PRACK (MO to S-S#1a) – see example in table 7.3.2.1-16**

The originator decides the final set of media streams, and includes this information in the PRACK request sent to S-CSCF#1 by the origination procedures.

Table 7.3.2.1-16: PRACK (MO to S-S#1a)

```
PRACK sip:[5555::eee:fff:aaa:bbb]scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Require:
Route: sip:scscf1.home1.net;lr, sip:764z87.1@scscf2.home2.net;lr,
sip:361k21.1@pcscf2.visited2.net;lr, [5555::eee:fff:aaa:bbb]
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 128 PRACK
Require: precondition
Max-Forwards: 69
Rack: 9021 127 INVITE
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 3456 RTP/AVP 97
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=qos:mandatory sendrecv
m=audio 0 RTP/AVP 97 96 0 15
```

17. **PRACK (S-CSCF to S-CSCF) – see example in table 7.3.2.1-17**

S-CSCF#1 forwards the PRACK request to S-CSCF#2.

Table 7.3.2.1-17: PRACK (S-CSCF to S-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb]scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Require:
Route: sip:scscf2.home2.net;lr, sip:361k21.1@pcscf2.visited2.net;lr, sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Require:
Max-Forwards: 68
Rack:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
```

```
a=
a=
a=
a=
a=
a=
m=
```

18. **PRACK (S-S#1a to MT) – see example in table 7.3.2.1-18**

S-CSCF#2 forwards the PRACK request to the terminating endpoint, as per the termination procedure.

Table 7.3.2.1-18: PRACK (S-S#1a to MT)

```
PRACK sip:pcscf2.visited2.netsip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Require:
Route: sip:pcscf2.visited2.net;lrsip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Require:
Max-Forwards: 67
Rack:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

19. **200 OK (MT to S-S#1a) – see example in table 7.3.2.1-19 (related to table 7.3.2.1-18)**

The terminating endpoint responds to the PRACK request (18) with a 200 OK response.

Table 7.3.2.1-19: 200 OK (MT to S-S#1a)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97
b=AS:25.4
```

```
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=conf:qos remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
m=audio 0 RTP/AVP 97 96 0 15
```

20. **200 OK (S-CSCF to S-CSCF) – see example in table 7.3.2.1-20**

S-CSCF#2 forwards the 200 OK response to S-CSCF#1.

Table 7.3.2.1-20: 200 OK (S-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

21. **200 OK (S-S#1a to MO) – see example in table 7.3.2.1-21**

S-CSCF#1 forwards the 200 OK response to the originating endpoint.

Table 7.3.2.1-21: 200 OK (S-S#1a to MO)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
```

```
a=
a=
m=
```

22. ~~COMET~~UPDATE (MO to S-S#1a) – see example in table 7.3.2.1-22

When the originating endpoint has completed the resource reservation procedures, it sends the ~~COMET~~UPDATE request to S-CSCF#1 by the origination procedures.

Table 7.3.2.1-22: ~~COMET~~UPDATE (MO to S-S#1a)

```
COMETUPDATE sip:[5555::eee:fff:aaa:bbb]scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:scscf1.home1.net;lr, sip:764z87.1@scscf2.home2.net;lr,
    sip:361k21.1@pcscf2.visited2.net;lr, sip:[5555::eee:fff:aaa:bbb]
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 129 COMETUPDATE
Max-Forwards: 69
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 3456 RTP/AVP 97
b=AS:25.4
a=curr:qos local sendrecv
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=qos:success sendonly
m=audio 0 RTP/AVP 97 96 0 15
```

23. ~~COMET~~UPDATE (S-CSCF to S-CSCF) – see example in table 7.3.2.1-23

S-CSCF#1 forwards the ~~COMET~~UPDATE request to S-CSCF#2.

Table 7.3.2.1-23: ~~COMET~~UPDATE (S-CSCF to S-CSCF)

```
COMETUPDATE sip:[5555::eee:fff:aaa:bbb]sip:scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scscf2.home2.net;lr, sip:361k21.1@pcscf2.visited2.net;lr, sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Max-Forwards: 68
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
```

```
a=
a=
a=
m=
```

24. ~~COMET~~UPDATE (S-S#1a to MT) – see example in table 7.3.2.1-24

S-CSCF#2 forwards the ~~COMET~~UPDATE request to the terminating endpoint, as per the termination procedure.

Table 7.3.2.1-24: ~~COMET~~UPDATE (S-S#1a to MT)

```
COMETUPDATE sip:[5555::eee:fff:aaa:bbb]pcscf2.visited2.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:pcscf2.visited2.net;lrsip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Max-Forwards: 67
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

25. **200 OK (MT to S-S#1a) – see example in table 7.3.2.1-25 (related to table 7.3.2.1-24)**

The terminating endpoint responds to the ~~COMET~~UPDATE request (24) with a 200 OK response.

Table 7.3.2.1-25: 200 OK (MT to S-S#1a)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=conf:qos remote sendrecv
```

```
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
m=audio 0 RTP/AVP 97 96 0 15
```

26. **200 OK (S-CSCF to S-CSCF) – see example in table 7.3.2.1-26**

S-CSCF#2 forwards the 200 OK response to S-CSCF#1.

Table 7.3.2.1-26: 200 OK (S-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

27. **200 OK (S-S#1a to MO) – see example in table 7.3.2.1-27**

S-CSCF#1 forwards the 200 OK response to the originating endpoint.

Table 7.3.2.1-27: 200 OK (S-S#1a to MO)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

28. **180 Ringing (MT to S-S#1a) – see example in table 7.3.2.1-28 (related to table 7.3.2.1-10)**

The terminating endpoint may optionally send a 180 Ringing provisional response indicating alerting is in progress. This response is sent by the termination procedure to S-CSCF#2.

Table 7.3.2.1-28: 180 Ringing (MT to S-S#1a)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:361k21.1@pcscf2.visited2.net,sip:764z87.1@scscf2.home2.net,
    sip:332b23.1@scscf1.home1.net, sip:240f34.1@pcscf1.visited1.netRecord-Route: 
    sip:pcscf2.visited2.net;lr, sip:scscf2.home2.net;lr, sip:scscf1.home1.net;lr, 
    sip:pcscf1.visited1.net;lr
Require:
From:
To:
Call-ID:
CSeq:
Require: 100rel
Contact: sip:[5555::eee:fff:aaa:bbb]
RSeq: 9022
Content-Length: 0
```

~~29. **Service Control**~~

~~The S-CSCF validates the service profile and performs any service control required for this subscriber.~~

~~30~~29. **180 Ringing (S-CSCF to I-CSCF) – see example in table 7.3.2.1-29~~30~~**

S-CSCF#2 forwards the 180 Ringing response to I-CSCF.

Table 7.3.2.1-29~~30~~: 180 Ringing (S-CSCF to I-CSCF)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Length:
```

30~~31~~. **180 Ringing (I-CSCF to S-CSCF) – see example in table 7.3.2.1-30~~1~~**

I-CSCF forwards the 180 Ringing response to S-CSCF#1.

Table 7.3.2.1-3~~1~~0: 180 Ringing (I-CSCF to S-CSCF)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Length:
```

~~32. **Service Control**~~

~~The S-CSCF validates the service profile and performs any service control required for this subscriber.~~

3~~3~~1. **180 Ringing (S-S#1a to MO) – see example in table 7.3.2.1-31~~3~~**

S-CSCF#1 forwards the 180 Ringing response to the originator, per the origination procedure.

Table 7.3.2.1-3~~3~~1: 180 Ringing (S-S#1a to MO)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
~~Require:~~
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Length:
```

32~~4~~. **PRACK (MO to S-S#1a) – see example in table 7.3.2.1-32~~4~~**

The originator acknowledges the 180 Ringing provisional response (3~~3~~1) with a PRACK request.

Table 7.3.2.1-3~~4~~2: PRACK (MO to S-S#1a)

```
~~PRACK sip:scscf1.home1.net ~~PRACK sip:[5555::eee:fff:aaa:bbb]SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:scscf1.home1.net;lr, sip:~~764z87.1@~~scscf2.home2.net;lr,
sip:~~361k21.1@~~pcscf2.visited2.net;lr~~, sip:[5555::eee:fff:aaa:bbb]~~
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 130 PRACK
~~Max-Forwards: 69~~
Rack: 9022 127 INVITE
Content-Length: 0
```

3~~5~~3. **PRACK (S-CSCF to S-CSCF) – see example in table 7.3.2.1-33~~5~~**

S-CSCF#1 forwards the PRACK request to S-CSCF#2.

Table 7.3.2.1-3~~5~~3: PRACK (S-CSCF to S-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb]~~sip:scscf2.home2.net ~~SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scscf2.home2.net;lr, sip:~~361k21.1@~~pcscf2.visited2.net;lr~~, sip:[5555::eee:fff:aaa:bbb]~~
From:
To:
Call-ID:
Cseq:
~~Max-Forwards: 68~~
Rack:
Content-Length:
```

3~~6~~4. **PRACK (S-S#1a to MT) – see example in table 7.3.2.1-34~~6~~**

S-CSCF#2 forwards the PRACK request to the terminating endpoint.

Table 7.3.2.1-34~~6~~: PRACK (S-S#1a to MT)

```
PRACK sip:[5555::eee:fff:aaa:bbb]~~sip:pcscf2.visited2.net~~ SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:pcscf2.visited2.net;lr~~sip:[5555::eee:fff:aaa:bbb]~~
From:
To:
Call-ID:
Cseq:
~~Max-Forwards: 67~~
Rack:
Content-Length:
```

3~~7~~5. **200 OK (MT to S-S#1a) – see example in table 7.3.2.1-3~~7~~5 (related to table 7.3.2.1-3~~6~~4)**

The terminating endpoint responds to the PRACK request (3~~6~~4) with a 200 OK response.

Table 7.3.2.1-3~~7~~5: 200 OK (MT to S-S#1a)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

36~~8~~. **200 OK (S-CSCF to S-CSCF) – see example in table 7.3.2.1-36~~8~~**

S-CSCF#2 forwards the 200 OK response to S-CSCF#1.

Table 7.3.2.1-36~~8~~: 200 OK (S-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

37~~9~~. **200 OK (S-S#1a to MO) – see example in table 7.3.2.1-37~~9~~**

S-CSCF#1 forwards the 200 OK response to the originating endpoint.

Table 7.3.2.1-~~39~~37: 200 OK (S-S#1a to MO)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

38~~40~~. **200 OK (MT to S-S#1a) – see example in table 7.3.2.1-38~~40~~ (related to table 7.3.2.1-10)**

The final response to the INVITE request (10), 200 OK, is sent by the terminating endpoint over the signalling path. This is typically generated when the subscriber has accepted the incoming session attempt. The response is sent to S-CSCF#2 per the termination procedure.

Table 7.3.2.1-38~~40~~: 200 OK (MT to S-S#1a)

```
SIP/2.0 200 OK
```

```
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:361k21.1@pcscf2.visited2.net;lr, sip:764z87.1@scscf2.home2.net;lr,
    sip:332b23.1@scscf1.home1.net;lr, sip:240f34.1@pcscf1.visited1.net;lr
From:
To:
Call-ID:
CSeq: 127 INVITE
Contact: sip:[5555::eee:fff:aaa:bbb]
Content-Type: application/sdp
Content-Length:0 (...)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97
b=AS:25.4
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=qos:success sendrecv
m=audio 0 RTP/AVP 97 96 0 15
```

~~41. **Service Control**~~

~~S-CSCF#2 performs whatever service control logic is appropriate for this session completion.~~

39~~42~~. **200 OK (S-CSCF to I-CSCF) – see example in table 7.3.2.1-39~~42~~**

The 200 OK response is forwarded to the I-CSCF.

Table 7.3.2.1-39~~42~~: 200 OK (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
m=
```

4~~3~~0. **200 OK (I-CSCF to S-CSCF) – see example in table 7.3.2.1-40~~3~~**

The 200 OK response is forwarded to S-CSCF#1.

Table 7.3.2.1-40~~3~~: 200 OK (I-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
```

```
Record-Route:
From:
To:
Call-ID:
CSeq:
Contact:
~~Content-Type: ~~
Content-Length:

~~v=~~
~~o=~~
~~s=~~
~~c=~~
~~t=~~
~~m=~~
~~m=~~
~~m=~~
~~b=~~
~~a=~~
~~a=~~
~~a=~~
~~m=~~
```

~~44. **Service Control**~~

~~S-CSCF#1 performs whatever service control logic is appropriate for this session completion.~~

4~~5~~1. **200 OK (S-S#1a to MO) – see example in table 7.3.2.1-41~~5~~**

The 200 OK response is returned to the originating endpoint, by the origination procedure.

Table 7.3.2.1-4~~5~~1: 200 OK (S-S#1a to MO)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
From:
To:
Call-ID:
CSeq:
Contact:
~~Content-Type: ~~
Content-Length:

~~v=~~
~~o=~~
~~s=~~
~~c=~~
~~t=~~
~~m=~~
~~m=~~
~~m=~~
~~b=~~
~~a=~~
~~a=~~
~~a=~~
~~m=~~
```

4~~6~~2. **ACK (MO to S-S#1a) – see example in table 7.3.2.1-42~~6~~**

The originating endpoint sends the final acknowledgement to S-CSCF#1 by the origination procedures.

Table 7.3.2.1-4~~6~~2: ACK (MO to S-S#1a)

```
ACK sip:[5555::eee:fff:aaa:bbb]~~sip:scscf1.home1.net~~ SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:scscf1.home1.net;lr, sip:~~764z87.1@~~scscf2.home2.net;lr,
sip:~~361k21.1@~~pcscf2.visited2.net;lr~~, sip:[5555::eee:fff:aaa:bbb]~~
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
```

```
Cseq: 127 ACK
Max-Forwards: 69
Content-Length: 0
```

47~~7~~3. **ACK (S-CSCF to S-CSCF) – see example in table 7.3.2.1-43~~7~~**

S-CSCF#1 forwards the ACK request to S-CSCF#2.

Table 7.3.2.1-4~~7~~3: ACK (S-CSCF to S-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]sip:scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scscf2.home2.net;lr, sip:361k21.1@pcscf2.visited2.net;lr, sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Max-Forwards: 68
Content-Length:
```

448. **ACK (S-S#1a to MT) – see example in table 7.3.2.1-448**

S-CSCF#2 forwards the ACK request to the terminating endpoint, as per the termination procedure.

Table 7.3.2.1-448: ACK (S-S#1a to MT)

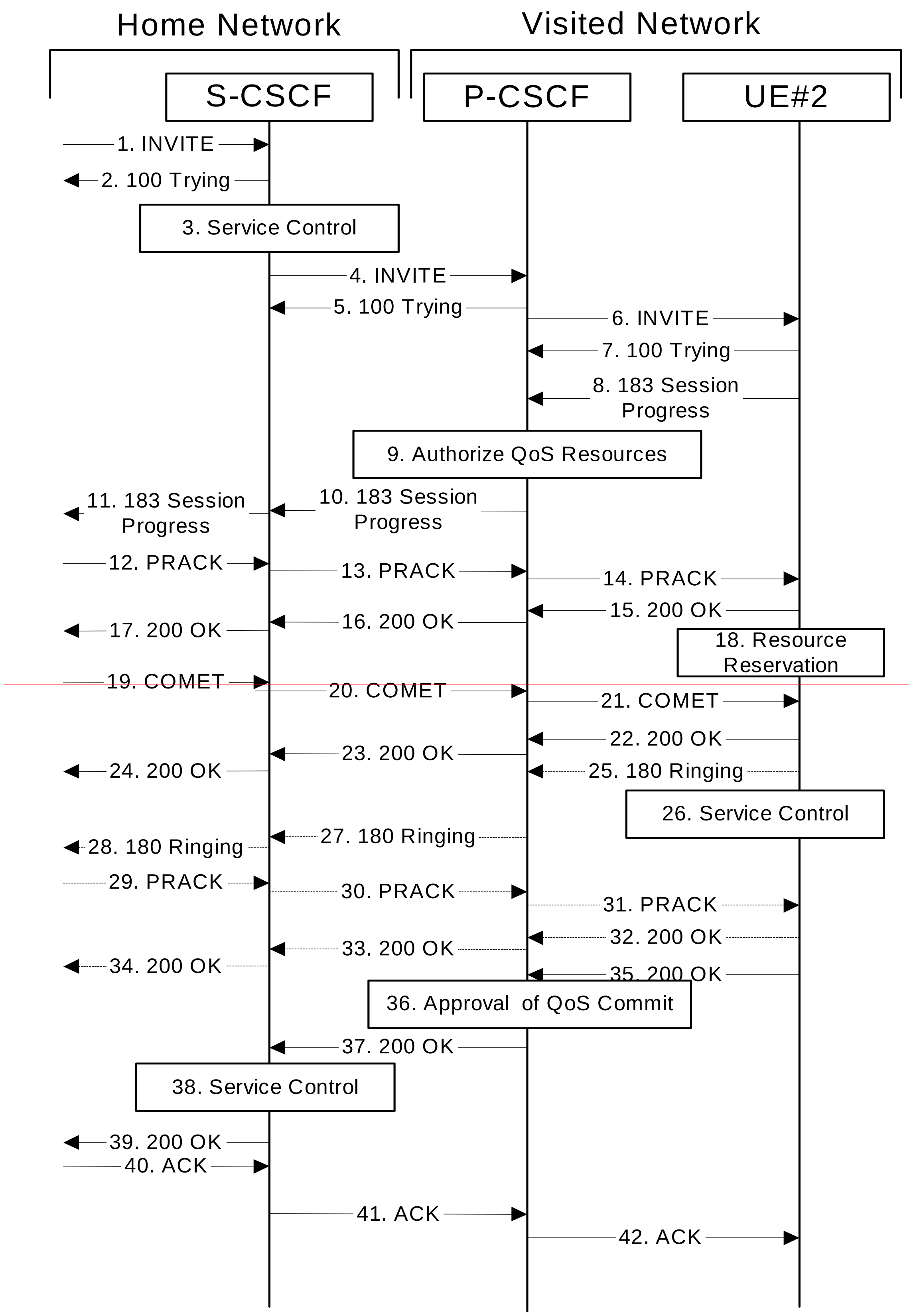
```
ACK sip:[5555::eee:fff:aaa:bbb]sip:pcscf2.visited2.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:pcscf2.visited2.net;lrsip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Max-Forwards: 67
Content-Length:
```

7.4.2 MT#1a

7.4.2.1 (MT#1a) Mobile termination, roaming (MO#1a, S-S#1a assumed)

Figure 7.4.2.1 shows a termination procedure which applies to roaming subscribers when the home network operator does not desire to keep its internal configuration hidden from the visited network. The UE is located in a visited network, and determines the P-CSCF via the P-CSCF discovery procedure. During registration, the home network allocates the S-CSCF.

When registration is complete, S-CSCF knows the name/address of P-CSCF and the UE Contact address, and P-CSCF obtains the name/address of the UE.


Home Network
Visited Network
S-CSCF
P-CSCF
UE#2
1. INVITE
2. 100 Trying
3. Service Control
4. INVITE
5. 100 Trying
6. INVITE
7. 100 Trying
8. 183 Session Progress
9. Authorize QoS Resources
10. 183 Session Progress
11. 183 Session Progress
12. PRACK
13. PRACK
14. PRACK
15. 200 OK
16. 200 OK
17. 200 OK
18. Resource Reservation
19. COMET
20. COMET
21. COMET
22. 200 OK
23. 200 OK
24. 200 OK
25. 180 Ringing
26. Service Control
27. 180 Ringing
28. 180 Ringing
29. PRACK
30. PRACK
31. PRACK
32. 200 OK
33. 200 OK
34. 200 OK
35. 200 OK
36. Approval of QoS Commit
37. 200 OK
38. Service Control
39. 200 OK
40. ACK
41. ACK
42. ACK

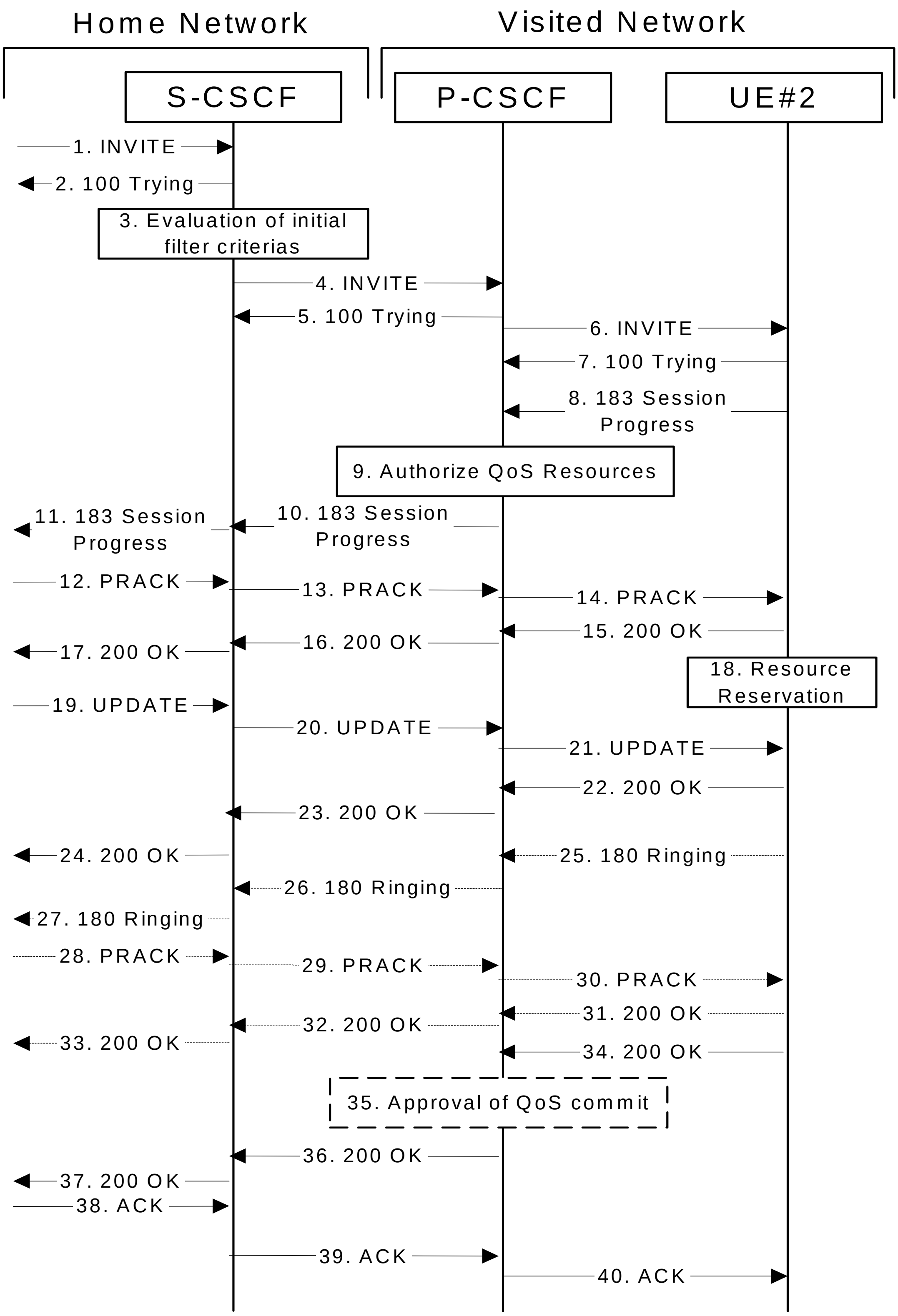


Figure 7.4.2.1-1: MT#1a

Procedure MT#1a is as follows:

1. **INVITE (S-S to MT#1a) – see example in table 7.4.2.1-1**

   The calling party sends the INVITE request, via one of the origination procedures and via one of the S-CSCF to S-CSCF procedures, to the S-CSCF for the terminating subscriber.

Table 7.4.2.1-1: INVITE (S-S to MT#1a)

```
INVITE sip:+1-212-555-2222@home2.net;user=phone ~~sip:scscf2.home2.net ~~SIP/2.0
Via: SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
~~Require: precondition, update, 100rel~~
Record-Route: sip:~~332b23.1@~~scscf1.home1.net;lr, sip:~~240f34.1@~~pcscf1.visited1.net;lr
Route: sip:scscf2.home2.net;lr~~sip:+1-212-555-2222@home2.net;user=phone~~
~~Supported: 100rel ~~
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>;~~privacy=off;~~screen=yes
RPID-Privacy: privacy=off;party=calling
~~Anonymity: Off ~~
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
    seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 127 INVITE
Require: precondition
Supported:
~~Max-Forwards: 67~~
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
b=AS:54.6
~~a=qos:mandatory sendrecv ~~
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=video 0 RTP/AVP 99
b=AS:54.6
~~a=qos:mandatory sendrecv~~
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
~~a=qos:mandatory sendrecv ~~
~~m=audio 3458 RTP/AVP 97 96 0 15~~
~~b=AS:25.4~~
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
~~a=qos:mandatory sendrecv ~~
```

SDP The SDP contains the complete set of supported codecs from the session originator, as restricted by the originating network operator. The "m=" lines for the video media streams show a port number zero, which removes them from the negotiation.

Upon receipt of the INVITE, the S-CSCF stores the following information about this session, for use in providing enhanced services or in possible error recovery actions – see example in table 7.4.2.1-1b.

Table 7.4.2.1-1b: Storage of information at S-CSCF

```
Request-URI: sip:+1-212-555-2222@home2.net;user=phone
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
     seq=72))@localhost>; tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
CSeq(2dest): 127 INVITE
CSeq(2orig): none
Route(2orig): sip:332b23.1@scscf1.home1.net, sip:240f34.1@pcscf1.visited1.net,
     sip:[5555::aaa:bbb:ccc:ddd]
Route(2dest): sip:pcscf2.visited2.net, sip:[5555::eee:fff:aaa:bbb]
Contact(orig): sip:[5555::aaa:bbb:ccc:ddd]
```

2. **100 Trying (MT#1a to S-S) – see example in table 7.4.2.1-2**

   S-CSCF responds to the INVITE request (1) with a 100 Trying provisional response.

Table 7.4.2.1-2: 100 Trying (MT#1a to S-S)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

3. **~~Service Control~~Evaluation of initial filter criterias**

   S-CSCF validates the service profile of this subscriber, and ~~performs any termination service control required for this subscriber.~~evaluates the initial filter criterias.~~. For this example, assume no Application Server involvement.~~

   ~~S-CSCF examines the media parameters, and removes any choices that the destination subscriber does not have authority to request.~~

   ~~For this example, assume the destination subscriber is not allowed stereo, so only a single audio stream is permitted.~~

4. **INVITE (S-CSCF to P-CSCF) – see example in table 83.2-4**

   S-CSCF remembers (from the registration procedure) the UE Contact address and the next hop CSCF for this UE. It forwards the INVITE to the P-CSCF.

   S-CSCF examines the media parameters, and removes any choices that the destination subscriber does not have authority to request. For this example, assume the destination subscriber is not allowed stereo, so only a single audio stream is permitted.

Table 7.4.2.1-4: INVITE (S-CSCF to P-CSCF)

```
INVITE sip:[5555::eee:fff:aaa:bbb]sip:pcscf2.visited2.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 66
Require:
Route: sip:pcscf2.visited2.net;lrsip:[5555::eee:fff:aaa:bbb]
Record-Route: sip:764z87.1@scscf2.home2.net;lr, sip:332b23.1@scscf1.home1.net;lr,
sip:240f34.1@pcscf1.visited1.net;lr
Supported:
Remote-Party-ID:
RPID-Privacy:
Anonymity:
From:
To:
Call-ID:
Cseq:
```

```
Require:
Supported:
Max-Forwards: 66
Contact:
P-Called-Party-ID: <sip:+1-212-555-2222@home12.net;user=phone>
Content-Type:
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=qos:mandatory sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 0 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
```

~~**Request-URI:** Built from the registration information.~~

Route: Built from the Path header ~~Contact address~~ stored at registration.

P-Called-Party-ID: Includes the dialled URL with its parameters.

Via:/Record-Route: S-CSCF adds itself.

SDP The SDP contains the restricted set of codecs allowed by the network operator. The "m=" lines for the second audio stream shows a port number zero, which removes it from the negotiation.

~~Upon receipts of the INVITE, the P-CSCF removes the Record-Route and Via headers, calculates the proper Route header to add to future requests, and~~ P-CSCF saves ~~that~~ information from the received INVITE request~~without passing it to UE~~. The saved value of the information for this session is – see example in table 7.4.2.1-4b.

Table 7.4.2.1-4b: Storage of information at P-CSCF

```
Request-URI: sip:+1-212-555-2222@home2.net;user=phonesip:[5555::eee:fff:aaa:bbb]
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
     seq=72))@localhost>; tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
```

```
CSeq(2dest): 127 INVITE
CSeq(2orig): none
Route(2dest): sip:[5555::eee:fff:aaa:bbb]
Route(2orig): sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net,
sip:240f34.1@pcscf1.visited1.net, sip:[5555::aaa:bbb:ccc:ddd]
Contact(orig): sip:[5555::aaa:bbb:ccc:ddd]
```

5. **100 Trying (P-CSCF to S-CSCF) – see example in table 7.4.2.1-5**

P-CSCF responds to the INVITE request (4) with a 100 Trying provisional response.

Table 7.4.2.1-5: 100 Trying (P-CSCF to S-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

6. **INVITE (P-CSCF to UE) – see example in table 7.4.2.1-6**

P-CSCF examines the media parameters, and removes any that the network operator decides, based on local policy, not to allow on the network.

For this example, assume the network operator does not allow 64 kb/s audio, so the PCMU codec is removed.

P-CSCF removes the Record-Route and Via headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE. ~~The P-CSCF extract the UE address from the Route header value and place it into the Request-URI.~~

Table 7.4.2.1-6: INVITE (P-CSCF to UE)

```
INVITE sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.visited2.net;branch=361k21.1
Media-Authorization: 0020000100100101706366322e78797a2e6e6574000c02013331533134363231
Supported:
Max-Forwards: 65
Remote-Party-ID:
RPID-Privacy:
Anonymity:
P-Media-Authorization: 0020000100100101706366322e78797a2e6e6574000c02013331533134363231
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Max-Forwards: 65
Contact:
P-Called-Party-ID:
Content-Type:
Content-Length: (...)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
```

```
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=audio 3456 RTP/AVP 97 96 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 0 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 3456 RTP/AVP 97
b=AS:25.4 96 15
a=qos:mandatory sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 0 RTP/AVP 97 96 0 15
```

~~P-CSCF removes the Record-Route and Via headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE. The saved value of the Route header is:~~

```
Route: sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net,
    sip:240f34.1@pcscf1.visited1.net
```

Via: P-CSCF removes the Via headers, and generates a locally unique token to identify the saves values. It inserts this as a branch value on its Via header.

~~Media-~~P-Media-Authorization: A P-CSCF generated authorization token. This particular example shows a Policy-Element generated by "pcf2.xyz.net" with credentials "31S14621".

SDP The SDP contains the restricted set of codecs allowed by the network operator. The "m=" lines for the first audio stream no longer contains codec "0" (PCMU), which removes it from the negotiation.

7. **100 Trying (UE to P-CSCF) – see example in table 7.4.2.1-7**

UE may optionally send a 100 Trying provisional response to P-CSCF.

Table 7.4.2.1-7: 100 Trying (UE to P-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP pcscf2.visited2.net;branch=361k21.1
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

8. **183 Session Progress (UE to P-CSCF) – see example in table 7.4.2.1-8**

UE#2 determines the complete set of codecs that it is capable of supporting for this session. It determines the intersection with those appearing in the SDP in the INVITE request. For each media flow that is not supported, UE#2 inserts a SDP entry for media (m= line) with port=0. For each media flow that is supported, UE#2 inserts a SDP entry with an assigned port and with the codecs in common with those in the SDP from UE#1.

For this example, assume UE#2 supports both AMR and G726, but not G728 (code 15).

UE responds with a 183 Session Progress response containing SDP back to the originator. This SDP may represent one or more media for a multimedia session. This response is sent to P-CSCF.

Table 7.4.2.1-8: 183 Session Progress (UE to P-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP pcscf2.visited2.net;branch=361k21.1
Remote-Party-ID: "John Smith" <tel:+1-212-555-2222>~~;privacy=offg~~
RPID-Privacy: privacy=off;party=called
~~Anonymity: Off~~
~~Require: 100rel~~
From:
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost; tag=314159
Call-ID:
CSeq:
Require: 100rel
Contact: sip:[5555::eee:fff:aaa:bbb]
RSeq: 9021
~~Content-Disposition: precondition~~
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97 96
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=conf:qos remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
~~a=qos:mandatory sendrecv confirm~~
a=rtpmap:96 G726-32/8000
m=audio 0 RTP/AVP 97 96 0 15
```

Remote-Party-ID: Identifies the answering subscriber. It contains the public user identity, and the name of the answering party.

To: A tag is added to the To header.

Contact: ~~Header identifies~~ Contains a SIP URL with the IP address or FQDN of the UE.

SDP The SDP contains the subset of codecs supported by UE. It requests a confirmation of the QoS preconditions for establishing the session

Upon receipt of the 183 Session Progress, the P-CSCF stores the following information about this session, for use in providing enhanced services or in possible error recovery actions – see example in table 7.4.2.1-8b.

Table 7.4.2.1-8b: Storage of information at P-CSCF

```
Request-URI: sip:+1-212-555-2222@home2.net;user=phone
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B; seq=72))@localhost>; tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost; tag=314159
```

```
~~From: "Anonymous" <sip:anonymous@localhost>; tag=171828~~
~~To: sip:anonymous@localhost; tag=314159~~
Call-ID: cb03a0s09a2sdfglkj490333
CSeq(2dest): 127 INVITE
CSeq(2orig): none
~~Route(2dest): sip:[5555::eee:fff:aaa:bbb]~~
Route(2orig): sip:scscf2.home2.net, sip:scscf1.home1.net, sip:pcscf1.visited1.net~~,~~
~~sip:[5555::aaa:bbb:ccc:ddd]~~
Contact(dest): sip:[5555::eee:fff:aaa:bbb]
Contact(orig): sip:[5555::aaa:bbb:ccc:ddd]
```

9. **Authorize QoS Resources**

P-CSCF authorizes the resources necessary for this session. The approval of QoS commitment either happens at this stage or after 200 OK of INVITE (34) based on operator local policy.

10. **183 Session Progress (P-CSCF to S-CSCF) – see example in table 7.4.2.1-10**

P-CSCF forwards the 183 Session Progress response to S-CSCF.

Table 7.4.2.1-10: 183 Session Progress (P-CSCF to S-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd])
Record-Route: sip:~~361k21.1@~~pcscf2.visited2.net;lr, sip:~~764z87.1@~~scscf2.home2.net;lr,
    sip:~~332b23.1@~~scscf1.home1.net;lr, sip:~~240f34.1@~~pcscf1.visited1.net;lr
Remote-Party-ID:
RPID-Privacy:
~~Anonymity:~~
~~Require:~~
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
~~Content-Disposition:~~
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

Via:/Record-Route: P-CSCF restores the Via headers and Record-Route headers from the branch value in its Via.

Upon receipt of the 183 Session Progress, the S-CSCF stores the following information about this session, for use in providing enhanced services or in possible error recovery actions – see example in table 7.4.2.1-10b.

Table 7.4.2.1-10~~9~~b: Storage of information at S-CSCF

```
Request-URI: sip:+1-212-555-2222@home2.net;user=phone
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
seq=72))@localhost>; tag=171828
```

```
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhostFrom: "Anonymous" 
    <sip:anonymous@localhost>; tag=171828
To: sip:anonymous@localhost 
Call-ID: cb03a0s09a2sdfglkj490333 
CSeq(2dest): 127 INVITE
CSeq(2orig): none
Route(2dest): sip:pcscf2.visited2.net, sip:[5555::eee:fff:aaa:bbb]
Route(2orig): sip:scscf1.home1.net, sip:pcscf1.visited1.net, sip:[5555::aaa:bbb:ccc:ddd]
Contact(dest): sip:[5555::eee:fff:aaa:bbb]
Contact(orig): sip:[5555::aaa:bbb:ccc:ddd]
```

11. **183 Session Progress (MT#1a to S-S) – see example in table 7.4.2.1-11**

S-CSCF forwards the 183 Session Progress response to the originator, per the S-CSCF to S-CSCF procedure.

Table 7.4.2.1-11: 183 Session Progress (MT#1a to S-S)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
Remote-Party-ID: "John Smith" <tel:+1-212-555-2222>;privacy=off;screen=yes
RPID-Privacy:
Anonymity: 
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Disposition: 
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
a=
m=
```

12. **PRACK (S-S to MT#1a) – see example in table 7.4.2.1-12**

The originating endpoint sends a PRACK request containing the final SDP to be used in this session, via the S-CSCF to S-CSCF procedure, to S-CSCF.

Table 7.4.2.1-12: PRACK (S-S to MT#1a)

```
PRACK sip:[5555::eee:fff:aaa:bbb]sip:scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Require:
Route: sip:scscf2.home2.net;lr, sip:361k21.1@pcscf2.visited2.net;lr, sip:[5555::eee:fff:aaa:bbb]
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 128 PRACK
Require: precondition
```

```
Max-Forwards: 68
Rack: 9021 127 INVITE
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 3456 RTP/AVP 97
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=qos:mandatory sendrecv
m=audio 0 RTP/AVP 97 96 0 15
```

13. **PRACK (S-CSCF to P-CSCF) – see example in table 7.4.2.1-13**

S-CSCF forwards the PRACK request to P-CSCF.

Table 7.4.2.1-13: PRACK (S-CSCF to P-CSCF)

```
PRACK sip:pcscf2.visited2.netPRACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Require:
Route: sip:pcscf2.visited2.net;lrsip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Max-Forwards: 67
Require:
Rack:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

14. **PRACK (P-CSCF to UE) – see example in table 7.4.2.1-14**

P-CSCF forwards the PRACK request to UE.

Table 7.4.2.1-14: PRACK (P-CSCF to UE)

```
PRACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.visited2.net;branch=361k21.1
Max-Forwards: 66
Require:
From:
```

```
To:
Call-ID:
Cseq:
Require:
Max-Forwards: 66
Rack:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

Via: P-CSCF removes the Via headers, and generates a locally unique token to identify the saved values. It inserts this as a branch value on its Via header.

15. **200 OK (UE to P-CSCF) – see example in table 7.4.2.1-15**

UE acknowledges the PRACK request (14) with a 200 OK response.

Table 7.4.2.1-15: 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf2.visited2.net;branch=361k21.1
From:
To:
Call-ID:
CSeq:
Content-Length: 0
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=conf:qos remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
m=audio 0 RTP/AVP 97 96 0 15
```

16. **200 OK (P-CSCF to S-CSCF) – see example in table 7.4.2.1-16**

P-CSCF forwards the 200 OK response to S-CSCF.

Table 7.4.2.1-16: 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
```

```
From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

17. **200 OK (MT#1a to S-S) – see example in table 7.4.2.1-17**

    S-CSCF forwards the 200 OK response to the originator, per the S-CSCF to S-CSCF procedure.

Table 7.4.2.1-17: 200 OK (MT#1a to S-S)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

18. **Resource Reservation**

    UE initiates the reservation procedures for the resources needed for this session.

19. **~~COMET~~UPDATE (S-S to MT#1a) – see example in table 7.4.2.1-19**

    When the originating endpoint has completed its resource reservation, it sends the ~~COMET~~UPDATE request to S-CSCF, via the S-CSCF to S-CSCF procedures.

Table 7.4.2.1-19: ~~COMET~~UPDATE (S-S to MT#1a)

```
COMETUPDATE sip:[5555::eee:fff:aaa:bbb]sip:scscf2.home2.net SIP/2.0
```

```
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scscf2.home2.net;lr, sip:361k21.1@pcscf2.visited2.net;lr, sip:[5555::eee:fff:aaa:bbb]
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 129 COMETUPDATE
Max-Forwards: 68
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 3456 RTP/AVP 97
b=AS:25.4
a=curr:qos local sendrecv
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=qos:success sendonly
m=audio 0 RTP/AVP 97 96 0 15
```

20. **~~COMET~~UPDATE (S-CSCF to P-CSCF) – see example in table 7.4.2.1-20**

S-CSCF forwards the ~~COMET~~UPDATE request to P-CSCF.

Table 7.4.2.1-20: ~~COMET~~UPDATE (S-CSCF to P-CSCF)

```
COMETUPDATE sip:[5555::eee:fff:aaa:bbb]sip:pcscf2.visited2.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:pcscf2.visited2.net;lrsip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Max-Forwards: 67
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

21. **~~COMET~~UPDATE (P-CSCF to UE) – see example in table 7.4.2.1-21**

P-CSCF forwards the ~~COMET~~UPDATE request to UE.

Table 7.4.2.1-21: ~~COMET~~UPDATE (P-CSCF to UE)

```
COMETUPDATE sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.visited2.net;branch=361k21.1
Max-Forwards: 66
From:
To:
Call-ID:
Cseq:
Max-Forwards: 66
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

Via: P-CSCF removes the Via headers, and generates a locally unique token to identify the saved values. It inserts this as a branch value on its Via header.

22. **200 OK (UE to P-CSCF) – see example in table 7.4.2.1-22**

UE acknowledges the ~~COMET~~UPDATE request (21) with a 200 OK response.

Table 7.4.2.1-22: 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf2.visited2.net;branch=361k21.1
From:
To:
Call-ID:
CSeq:
Content-Length: 0
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=conf:qos remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
m=audio 0 RTP/AVP 97 96 0 15
```

~~22. **Approval of QoS Commit**~~

~~The P-CSCF approves the commitment of the QoS resources.~~

23. **200 OK (P-CSCF to S-CSCF) – see example in table 7.4.2.1-23**

P-CSCF forwards the 200 OK response to S-CSCF.

Table 7.4.2.1-23: 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

24. **200 OK (MT#1a to S-S) – see example in table 7.4.2.1-24**

S-CSCF forwards the 200 OK response to the originator, per the S-CSCF to S-CSCF procedure.

Table 7.4.2.1-24: 200 OK (MT#1a to S-S)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

25. **180 Ringing (UE to P-CSCF) – see example in table 7.4.2.1-25**

Before proceeding with session establishment, the UE waits for two events. First, the resource reservation initiated in step #178 must complete successfully. Second, the resource reservation initiated by the originating endpoint must complete successfully (which is indicated by message #2~~1~~0 received by UE). The UE may now immediately accept the session (and proceed with step #34~~5~~), or alert the destination subscriber of an incoming session attempt; if the latter it indicates this to the calling party by a 180 Ringing provisional response sent to P-CSCF.

Table 7.4.2.1-25: 180 Ringing (UE to P-CSCF)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP pcscf2.visited2.net;branch=361k21.1
Require: 100rel
From:
To:
Call-ID:
CSeq:
Require: 100rel
Contact: sip:[5555::eee:fff:aaa:bbb]
RSeq: 9022
Content-Length: 0
```

26. **180 Ringing (P-CSCF to S-CSCF) – see example in table 7.4.2.1-26**

P-CSCF forwards the 180 Ringing response to S-CSCF.

Table 7.4.2.1-26: 180 Ringing (P-CSCF to S-CSCF)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:361k21.1@pcscf2.visited2.net,sip:764z87.1@scscf2.home2.net,
    sip:332b23.1@scscf1.home1.net, sip:240f34.1@pcscf1.visited1.netRecord-Route:
    sip:pcscf2.visited2.net;lr,sip:scscf2.home2.net;lr, sip:scscf1.home1.net;lr,
    sip:pcscf1.visited1.net;lr
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Length:
```

~~27. **Service Control**~~

~~The S-CSCF validates the service profile and performs any service control required for this subscriber.~~

2~~8~~7. **180 Ringing (MT#1a to S-S) – see example in table 7.4.2.1-27~~8~~**

S-CSCF forwards the 180 Ringing response to the originating endpoint, per the S-CSCF to S-CSCF procedure.

Table 7.4.2.1-2~~8~~7: 180 Ringing (MT#1a to S-S)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Length:
```

~~29~~28. **PRACK (S-S to MT#1a) – see example in table 7.4.2.1-28~~29~~**

The originator acknowledges the 180 Ringing response (~~28~~27) with a PRACK request.

Table 7.4.2.1-~~2~~28~~9~~: PRACK (S-S to MT#1a)

```
PRACK sip:[5555::eee:fff:aaa:bbb]~~sip:scscf2.home2.net ~~ SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scscf2.home2.net;lr, sip:~~361k21.1@~~pcscf2.visited2.net;lr~~, sip:[5555::eee:fff:aaa:bbb]~~
From:
To:
Call-ID:
Cseq: 130 PRACK
~~Max-Forwards: 68~~
Rack: 9022 127 INVITE
Content-Length: 0
```

~~30~~29. **PRACK (S-CSCF to P-CSCF) – see example in table 7.4.2.1-~~30~~29**

S-CSCF forwards the PRACK request to P-CSCF.

Table 7.4.2.1-~~30~~29: PRACK (S-CSCF to P-CSCF)

```
~~PRACK sip:pcscf2.visited2.net~~PRACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:pcscf2.visited2.net;lr~~sip:[5555::eee:fff:aaa:bbb]~~
From:
To:
Call-ID:
Cseq:
~~Max-Forwards: 67~~
Rack:
Content-Length:
```

3~~1~~0. **PRACK (P-CSCF to UE) – see example in table 7.4.2.1-30~~1~~**

P-CSCF forwards the PRACK request to UE.

Table 7.4.2.1-3~~1~~0: PRACK (P-CSCF to UE)

```
PRACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.visited2.net;branch=361k21.1
Max-Forwards: 66
From:
To:
Call-ID:
Cseq:
~~Max-Forwards: 66~~
Rack:
Content-Length:
```

Via: P-CSCF removes the Via headers, and generates a locally unique token to identify the saved values. It inserts this as a branch value on its Via header.

3~~2~~1. **200 OK (UE to P-CSCF) – see example in table 7.4.2.1-31~~2~~**

UE acknowledges the PRACK request (31) with a 200 OK response.

Table 7.4.2.1-3~~2~~1: 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf2.visited2.net;branch=361k21.1
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

33~~3~~2. **200 OK (P-CSCF to S-CSCF) – see example in table 7.4.2.1-32~~3~~**

P-CSCF forwards the 200 OK response to S-CSCF.

Table 7.4.2.1-32~~3~~: 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

3~~4~~33. **200 OK (MT#1a to S-S) – see example in table 7.4.2.1-33~~4~~**

S-CSCF forwards the 200 OK response to the session originator, per the S-CSCF to S-CSCF procedures.

Table 7.4.2.1-33~~4~~: 200 OK (MT#1a to S-S)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

3~~5~~4. **200 OK (UE to P-CSCF) – see example in table 7.4.2.1-34~~5~~**

When the called party answers the UE sends a 200 OK final response to the INVITE request (6) to P-CSCF, and starts the media flow(s) for this session.

Table 7.4.2.1-3~~5~~4: 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf2.visited2.net;branch=361k21.1
From:
To:
Call-ID:
CSeq: 127 INVITE
Contact: sip:[5555::eee:fff:aaa:bbb]
Content-Type: application/sdp
Content-Length:0 (...)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97
b=AS:25.4
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=qos:success sendrecv
m=audio 0 RTP/AVP 97 96 0 15
```

3~~6~~5. **Approval of QoS Commit**

The P-CSCF approves the commitment of the QoS resources if it was not approved already in step (9).

~~37~~365. **200 OK (P-CSCF to S-CSCF) – see example in table 7.4.2.1-~~37~~365**

P-CSCF ~~indicates the resources reserved for this session should now be committed, and~~ sends the 200 OK final response to S-CSCF.

Table 7.4.2.1-~~37~~365: 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:361k21.1@pcscf2.visited2.net;lr, sip:764z87.1@scscf2.home2.net;lr,
    sip:332b23.1@scscf1.home1.net;lr, sip:240f34.1@pcscf1.visited1.net;lr
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
m=
```

~~38. **Service Control**~~

~~S-CSCF performs whatever service control is required for the session completion.~~

~~39~~376. **200 OK (MT#1a to S-S) – see example in table 7.4.2.1-~~39~~376**

S-CSCF forwards the 200 OK final response along the signalling path back to the session originator, as per the S-CSCF to S-CSCF procedure.

Table 7.4.2.1-~~39~~376: 200 OK (MT#1a to S-S)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
m=
```

~~40~~38~~7~~. **ACK (S-S to MT#1a) – see example in table 7.4.2.1-~~40~~38~~7~~**

The calling party responds to the 200 OK final response (~~39~~376) with an ACK request which is sent to S-CSCF via the S-CSCF to S-CSCF procedure.

Table 7.4.2.1-~~40~~387: ACK (S-S to MT#1a)

```
ACK sip:[5555::eee:fff:aaa:bbb]sip:scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scscf2.home2.net;lr, sip:361k21.1@pcscf2.visited2.net;lr, sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq: 127 ACK
Max-Forwards: 68
Content-Length: 0
```

~~41~~398. ACK (S-CSCF to P-CSCF) – see example in table 7.4.2.1-~~41~~398

S-CSCF forwards the ACK request to P-CSCF.

Table 7.4.2.1-~~41~~398: ACK (S-CSCF to P-CSCF)

```
ACK sip:pcscf2.visited2.netACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:pcscf2.visited2.net;lrsip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Max-Forwards: 67
Content-Length:
```

~~42~~4039. ACK (P-CSCF to UE) – see example in table 7.4.2.1-~~42~~4039

P-CSCF forwards the ACK request to UE.

Table 7.4.2.1-~~42~~4039: ACK (P-CSCF to UE)

```
ACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.visited2.net;branch=361k21.1
Max-Forwards: 66
From:
To:
Call-ID:
Cseq:
Max-Forwards: 66
Content-Length:
```

Via: P-CSCF removes the Via headers, and generates a locally unique token to identify the saved values. It inserts this as a branch value on its Via header.

3GPP TSG-CN1 Meeting #23 **Tdoc N1-020813**
Ft Lauderdale, Florida, 8th – 12th April 2002

CR-Form-v5

CHANGE REQUEST

⌘	**24.228**	**CR 005**	⌘ **rev**	**-**	⌘ Current version:	**5.0.0** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [X] Radio Access Network [ ] Core Network [X]

Title: ⌘	Addition of Max-Forwards Header to Registration Flows		
Source: ⌘	dynamicsoft		
Work item code: ⌘	IMS-CCR	***Date:*** ⌘	22.03.2002
Category: ⌘	**F**	***Release:*** ⌘	REL-5
	Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change: ⌘	RFC 3261 defines a mandatory header for all Requests Max-Forwards.
Summary of change: ⌘	Max-Forwards header added to all REGISTER, SUBSCRIBE and NOTIFY requests.
Consequences if not approved: ⌘	The registration flows in 24.228 will be incorrect and out of alignment with RFC 3261.

Clauses affected: ⌘	6, 16	
Other specs affected: ⌘	[ ] Other core specifications ⌘ [ ] Test specifications [ ] O&M Specifications	
Other comments: ⌘		

FIRST MODIFICATION

6 Signalling flows for REGISTER (non hiding)

6.1 Introduction

In IMS Authentication is performed at registration time. The following sections show examples of SIP registration and UMTS AKA authentication. It is possible for the home to require other types of authentication.

In the example below, Extensible Authentication Protocol (EAP) is used within SIP headers to carry the information related to the authentication-challenge and response.

6.2 Registration signalling: user not registered

Figure 6.2-1 shows the registration signalling flow for the scenario when the user is not registered. For the purpose of this registration signalling flow, the subscriber is considered to be roaming. This flow also shows the authentication of the private user identity. In this signalling flow, the home network does not have network configuration hiding active.

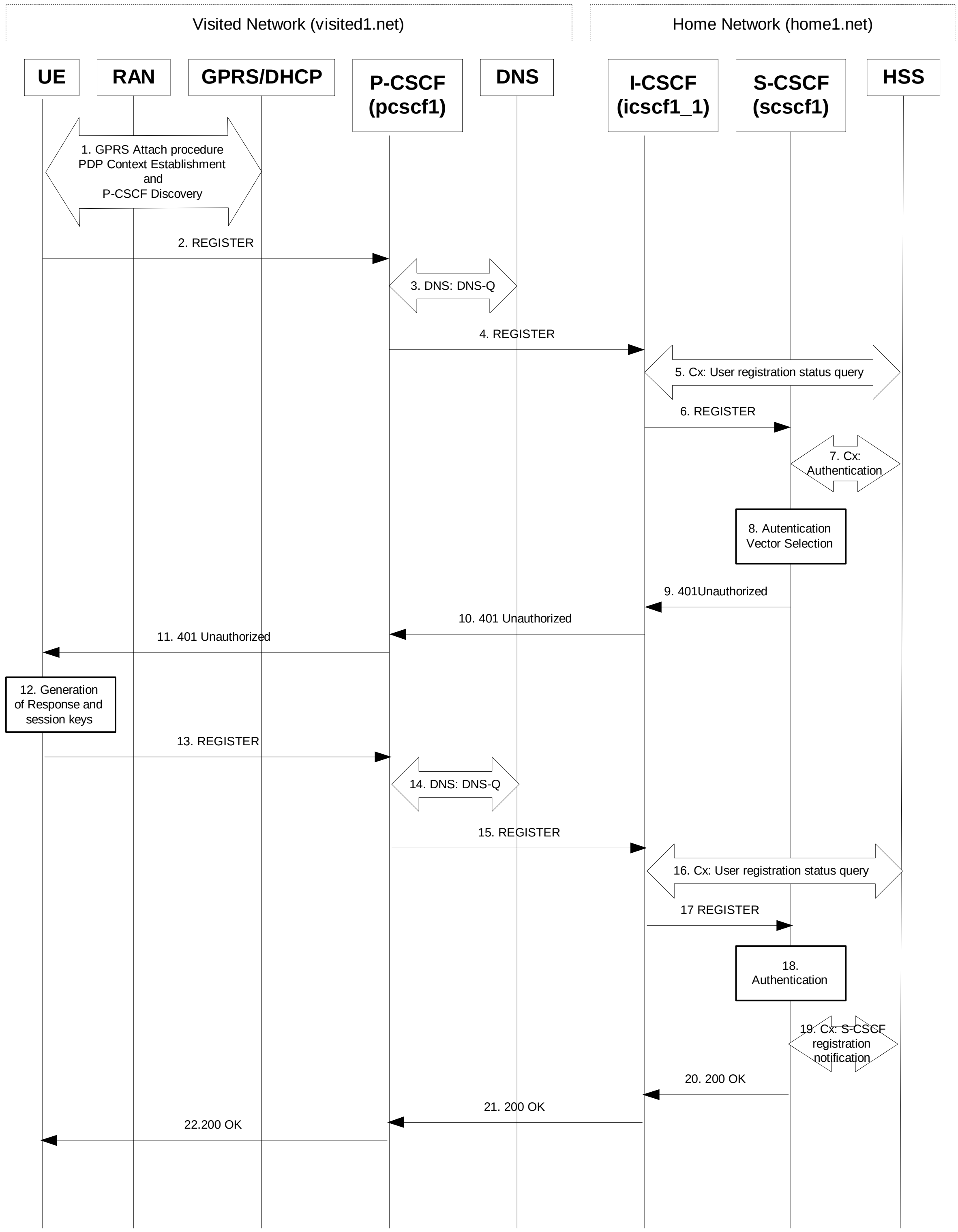


Figure 6.2-1: Registration signalling: user not registered

1. **GPRS Attach / PDP Context Establishment and P-CSCF Discovery (UE to GPRS)**

   This signalling flow is shown to indicate prerequisites for the registration signalling.

   See subclause 5.2 for details.

2. **REGISTER request (UE to P-CSCF) – see example in table 6.2-2**

The purpose of this request is to register the user's SIP URI with a S-CSCF in the home network. This request is routed to the P-CSCF because it is the only SIP server known to the UE. In the following SIP request, the Contact field contains the user's host address.

The P-CSCF will perform two actions, binding and forwarding. The binding is between the User's SIP address (user1_public1@home1.net) and the host (terminal) address ([5555::aaa:bbb:ccc:ddd]) which was acquired during PDP context activation process.

[Editor's note: The security mode set-up procedure supports the negotiation of different protection mechanisms. This will involve the addition of a "security-setup" field to the SIP REGISTER request and the REGISTER response performing the authentication challenge containing the parameters:

- list of Authentication (integrity} algorithms, and optionally list of encryption (confidentiality) algorithms
- SA-ID that is used to uniquely identify the SA at the receiving side.
- Key length: the length of encryption and authentication (integrity) keys is 128 bits.

The exact format and use for the security mode setup is being worked through IETF and is FFS]

Table 6.2-2: REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: eap eap-p=base64(user1_private1@home1.net)
CSeq: 1 REGISTER
Expires: 7200
Content-Length: 0
```

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Via: IPv6 address of the SIP session allocated during the PDP Context Activation process.

Max-Forwards: Set to 70 by the UE and used to prevent loops.

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates the public user identity being registered. This is the identity by which other parties know this subscriber. It may be obtained from the USIM.

Contact: This indicates the point-of-presence for the subscriber - the IP address of the UE. This is the temporary point of contact for the subscriber that is being registered. Subsequent requests destined for this subscriber will be sent to this address. This information is stored in the P-CSCF and S-CSCF.

Authorization: It carries authentication information. The private user identity (user1_private1@home1.net) is carried in the user ID field of the extensible authentication protocol (EAP).

NOTE: The actual Authorization header value may look like this as it is in base64 form:
Authorization: eap eap-p=QWxhZGRpbjpvcGVuIHNlc2FtZQ==

Upon receiving this request the P-CSCF will set it's SIP registration timer for this UE to the Expires time in this request.

3. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify the transport protocol, the P-CSCF selects the UDP.

Table 6.2-3a: DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=_sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 6.2-3b: DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=_sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net        0 IN SRV 1 10 5060 icscf1_p.home1.net
                                        0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                 0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                 0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

4. **REGISTER request (P-CSCF to I-CSCF) - see example in table 6.2-4**

The P-CSCF needs to be in the path for all mobile originated and mobile terminated requests for this user. To ensure this, the P-CSCF adds itself to the Path header value for future requests.

The P-CSCF binds the public user identity under registration to the Contact header supplied by the user.

The P-CSCF adds also the Roaming-Info header (if not present). The P-CSCF adds the *vnid* parameter with the contents of the identifier of the P-CSCF network. This may be the visited network domain name or any other identifier that identifies the visited network at the home network.

This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 6.2-4: REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

Require:/Proxy-Require: These headers are included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating "path". Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

5. **Cx: User registration status query procedure**

The I-CSCF makes a request for information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF required capabilities and the I-CSCF uses this information to select a suitable S-CSCF.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-5a provides the parameters in the REGISTER request (flow 4) which are sent to the HSS.

Table 6.2-5a Cx: User registration status query procedure (I-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
I-CSCF to HSS	Private User Identity	Authorization:	The Private User Identity is encoded according to the Authorization protocol.
	Public User Identity	To:	Identity which is used to communicate with other users
	Visited Network Identifier	Roaming Info: vnid	This information indicates the network identifier of the visited network

6. **REGISTER request (I-CSCF to S-CSCF) – see example in table 6.2-6**

I-CSCF does not modify the Path header.

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 6.2-6: REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

Upon receiving this request the S-CSCF may set its SIP registration timer for this UE to the Expires time in this request or the S-CSCF may assign another registration timer for this registration

7. **Cx: Authentication procedure**

On receiving a REGISTER request from an unauthenticated user, the S-CSCF requires at least one authentication vector to be used in the challenge to the user. If a valid AV is not available, then the S-CSCF requests at least one AV from the HSS.

The S-CSCF indicates to the HSS that it has been assigned to serve this user.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-7a provides the parameters in the REGISTER request (flow 6) which are sent to the HSS.

Table 6.2-7a Cx: S-CSCF authentication information procedure (S-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
S-CSCF to HSS	Public User Identify	To:	Identity which is used to communicate with other users
	Private User Identity	Authorization:	The Private User Identity is encoded according to the Authorization protocol.
	S-CSCF Name	Request-URI:	This information element contains the name of the S-CSCF. The presence of this IE indicates that the user has not been authenticated yet by the S-CSCF

8. **Authentication vector selection**

The S-CSCF selects an authentication vector for use in the authentication challenge. For detailed description of the authentication vector, see 3GPP TS 33.203.

NOTE 1: The authentication vector may be of the form as in 3GPP TS 33.203 (if IMS AKA is the selected authentication scheme):

- $AV = RAND_n||AUTN_n||XRES_n||CK_n||IK_n$ where:
  - RAND: random number used to generate the XRES, CK, IK, and part of the AUTN. It is also used to generate the RES at the UE.
  - AUTN: Authentication token (including MAC and SQN).
  - XRES: Expected (correct) result from the UE.
  - CK: Cipher key (optional).
  - IK: Integrity key.

9. **401 Unauthorized response (S-CSCF to I-CSCF) - see example in table 6.2-9**

   The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.2-9: 401 Unauthorized response (S-CSCF to I-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Call-ID: apb03a0s09dkjdfglkj49111
WWW-Authenticate: eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)
CSeq: 1 REGISTER
Content-Length: 0
```

NOTE 2: The actual WWW-Authenticate header value may look like this as it is in base64 form: WWW-Authenticate: eap eap-p=QWxh4ZGRpb2jpvcGVuNlctZQ==

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

10. **401 Unauthorized response (I-CSCF to P-CSCF) - see example in table 6.2-10**

    The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.2-10: 401 Unauthorized response (I-CSCF to P-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate:
CSeq:
Content-Length:
```

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

11. **401 Unauthorized response (P-CSCF to UE) - see example in table 6.2-11**

    The P-CSCF removes any keys received in the 401 Unauthorized response and forwards the rest of the response to the UE.

Table 6.2-11: 401 Unauthorized response (P-CSCF to UE)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate: eap eap-p=base64(user1_private1.home1.net, RAND, AUTN)
CSeq:
Content-Length:
```

12. **Generation of response and session keys at UE**

Upon receiving the Unauthorised response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in the REGISTER request.

13. **REGISTER request (UE to P-CSCF) - see example in table 6.2-13**

Table 6.2-13 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49112
Authorization: eap eap-p=base64(user1_private1@home1.net, RES)
CSeq: 2 REGISTER
Expires: 7200
Content-Length: 0
```

Authorization: This carries the response to the authentication challenge received in step 11 along with the private user identity both encoded in base64 format.

14. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify the transport protocol the, P-CSCF selects the UDP.

Table 6.2-14a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 6.2-14b DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net        0 IN SRV 1 10 5060 icscf1_p.home1.net
                                        0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                 0 IN AAAA     5555::aba:dab:aaa:daa
```

```
icscf7_p.home1.net                0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

15. **REGISTER request (P-CSCF to I-CSCF) - see example in table 6.2-15**

This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.

Table 6.2-15 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

16. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF name which was previously selected in step 5 (Cx: User registration status query procedure).

For detailed message flows see 3GPP TS 29.228.

Table 6.2-16a provides the parameters in the REGISTER request (flow 15), which are sent to the HSS.

Table 6.2-16a Cx: User registration status query procedure (I-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
I-CSCF to HSS	Private User Identity	Authorization:	The Private User Identity is encoded according to the Authorization protocol.
	Public User Identity	To:	Identity which is used to communicate with other users
	Visited Network Identifier	Roaming-Info: vnid	This information indicates the network identifier of the visited network

17. **REGISTER request (I-CSCF to S-CSCF) - see example in table 6.2-17**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF.

Table 6.2-17: REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

18. **Authentication**

Upon receiving the REGISTER request carrying the authentication response, RES, the S-CSCF checks that the user's active, XRES matches the received RES. If the check is successful then the user has been authenticated and the public user identity is registered in the S-CSCF.

19. **Cx: S-CSCF registration notification procedure**

On registering a user the S-CSCF informs the HSS that the user has been registered at this instance. Upon being requested by the S-CSCF , the HSS will also include the user profile in the response sent to the S-CSCF.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-19a provides the parameters in the REGISTER request (flow 17), which are sent to the HSS.

Table 6.2-19a Cx: S-CSCF registration notification procedure (S-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
S-CSCF to HSS	Public User Identify	To:	Identity which is used to communicate with other users
	Private User Identity	Authorization:	The Private User Identity is encoded according to the Authorization protocol. Unique identity in IMS which is used by network to authenticate this user
	S-CSCF name	Request-URI:	This information indicates the serving CSCF's name of that user

20. **200 OK response (S-CSCF to I-CSCF) - see example in table 6.2-20**

The S-CSCF sends acknowledgement to the I-CSCF indicating that Registration was successful.

Table 6.2-20: 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact: sip:[5555::aaa:bbb:ccc:ddd]
CSeq:
Date: Wed, 11 July 2001 08:49:37 GMT
Expires: 7200
Content-Length:
```

Path: The S-CSCF inserts its own name to the front of the list.

21. **200 OK response (I-CSCF to P-CSCF) - see example in table 6.2-21**

    The I-CSCF forwards acknowledgement from the S-CSCF to the P-CSCF indicating that Registration was successful.

Table 6.2-21: 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

22. **200 OK response (P-CSCF to UE) - see example in table 6.2-22**

    The P-CSCF removes its address from the Path header, reverses the order of the fields, saves the resulting Path header and associates it with the UE. The P-CSCF then removes the Path header from the 200 OK response. The P-CSCF then forwards acknowledgement from the I-CSCF to the UE indicating that Registration was successful.

Table 6.2-22: 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

6.3 Registration signalling: reregistration - user currently registered

For the purpose of the reregistration signalling flow shown in figure 6.3-1, the subscriber is considered to be roaming. The HSS information indicates that the subscriber is registered and authenticated, and that the S-CSCF has been allocated to this subscriber. In this signalling flow, the home network does not have network configuration hiding active. This flow also shows the authentication of the private user identity.

This signalling flow assumes:

1. That the same PDP Context allocated during the initial registration scenario is still used for reregistration. For the case when the UE does not still have an active PDP context then PDP context procedures from subclause 16.2 is completed first.

Editor's Note: If the same PDP-Context is not available, is it guaranteed that the UE will get back the same IP address at this point? If this is not possible, would there be a problem with the binding in the P-CSCF (user_public1@home1.net and [5555::aaa:bbb:ccc:ddd])?

2. The DHCP procedure employed for P-CSCF discovery is not needed.

3. The S-CSCF selection procedure invoked by the I-CSCF is not needed.

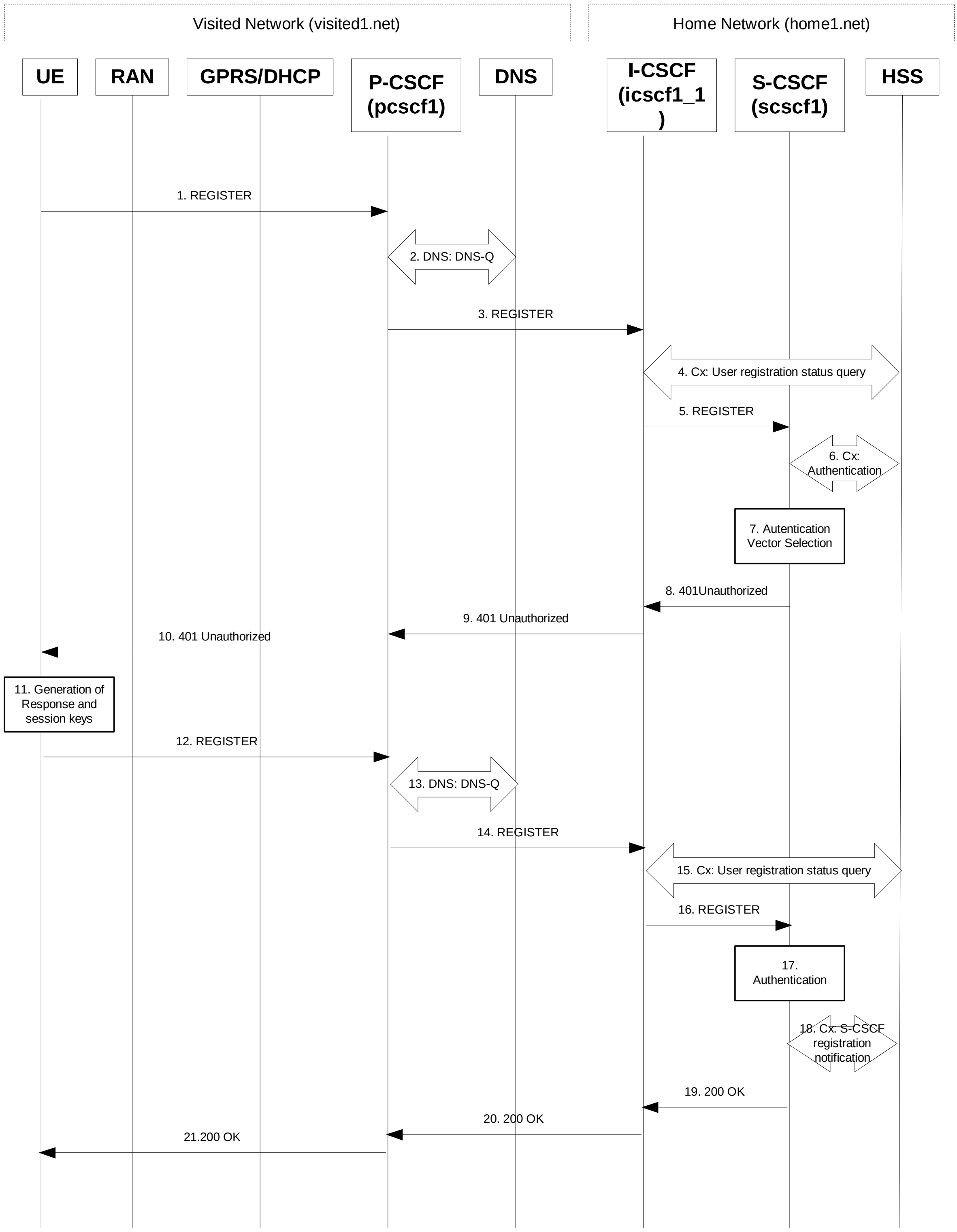


Figure 6.3-1: Reregistration when UE roaming

1. **REGISTER request (UE to P-CSCF) - see example in table 6.3-1**

   The registration expires in the UE. The UE reregisters by sending a new REGISTER request. This request is sent to the same P-CSCF with which the UE initially registered. The P-CSCF maintains the same binding between the public user address (user1_public1@home1.net) and the host (terminal) address ([5555::aaa:bbb:ccc:ddd]) which it established during the original registration.

Table 6.3-1: REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: eap eap-p=base64(user1_private1@home1.net)
CSeq: 3 REGISTER
Expires: 7200
Content-Length: 0
```

The header field usage is the same as for the initial registration scenario:

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates public user identity being registered. This is the identity by which other parties know this subscriber.

Contact: This indicates the point-of-presence for the subscriber – the IP address of the UE. This is the temporary identifier for the subscriber that is being registered. Subsequent requests destined for this subscriber will be sent to this address. This information is stored in the P-CSCF and the S-CSCF.

Authorization: It carries authentication information. The private user identity (user1_private1@home1.net) is carried in the user ID field of the extensible authentication protocol (EAP).

NOTE 1: The actual Authorization header value may look like this as it is in base64 form:
Authorization: eap eap-p=QWxhZGRpbjpvcGVuIHNlc2FtZQ==

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Upon receiving this request the P-CSCF will detect that it already has a registration record for this UE and will reset it's SIP registration timer for this UE to the Expires time in this request.

2. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI. The DNS provides the P-CSCF with an address of the I-CSCF in the home network. The P-CSCF must not use the I-CSCF address cached as a result of the previous registration.

3. **REGISTER request (P-CSCF to I-CSCF) - see example in table 6.3-3**

This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 6.3-3 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
```

```
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

Require:/Proxy-Require: These headers are included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating "path". Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

4. **Cx: User registration status query procedure**

   The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. Because the user has registered, the HSS returns the I-CSCF with the S-CSCF address for the subscriber.

   For detailed message flows see 3GPP TS 29.228.

   For the parameters in the REGISTER request (flow 3) which need to be sent to HSS, see table 6.2-5a.

   Table 6.3-4a provides the parameters in the REGISTER request (flow 5), which are obtained from the information sent back from the HSS.

Table 6.3-4a Cx: User registration status query procedure (HSS to I-CSCF)

Message source & destination	Cx Information element name	Mapping to SIP header in REGISTER	Description
HSS to I-CSCF	S-CSCF name	Request-URI:	This information indicates the serving CSCF's name of that user

5. **REGISTER request (I-CSCF to S-CSCF) - see example in table 6.3-5**

   This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected. The Request-URI is changed to the address of the S-CSCF.

Table 6.3-5: REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming_Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

Upon receiving this request the S-CSCF will detect that it already has a registration record for this UE and will reset it's SIP registration timer for this UE to the Expires time in this request.

6. **Cx: Authentication procedure**

On receiving a REGISTER request from a registered user, the S-CSCF requires at least one authentication vector to be used in the challenge to the user. If a valid AV is not available, then the S-CSCF requests at least one AV from the HSS.

For detailed message flows see 3GPP TS 29.228.

Table 6.3-6a provides the parameters in the REGISTER request (flow 5) which need to been sent to HSS.

Table 6.3-6a Cx: S-CSCF authentication information procedure (S-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
S-CSCF to HSS	Public User Identify	To:	Identity which is used to communicate with other users
	Private User Identity	Authorization:	The Private User Identity is encoded according to the Authorization protocol.
	S-CSCF name	Request-URI:	This information indicates the serving CSCF's name of that user

7. **Authentication vector selection**

The S-CSCF selects an authentication vector for use in the authentication challenge. For detailed description of the authentication vector, see 3GPP TS 33.203.

NOTE 2: The authentication vector may be of the form as in 3GPP TS 33.203 (if IMS AKA is the selected authentication scheme):

- AV = $RAND_n||AUTN_n||XRES_n||CK_n||IK_n$ where:
  - RAND: random number used to generate the XRES, CK, IK, and part of the AUTN. It is also used to generate the RES at the UE.
  - AUTN: Authentication token (including MAC and SQN).
  - XRES:Expected (correct) result from the UE.
  - CK: Cipher key (optional).
  - IK: Integrity key.

8. **401 Unauthorized response (S-CSCF to I-CSCF) - see example in table 6.3-8**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.3-8: 401 Unauthorized response (S-CSCF to I-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49111
WWW-Authenticate: eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)
CSeq: 1 REGISTER
Expires: 7200
Content-Length: 0
```

NOTE 3: The actual WWW-Authenticate header value may look like this as it is in base64 form:
WWW-Authenticate: eap eap-p=QWxh4ZGRpb2jpvcGVuNlctZQ==

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

9. **401 Unauthorized response (I-CSCF to P-CSCF) - see example in table 6.3-9**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.3-9: 401 Unauthorized response (I-CSCF to P-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Contact:
Call-ID:
WWW-Authenticate:
CSeq:
Expires:
Content-Length:
```

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS

10. **401 Unauthorized response (P-CSCF to UE) - see example in table 6.3-10**

The P-CSCF removes any keys received in the 401 Unauthorized response and forwards the rest of the response to the UE.

Table 6.3-10: 401 Unauthorized response (P-CSCF to UE)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Contact:
Call-ID:
WWW-Authenticate: eap eap-p=base64(user1_private1.home1.net, RAND, AUTN)
CSeq:
Expires:
Content-Length:
```

11. **Generation of response and session keys at UE**

Upon receiving the Unauthorised response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in a REGISTER request.

12. **REGISTER request (UE to P-CSCF) - see example in table 6.3-12**

Table 6.3-12: REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49112
Authorization: eap eap-p=base64(user1_private1@home1.net, RES)
CSeq: 4 REGISTER
Expires: 7200
Content-Length: 0
```

Authorization: This carries the response to the authentication challenge received in step 10 along with the private user identity both encoded in base64 format.

13. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify the transport protocol the, P-CSCF selects the UDP.

Table 6.3-13a: DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 6.3-13b: DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net        0 IN SRV 1 10 5060 icscf1_p.home1.net
                                        0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                  0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                  0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

14. **REGISTER request (P-CSCF to I-CSCF) - see example in table 6.2-14**

This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.

Table 6.3-14: REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

15. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. Because the user has registered, the HSS returns the I-CSCF with the S-CSCF address for the subscriber.

For detailed message flows see 3GPP TS 29.228.

For the parameters in the REGISTER request (flow 14) which need to be sent to HSS, see table 6.2-16a.

Table 6.3-15a provides the parameters in the REGISTER request (flow 16), which are obtained from the information sent back from the HSS

Table 6.3-15a: User registration status query response (*HSS to I-CSCF*)

Message source & destination	Cx Information element name	Mapping to SIP header in REGISTER	Description
HSS to I-CSCF	S-CSCF name	Request-URI:	This information indicates the serving CSCF's name of that user

16. **REGISTER request (I-CSCF to S-CSCF) - see example in table 6.3-16**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 6.3-16: REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

17. **Authentication**

Upon receiving the REGISTER request, carrying the authentication response, RES, the S-CSCF checks that the user's active, XRES matches the received RES. If the check is successful then the user has been authenticated and the public user identity is registered in the S-CSCF.

18. **Cx: S-CSCF registration notification procedure**

On registering a user the S-CSCF informs the HSS that the user has been re-registered at this instance.

For detailed message flows see 3GPP TS 29.228.

19. **200 OK response (S-CSCF to I-CSCF) - see example in table 6.3-19**

The S-CSCF sends acknowledgement to the I-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 6.3-19 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact: sip:[5555::aaa:bbb:ccc:ddd]
CSeq:
Date: Wed, 11 July 2001 08:49:37 GMT
Expires: 7200
Content-Length:
```

Path: The S-CSCF inserts its own name to the front of the list.

20. **200 OK response (I-CSCF to P-CSCF) - see example in table 6.3-20**

The I-CSCF forwards acknowledgement from the S-CSCF to the P-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 6.3-20: 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

21. **200 OK response (P-CSCF to UE) - see example in table 6.3-21**

The P-CSCF removes its address from the Path header, reverses the order of the fields, saves the resulting Path header and associates it with the UE. The P-CSCF then removes the Path header from the 200 OK response. The P-CSCF then forwards acknowledgement from the I-CSCF to the UE indicating that Registration was successful.

Table 6.3-21: 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

6.4 Registration signalling: mobile initiated deregistration (not provided)

An example of this flow is not shown in the present document.

6.5 UE subscription for the registration state event package

This subclause describes the subscription procedure for the registration state event , whereby the UE requests to be notified by the S-CSCF when the event has occurred. This is done using the information structure specified for the 'presence' package.

It is assumed that the user has registered prior to initiating subscription of an event. Also, the subscriber is considered to be roaming and the home network operator does not desire to keep its internal configuration hidden from the visited network. For this example the trigger point at the P-CSCF for sending out the SUBSCRIBE request is the 200 OK response of the users registration.

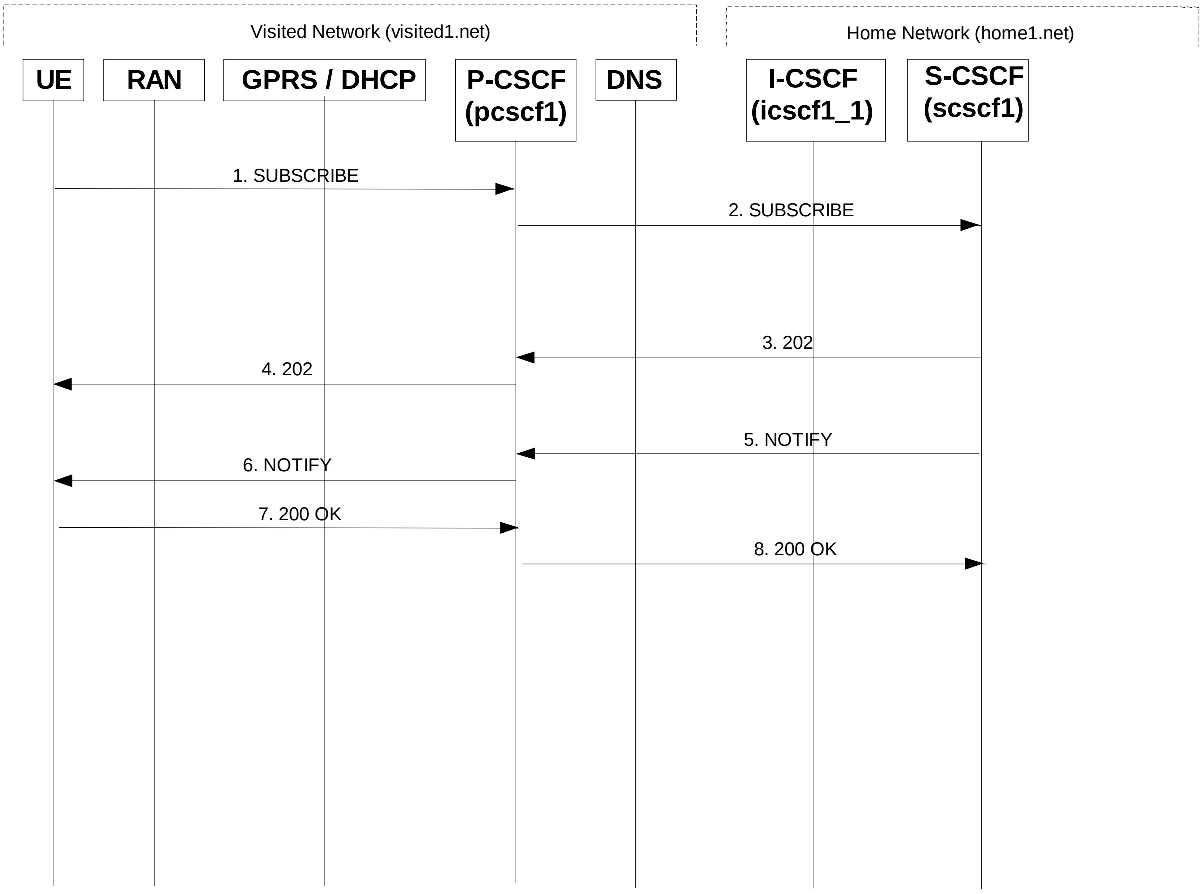


Figure 6.5-1: UE subscription for the registration state event package (without I-CSCF providing configuration independence)

1. **SUBSCRIBE request (UE to P-CSCF) - see example in table 6.5-1**

   The UE sends SUBSCRIBE request for the registration-state event package.

Table 6.5-1: SUBSCRIBE request (UE to P-CSCF)

```
SUBSCRIBE sip:user1_public1@home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: <sip:user1_public1@home1.net>;tag=31415
To: <sip:user1_public@home1.net>
Call-ID: b89rjhnedlrfjflslj40a222
CSeq: 61 SUBSCRIBE
Event:  presence
Expires: 7200
Accept: application/cpim-pidf+xml
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Content-Length: 0
```

From: This field is populated with logical representation (FQDN) for the entity sending the SUBSCRIBE.

Event: This field is populated with the value 'presence' to specify the use of the presence package.

Accept: This field is populated with the value 'application/cpim-pidf+xml' in keeping with the use of the 'presence' package.

2. **SUBSCRIBE request (P-CSCF to S-CSCF) - see example in table 6.5-2**

   P-CSCF looks up the serving network information for the public user identity that was stored during the registration procedure. The SUBSCRIBE request is forwarded to S-CSCF.

Table 6.5-2: SUBSCRIBE request (P-CSCF to S-CSCF)

```
SUBSCRIBE sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:user1_public1@home1.net
Record-Route: sip:431h23.1@pcscf1.home1.net
From:
To:
Call-ID:
CSeq:
Event:
Expires:
Accept:
Contact:
Content-Length:
```

Route: The Route: header is populated with the Request-URI received from the UE in the SUBSCRIBE.

3. **202 Accepted response (S-CSCF to P-CSCF) - see example in table 6.5-3**

   The S-CSCF sends an acknowledgement towards the UE indicating that the subscription was successful. This response will traverse the path that the SUBSCRIBE request took as described in the Via list.

NOTE 1: If the S-CSCF can process the SUBSCRIBE request and send the NOTIFY request immediately, it can send a 200 OK response instead of a 202 Accepted response.

Table 6.5-3: 202 Accepted response (S-CSCF to P-CSCF)

```
SIP/2.0 202 Accepted
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: scscf1.home1.net, pcscf1.home1.net
Remote-Party-ID: "Registrar" <sip:registrar.home1.net>
From:
To: <sip:user1_public1@home1.net>;tag=151170
Call-ID:
CSeq:
Event:
Expires:
Content-Length:
```

Expires: If the value of the Expires header in SUBSCRIBE request is different from the one received in REGISTER method, then the value of Expires header in 202 Accepted is set to match the value of Expires header in REGISTER method.

4. **202 Accepted response (P-CSCF to UE) - see example in table 6.5-4**

   P-CSCF sends the response to UE.

Table 6.5-4: 202 Accepted response (P-CSCF to UE)

```
SIP/2.0 202 Accepted
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Remote-Party-ID:
From:
To:
Call-ID:
CSeq:
Event:
Expires:
Content-Length:
```

5. **NOTIFY request (S-CSCF to P-CSCF) - see example in table 6.5-5**

   The S-CSCF sends a first NOTIFY request towards the UE in order to inform the UE about the registration status of the monitored user.

   In the example below, the NOTIFY specifies the following public user identity as registered (i.e. status=open): sip:user1_public1@home1.net, tel: +498972233114.

   The following public user identity has been de-registered (i.e. status=closed) sip:user1_public2@home1.net. They are arranged in the preferred order of priority in this example.

   The Route header is constructed from the information saved at registration.

Table 6.5-5: NOTIFY request (S-CSCF to P-CSCF)

```
NOTIFY sip:pcscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
Max-Forwards: 70
Route: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Remote-Party-ID:
From: <sip:user1_public1@home1.net>;tag=31415
To: <sip:user1_public1@home1.net>;tag=151170
Call-ID:
CSeq: 42 NOTIFY
Expires:
Event:  presence
Content-Type:  application/cpim-pidf+xml
Content-Length: (...)

<presence xmlns="http://www.ietf.org/ns/cpim-pidf-xml-1.0">

        <tuple name="sip:user1_public1@home1.net">
          <status><value>open</value></status>
        </tuple>

        <tuple name="sip:user1_public2@home1.net">
          <status> <value>closed</value> </status>
        </tuple>

        <tuple name="tel:+498972233114">
          <status><value>open</value></status>
        </tuple>

      </presence>
```

From: The tag of this field matches that of the To; field in the received 200/202 for the SUBSCRIBE.

Content-Type: Set to the value of the Accept: header received in the subscribe or 'application/cpim-pidf+xml' if Accept: was not present in the SUBSCRIBE.

The message body in the NOTIFY request that carries the subscriber's registration state is of the following form:

- The registration state is expressed in XML with the information enclosed in the root <presence> element, enclosed between <presence> and </presence> tags.

- The <presence> element consist of one or more <tuple> elements and an optional <timestamp>. It contains a mandatory xmlns attribute that specifies the namespace for this version of the registration-information payload.

- Each <tuple> element carries the registration state of a single public user identity and carries a mandatory 'name' attribute. The <tuple> element carries mandatory <status> element and optional <contact> and <note> elements.

- The <status> element carries a mandatory <value> = open|closed and an optional <detail> element. The <contact> element carries any updated contact information (with priority). The <note> is human-readable for extra details.

NOTE 2: The registration states in 3GPP are mapped as follows to the status values in the presence-package:

- Open (status value) is mapped to Registered (3GPP).
- Closed (status value) is mapped to De-Registered (3GPP).

Editor's Note: further mappings of status values to 3GPP are for future study

- The optional <detail> element carries a mandatory 'type' attribute and an optional schema that is usually a DTD related to the specified 'type'.

6. **NOTIFY request (P-CSCF to UE) - see example in table 6.5-6**

   The P-CSCF forwards the NOTIFY request to the UE.

Table 6.5-6: NOTIFY request (P-CSCF to UE)

```
NOTIFY sip:[5555::aaa:bbb:ccc:ddd] SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1
Max-Forwards: 69
Remote-Party-ID:
From:
To:
Call-ID:
CSeq:
Expires:
Event:
Content-Type:
Content-Length:
```

7. **200 OK response (UE to P-CSCF) – see example in table 6.5-7**

   The UE generates a 200 OK response to the NOTIFY.

Table 6.5-7 200 OK response (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1
From:
To:
Call-ID:
CSeq:Content-Length: 0
```

8. **200 OK response (P-CSCF to S-CSCF) - see example in table 6.5-8**

   P-CSCF forwards the 200 OK to S-CSCF.

Table 6.5-8: 200 OK response (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
From:
To:
Call-ID:
CSeq:
Content-Length:
```

6.6 P-CSCF subscription for the registration state event package (without I-CSCF providing configuration independence)

This section describes the subscription procedure for the network initiated deregistration event, whereby the P-CSCF requests to be notified by the S-CSCF when the event has occurred. This is done using the 'presence' package.

It is assumed that the user has registered prior to initiating subscription of an event. Also, the subscriber is considered to be roaming and the home network operator does not desire to keep its internal configuration hidden from the visited network. For this example the trigger point at the P-CSCF for sending out the SUBSCRIBE request is the 200 OK response of the users registration.

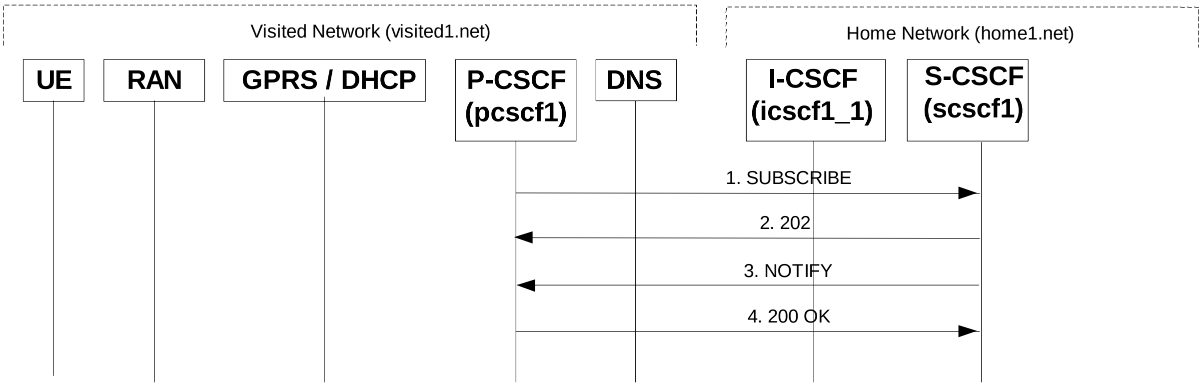


Figure 6.6-1: P-CSCF subscription for the registration state event package (without I-CSCF providing configuration independence)

1. **SUBSCRIBE request (P-CSCF to S-CSCF) - see example in table 6.6-1**

   The P-CSCF sends SUBSCRIBE request for the registration-state event package.

Table 6.6-1: SUBSCRIBE request (P-CSCF to S-CSCF)

```
SUBSCRIBE scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1
Max-Forwards: 70
From: <sip:pcscf1.visited1.net>;tag=31415
To: <sip:user1_public1@home1.net>
Call-ID: 223456789@pcscf1.visited1.net
CSeq: 61 SUBSCRIBE
Event: presence
Expires: 7200
Accept: application/cpim-pidf+xml
Contact: <sip:pcscf1.visited1.net>
Content-Length: 0
```

From: This header is populated with the SIP URI that identifies the P-CSCF.

Contact: This is where the NOTIFY requests for this subscription will be sent. It consists of the SIP URL-escaped public user identity at the P-CSCF.

Event: This field shall be set to the value 'presence' to specify the use of the presence package.

Accept: This field shall be set to the value 'application/cpim-pidf+xml' in keeping with the use of the 'presence' package.

2. **202 Accepted response (S-CSCF to P-CSCF) - see example in table 6.6-2**

The S-CSCF sends an acknowledgement towards the P-CSCF indicating that the subscription was successful. This response will traverse the path that the SUBSCRIBE request took as described in the Via list.

NOTE 1: If the S-CSCF can process the SUBSCRIBE request and send the NOTIFY request immediately, it can send a 200 OK response instead of a 202 Accepted response.

Table 6.6-2: 202 Accepted response (S-CSCF to P-CSCF)

```
SIP/2.0 202 Accepted
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Remote-Party-ID: "Registrar" <sip:registrar.home1.net>
From:
To: <sip:user1_public1@home1.net>;tag=151170
Call-ID:
CSeq:
Event:
Expires:
Content-Length:
```

Expires: If value of the Expires header in SUBSCRIBE request is different from the one received in REGISTER method, then the value of Expires header in 202 Accepted is set to match the value of Expires header in REGISTER method.

3. **NOTIFY request (S-CSCF to P-CSCF) - see example in table 6.6-3**

The S-CSCF sends a first NOTIFY request towards the P-CSCF in order to inform the P-CSCF about the registration status of monitored user.

Table 6.6-3: NOTIFY request (S-CSCF to P-CSCF)

```
NOTIFY sip:pcscf1.visited1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
Max-Forwards: 70
Remote-Party-ID: "Registrar" <sip:user1_public1@registrar.home1.net>
From: <sip:user1_public1@home1.net>;tag=151170
To: <sip:user1_public1@pcscf1.visited1.net>;tag=31415
Call-ID: 223456789@pcscf1.visited1.net
CSeq: 42 NOTIFY
Event: presence
Content-Type: application/cpim-pidf+xml
Content-Length: (...)

<presence xmlns="http://www.ietf.org/ns/cpim-pidf-xml-1.0">

        <tuple name="sip:user1_public1@home1.net">
          <status><value>closed</value></status>
        </tuple>

</presence>
```

From: The tag of this field matches that of the To; field in the received 200/202 for the SUBSCRIBE.

Content-Type: Set to the value of the Accept: header received in the subscribe or 'application/cpim-pidf+xml' if Accept: was not present in the SUBSCRIBE.

The message body in the NOTIFY request that carries the subscriber's registration state is of the following form:

- The registration state is expressed in XML with the information enclosed in the root <presence> element, enclosed between <presence> and </presence> tags.
- The <presence> element consist of one or more <tuple> elements and an optional <timestamp>. It contains a mandatory xmlns attribute that specifies the namespace for this version of the registration-information payload.
- Each <tuple> element carries the registration state of a single public user identity and carries a mandatory 'name' attribute. The <tuple> element carries mandatory <status> element and optional <contact> and <note> elements.

- The <status> element carries a mandatory <value> = open|closed and an optional <detail> element. The <contact> element carries any updated contact information (with priority). The <note> is human-readable for extra details.

NOTE 2: The registration states in 3GPP are mapped as follows to the status values in the presence-package:

- Open (status value) is mapped to Registered (3GPP).
- Closed (status value) is mapped to De-Registered (3GPP).

Editor's Note: further mappings of status values to 3GPP are for future study

- The optional <detail> element carries a mandatory 'type' attribute and an optional schema that is usually a DTD related to the specified 'type'.

4. 200 OK response (P-CSCF to S-CSCF) - see example in table 6.6-4

P-CSCF forwards the 200 OK to S-CSCF.

Table 6.6-4: 200 OK response (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length: 0
```

6.7 Notifying of the network initiated deregistration event

6.7.1 Network Initiated Deregistration event occurs in the S-CSCF

Figure 6.7.1-1 assumes that the UE and the P-CSCF both have subscribed for the Users registration state event package according to subclause 6.5 and shows how the UE and the P-CSCF are notified when the Network Initiated Deregistration event occurs in the S-CSCF.

Also, it is assumed that the home network does not have network configuration hiding active.

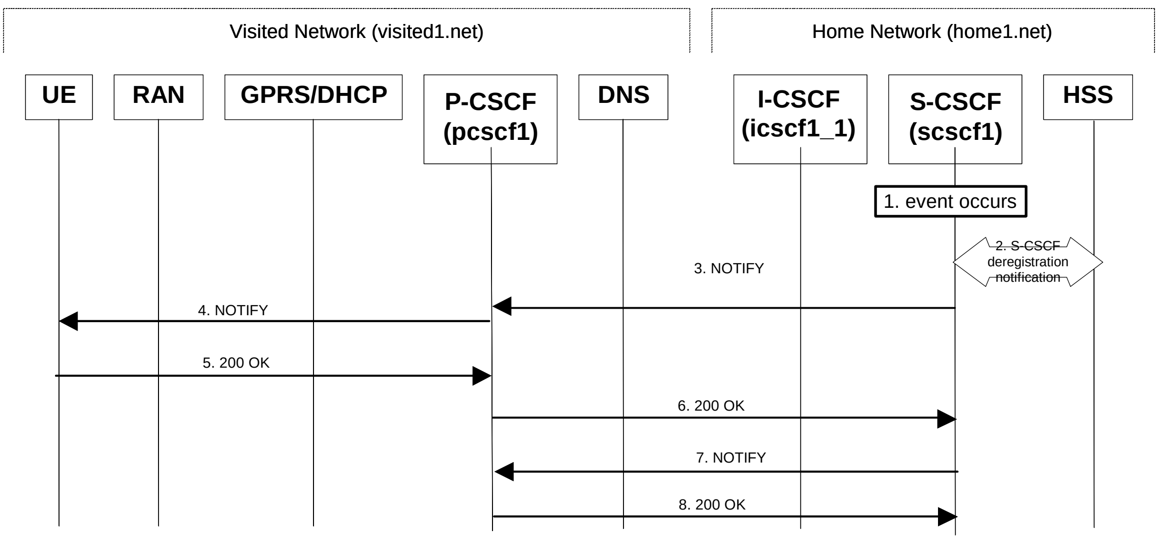


Figure 6.7.1-1: Network Initiated Deregistration event occurs in the S-CSCF

1. **Network Initiated Deregistration event occurs in the S-CSCF**

2. **S-CSCF deregistration notification**

   When the Network Initiated Deregistration Event occurs in the S-CSCF, the S-CSCF sends an update to the HSS to remove itself as the registered S-CSCF for this UE. And HSS sends response to confirm.

   For detailed message flows see 3GPP TS 29.228.

3 **SIP NOTIFY (S-CSCF to P-CSCF) - see example in table 6.7.1-3**

   After the S-CSCF deregistration notification procedure the S-CSCF immediately sends a NOTIFY towards the UE in order to inform about the network initiated deregistration. The same Request URI, To, From, Call-ID are used as in the first NOTIFY. CSeq is incremented since this is the second NOTIFY request sent towards the UE.

Table 6.7.1-3: SIP NOTIFY (S-CSCF to P-CSCF)

```
NOTIFY sip:pcscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
Max-Forwards: 70
Route: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=151170
To: <sip:user1_public1@home1.net>;tag=31415
Call-ID: b89rjhnedlrfjflslj40a222
CSeq: 43 NOTIFY
Expires: 7200
Event:  presence
Content-Type:  application/cpim-pidf+xml
Content-Length: (...)

<presence xmlns="http://www.ietf.org/ns/cpim-pidf-xml-1.0">

        <tuple name="sip:user1_public1@home1.net">
          <status><value>closed</value>
             <detail>
             reason-phrase: "You have been deregistered from the network, please register
again";
             registrar: registrar.home1.net
             </detail>
       </status>
        </tuple>

     <tuple name="sip:user1_public2@home1.net">
          <status> <value>closed</value> </status>
        </tuple>

     <tuple name="tel:+498972233114">
          <status><value>closed</value>
             <detail>
             reason-phrase: "This ID has been automatically de-registered";
             registrar: registrar.home1.net
             </detail>
       </status>
        </tuple>

      </presence>
```

4. **SIP NOTIFY (P-CSCF to UE) - see example in table 6.7.1-4**

   P-CSCF forwards the NOTIFY request to the UE.

Table 6.7.1-4: SIP NOTIFY (P-CSCF to UE)

```
NOTIFY sip:[5555::aaa:bbb:ccc:ddd] SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1
Max-Forwards: 69
From:
To:
Call-ID:
CSeq:
Expires:
Event:
Content-Length:
```

5. **200 OK (UE to P-CSCF) - see example in table 6.7.1-5**

Table 6.7.1-5: SIP 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1
From:
To:
Call-ID:
CSeq:
Content-Length:
```

6. **SIP 200 OK (P-CSCF to S-CSCF) - see example in table 6.7.1-6**

Table 6.7.1-6: SIP 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
From:
To:
Call-ID:
CSeq:
Content-Length:
```

7 **SIP NOTIFY (S-CSCF to P-CSCF) - see example in table 6.7.1-7**

After sending the Cx.Put request the S-CSCF also immediately sends a NOTIFY towards the P-CSCF to which the UE is attached to, in order to inform about the network initiated deregistration. The same Request URI, To, From, Call-ID are used as in the first NOTIFY. CSeq is incremented since this is the second NOTIFY request sent towards the P-CSCF.

Table 6.7.1-7: SIP NOTIFY (S-CSCF to P-CSCF)

```
NOTIFY sip:pcscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
Max-Forwards: 70
From: <sip:user1_public1@home1.net>;tag=151170
To: <sip:pcscf1.visited1.net>;tag=31415
Call-ID: 1234567890@[5555::aaa:bbb:ccc:ddd]
CSeq: 43 NOTIFY
Expires: 7200
Event:  presence
Content-Type:  application/cpim-pidf+xml
Content-Length: (...)

<presence xmlns="http://www.ietf.org/ns/cpim-pidf-xml-1.0">

        <tuple name="sip:user1_public1@home1.net">
          <status><value>closed</value>
             <detail>
             reason-phrase: "This public ID has been de-registered by the network";
             registrar: registrar.home1.net
             </detail>
       </status>
        </tuple>

     <tuple name="sip:user1_public2@home1.net">
          <status> <value>closed</value> </status>
        </tuple>

     <tuple name="tel:+498972233114">
          <status><value>closed</value>
             <detail>
             reason-phrase: "This ID has been automatically de-registered";
             registrar: registrar.home1.net
             </detail>
       </status>
        </tuple>
```

```
    </presence>
```

8. **SIP 200 OK (P-CSCF to S-CSCF) - see example in table 6.7.1-8**

Table 6.7.1-8: SIP 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
From:
To:
Call-ID:
CSeq:
Content-Length:
```

6.7.2 Network Initiated Deregistration event occurs in the HSS

Figure 6.7.2-1 assumes that the UE and the P-CSCF both have subscribed for the Users registration state event package according to subclause 6.5 and shows how the UE and the P-CSCF are notified when the Network Initiated Deregistration event occurs in the HSS.

Also, it is assumed that the home network does not have network configuration hiding active.

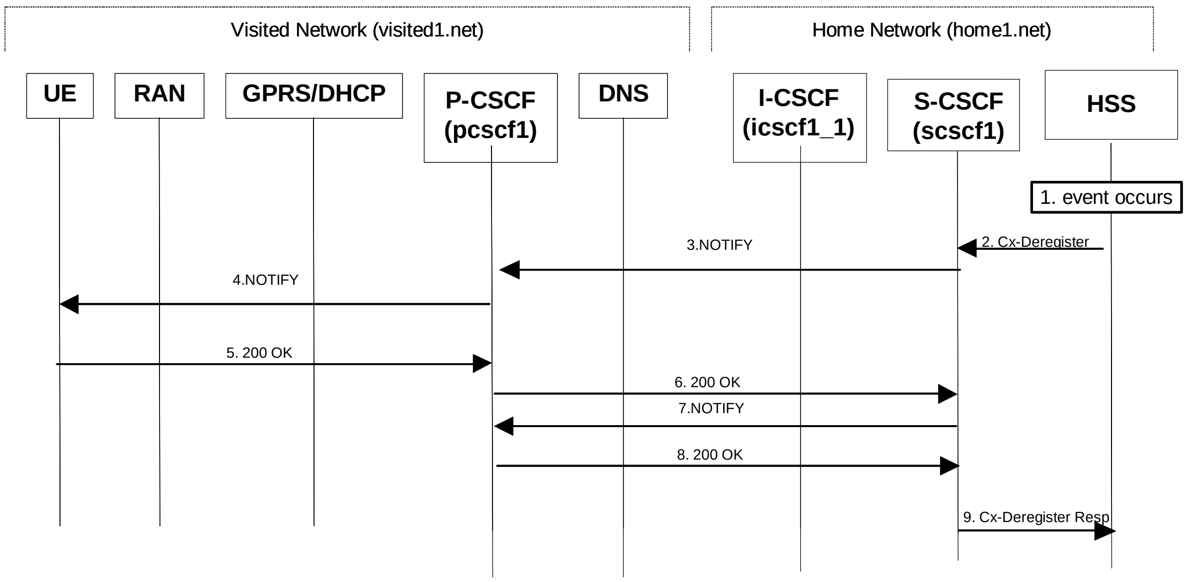


Figure 6.7.2-1: Network Initiated Deregistration event occurs in the HSS

1. **Network Initiated Deregistration event occurs in the HSS**

2. **Cx-Deregister**

   HSS initiates the de-registration, sending a Cx-Deregister (subscriber identity). For detailed message information see 3GPP TS 29.228.

3. **SIP NOTIFY (S-CSCF to P-CSCF) - see example in table 6.7.2-3**

   After getting the Cx-Deregister message the S-CSCF immediately sends a NOTIFY towards the UE order to inform about the network initiated deregistration. The same Request URI, To, From, Call-ID are used as in the first NOTIFY. CSeq is incremented since this is the second NOTIFY request sent towards the UE.

Table 6.7.2-3: SIP NOTIFY (S-CSCF to P-CSCF)

```
NOTIFY sip:pcscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
Max-Forwards: 70
Route: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=151170
To: <sip:user1_public1@home1.net>;tag=31415
Call-ID: b89rjhnedlrfjflslj40a222
CSeq: 43 NOTIFY
Expires: 7200
Event:  presence
Content-Type:  application/cpim-pidf+xml
Content-Length: (...)

<presence xmlns="http://www.ietf.org/ns/cpim-pidf-xml-1.0">

        <tuple name="sip:user1_public1@home1.net">
          <status><value>closed</value>
             <detail>
             reason-phrase: "You have been deregistered from the network, please register
again";
             registrar: registrar.home1.net
             </detail>
       </status>
        </tuple>

     <tuple name="sip:user1_public2@home1.net">
          <status> <value>closed</value> </status>
        </tuple>

     <tuple name="tel:+498972233114">
          <status><value>closed</value>
             <detail>
             reason-phrase: "This ID has been automatically de-registered";
             registrar: registrar.home1.net
             </detail>
       </status>
        </tuple>

      </presence>
```

4. **SIP NOTIFY (P-CSCF to UE) - see example in table 6.7.2-4**

   P-CSCF forwards the NOTIFY response to the UE.

Table 6.7.2-4: SIP NOTIFY (P-CSCF to UE)

```
NOTIFY sip:[5555::aaa:bbb:ccc:ddd] SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1
Max-Forwards: 69
From:
To:
Call-ID:
CSeq:
Expires:
Event:
Content-Length:
```

5. **200 OK (UE to P-CSCF) - see example in table 6.7.2-5**

Table 6.7.2-5: SIP 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1
From:
To:
Call-ID:
CSeq:
Content-Length:
```

6. **SIP 200 OK (P-CSCF to S-CSCF) - see example in table 6.7.2-6**

Table 6.7.2-6: SIP 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
From:
To:
Call-ID:
CSeq:
Content-Length:
```

7 **SIP NOTIFY (S-CSCF to P-CSCF) - see example in table 6.7.2-7**

After receiving the 200 OK from the UE the S-CSCF also immediately sends a NOTIFY towards the P-CSCF to which the UE is attached to, in order to inform about the network initiated deregistration. The same Request URI, To, From, Call-ID are used as in the first NOTIFY. CSeq is incremented since this is the second NOTIFY request sent towards the P-CSCF.

Table 6.7.2-7: SIP NOTIFY (S-CSCF to P-CSCF)

```
NOTIFY sip:pcscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
Max-Forwards: 70
From: <sip:user1_public1@home1.net>;tag=151170
To: <sip:pcscf1.visited1.net>;tag=31415
Call-ID: 1234567890@[5555::aaa:bbb:ccc:ddd]
CSeq: 43 NOTIFY
Expires: 7200
Event:  presence
Content-Type:  application/cpim-pidf+xml
Content-Length: (...)

<presence xmlns="http://www.ietf.org/ns/cpim-pidf-xml-1.0">

        <tuple name="sip:user1_public1@home1.net">
          <status><value>closed</value>
             <detail>
             reason-phrase: "This public ID has been de-registered by the network";
             registrar: registrar.home1.net
             </detail>
       </status>
        </tuple>

     <tuple name="sip:user1_public2@home1.net">
          <status> <value>closed</value> </status>
        </tuple>

     <tuple name="tel:+498972233114">
          <status><value>closed</value>
             <detail>
             reason-phrase: "This ID has been automatically de-registered";
             registrar: registrar.home1.net
             </detail>
       </status>
        </tuple>

      </presence>
```

8. **SIP 200 OK (P-CSCF to S-CSCF) - see example in table 6.7.2-8**

Table 6.7.2-8 SIP 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
From:
To:
Call-ID:
CSeq:
Content-Length:
```

9. **Cx-Deregister Resp**

After receiving the 200 OK from the P-CSCF, the S-CSCF sends Cx-Deregister Resp to the HSS. For detailed message information see 3GPP TS 29.228.

6.7.3 Network Initiated De-Registration Upon UE Roaming and Registration to a New Network. Assumes that the previous registration has not expired

This shows the registration signalling flow for the scenario that the UE loses the GPRS attachment in current visited access network and roams to makes a new GPRS attachment in a new visited access network without de-registration from its previous network the IMS. The GGSN and P-CSCF are assumed to be in the visited network. When the UE starts registration in via the new visited access network and P-CSCF, the home S-CSCF in the home IMS network initiates the de-registration to its the P-CSCF in the previous visited IMS network. It is assumed that the old P-CSCF has subscribed the event package to the S-CSCF and the subscription has not expired. For the reason of simplicity, the authentication procedure is not shown because it has no technical impact on this flow.

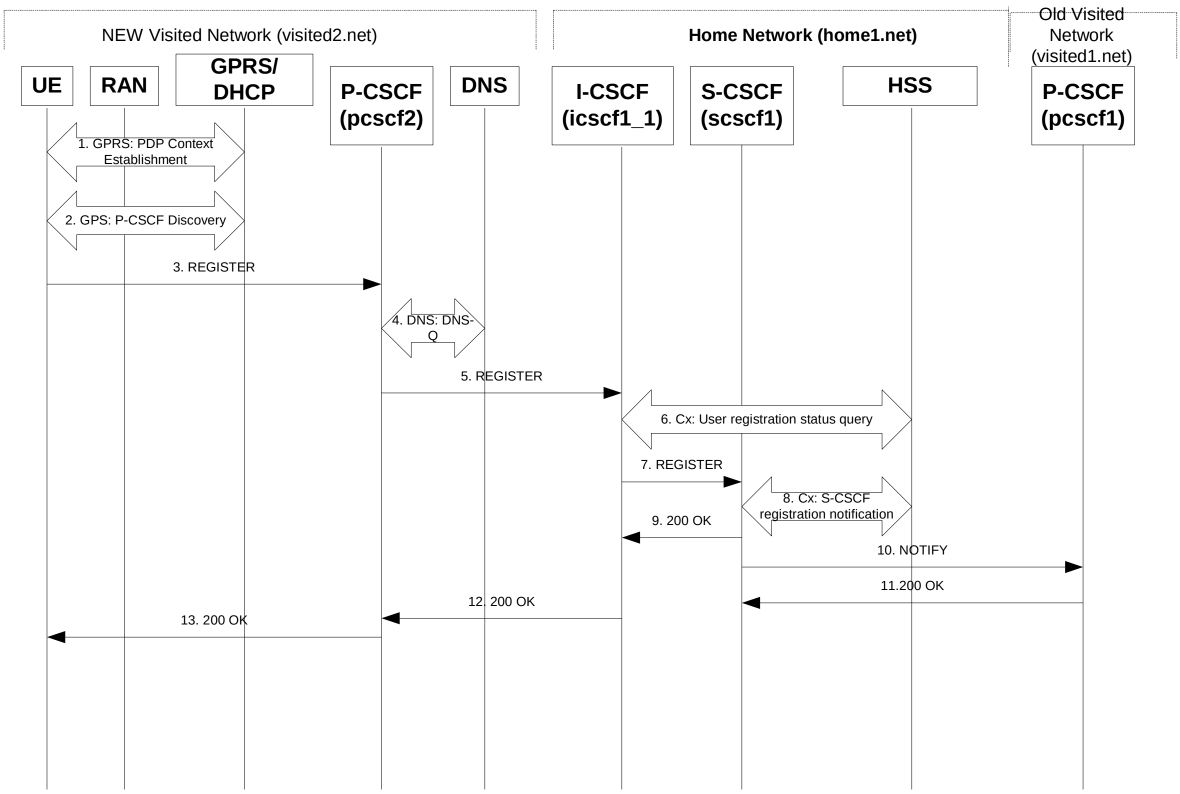


Figure 6.7.3-1: Network Initiated De-registration upon UE roaming without De-registration

Flows from 1 to 5 are the same as those in subclause 6.2.

6. **Cx: User Registration Status Query**

The I-CSCF shall send the Cx-Query signalling flow to the HSS (Visited Network Identifier, subscriber identity, home domain name,). Because user has not de-registered with its previous network, so that HSS finds a S-CSCF assigned for that user and treats this as a re-registration procedure. Therefore, the HSS returns the S-CSCF name to the I-CSCF.For detailed message flows see 3GPP TS 29.228.

For the parameters in the REGISTER request (flow 5) which need to be sent to HSS, see table 6.2-5a.

Table 6.3-15a provides the parameters in the REGISTER (flow 7) message which are obtained from the information sent back from the HSS.

7. **REGISTER (I-CSCF to S-CSCF)**

   The I-CSCF forwards the REGISTER to S-CSCF assigned to that user.

8. **Cx-S-CSCF Registration Notification**

   The S-CSCF shall notify the HSS to update its location information for that subscriber. The HSS sends a response to the S-CSCF to acknowledge the update of location information and also with the user profile.

10. **NOTIFY (S-CSCF to Old P-CSCF) - see example in table 6.7.3-10**

   Upon receiving flow 7, the S-CSCF found that the P-CSCF address in that message is different with the one in its database, so that the S-CSCF knows that the UE has left its previous P-CSCF without de-register itself. And the old P-CSCF has subscribed with the registration event package for that user, therefore, the S-CSCF sends a NOTIFY to that P-CSCF.

Table 6.7.3-10: SIP NOTIFY (S-CSCF to Old P-CSCF)

```
NOTIFY sip:pcscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
Max-Forwards: 70
From: <sip:user1_public1@home1.net>;tag=151170
To: <sip:pcscf1.visited1.net>;tag=31415
Call-ID: 1234567890@[5555::aaa:bbb:ccc:ddd]
CSeq: 43 NOTIFY
Expires: 7200
Event:  presence
Content-Type:  application/cpim-pidf+xml
Content-Length: (...)

<presence xmlns="http://www.ietf.org/ns/cpim-pidf-xml-1.0">

        <tuple name="sip:user1_public1@home1.net">
          <status><value>closed</value>
             <detail>
             reason-phrase: "This public ID has been de-registered by the network";
             registrar: registrar.home1.net
             </detail>
       </status>
        </tuple>

     <tuple name="sip:user1_public2@home1.net">
          <status> <value>closed</value> </status>
        </tuple>

     <tuple name="tel:+498972233114">
          <status><value>closed</value>
             <detail>
             reason-phrase: "This ID has been automatically de-registered";
             registrar: registrar.home1.net
             </detail>
       </status>
        </tuple>

       </presence>
```

11. **SIP 200 OK (Old P-CSCF to S-CSCF) - see example in table 6.7.3-11**

   Upon receiving the NOTIFY, the P-CSCF discards any information binding with that user.

Table 6.7.3-11: SIP 200 OK (Old P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
From:
To:
Call-ID:
CSeq:
Content-Length:
```

6.8 Network initiated re-authentication

This subclause describes the notification of a user about the re-authentication event that occurs at the S-CSCF assigned to that user.

It is assumed that user has registered and also subscribed to the registration state event before. Also, the subscriber is considered to be roaming and the home network operator does not desire to keep its internal configuration hidden from the visited network.

After this procedure the users UE might automatically initiated re-registration procedures.

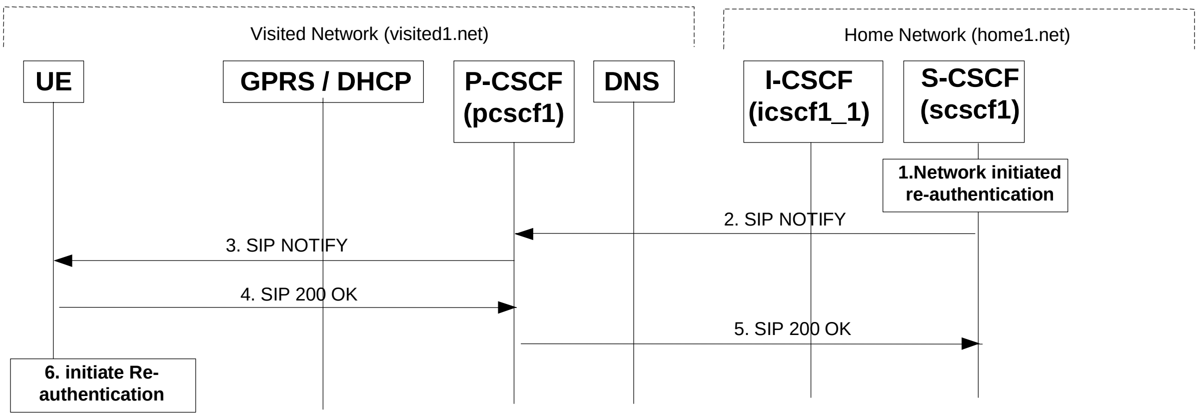


Figure 6.8-1: S-CSCF informs UE about network initiated re-authentication event (without I-CSCF providing configuration independence)

1. **Network initiated re-authentication (S-CSCF)**

   The network initiated re-authentication event for the private user identity of the user occurs at the S-CSCF. As the user has subscribed to the registration state event package this is the trigger point for the S-CSCF to notify the user about the event occurrence.

2. **SIP NOTIFY request (S-CSCF to P-CSCF) - see example in table 6.8-2**

   The S-CSCF sends a NOTIFY request towards the UE in order to inform the UE about the occurrence of the network initiated re-authentication event.

   The Route header is constructed from the information saved at registration.

Table 6.8-2: SIP NOTIFY request (S-CSCF to P-CSCF)

```
NOTIFY sip:pcscf1.visited1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
Max-Forwards: 70
Route: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Remote-Party-ID:
From: <sip:user1_public1@home1.net>;tag=31415
To: <sip:user1_public1@home1.net>;tag=151170
Call-ID:
CSeq: 43 NOTIFY
Expires:
Event:  presence
Content-Type:  application/cpim-pidf+xml
Content-Length: (...)

<presence xmlns="http://www.ietf.org/ns/cpim-pidf-xml-1.0">

        <tuple name="sip:user1_public1@home1.net">
          <status><value>re-authenticate</value></status>
        </tuple>
      </presence>
```

From: The tag of this field matches that of the To; field in the received 200/202 for the SUBSCRIBE.

Content-Type: Set to the value of the Accept: header received in the subscribe or 'application/cpim-pidf+xml' if Accept: was not present in the SUBSCRIBE.

The message body in NOTIFY that carries the subscriber's registration state is of the following form:

- The registration state is expressed in XML with the information enclosed in the root <presence> element, enclosed between <presence> and </presence> tags.
- The <presence> element consist of only one <tuple> element and an optional <timestamp>. It contains a mandatory xmlns attribute that specifies the namespace for this version of the registration-information payload..
- The <tuple> element carries the registration state the public user identity and carries a mandatory 'name' attribute. The <tuple> element carries mandatory <status> element and optional <contact> and <note> elements.
- The <status> element carries the <value> = re-authenticate and an optional <detail> element. The <contact> element carries any updated contact information (with priority). The <note> is human-readable for extra details.
- The optional <detail> element carries a mandatory 'type' attribute and an optional schema that is usually a DTD related to the specified 'type'

3. **SIP NOTIFY request (P-CSCF to UE) - see example in table 6.8-3**

   P-CSCF forwards the NOTIFY message to UE.

Table 6.8-3: SIP NOTIFY request (P-CSCF to UE)

```
NOTIFY sip:[5555::aaa:bbb:ccc:ddd] SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1
Max-Forwards: 69
Remote-Party-ID:
From:
To:
Call-ID:
CSeq:
Expires:
Event:
Content-Type:
Content-Length:
```

4. **SIP 200 OK response (UE to P-CSCF) - see example in table 6.8-4**

   The UE generates a 200 OK response to the NOTIFY.

Table 6.8-4: SIP 200 OK response (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1
From:
To:
Call-ID:
CSeq:Content-Length: 0
```

5. **SIP 200 OK response (P-CSCF to S-CSCF) - see example in table 6.8-5**

   P-CSCF forwards the 200 OK to S-CSCF.

Table 6.8-5: SIP 200 OK response (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
From:
To:
Call-ID:
CSeq:
Content-Length:
```

6. **Re-authentication (UE)**

   The UE shall now initiate re-authentication procedures.

6.9 Registration error conditions

6.9.1 Reregistration - failure of reregistration

See subclause 16.9.1.

6.9.2 User not registered, user not allowed to roam / user unknown

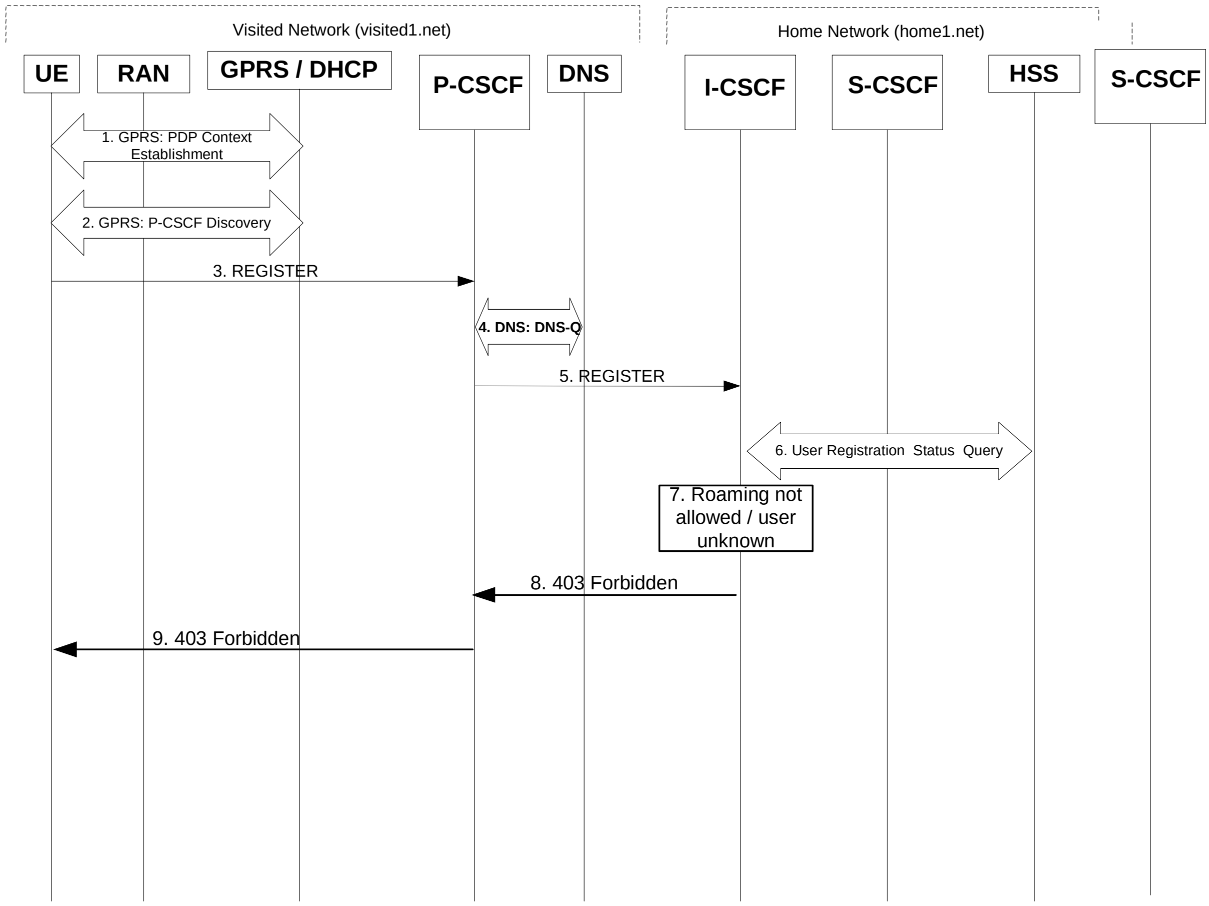


Figure 6.9.2-1: Registration failure: User not registered, user not allowed to roam

The first six steps are similar with the regular Registration signalling flows described in subclause 16.2.

The "Roaming not allowed" and "User unknown" error conditions would result in the same signalling flow (only the actions taken by I-CSCF will differ), thus the signalling flows are merged and only the I-CSCF action is described depending on the error condition.

7. **Roaming not allowed / User unknown**

   The information received as a response to the Cx-Query may indicate that "Roaming is not allowed" for the subscriber from the visited1.net network. In this case I-CSCF needs to send a 403 Forbidden response back to the UE. I-CSCF will insert a warning header in the response, indicating to the UE the reason of refusing the Registration request. Warning header should contain the name of the network inserting the warning header (warn-agent = icscf1.home1.net) and optionally a warn-text. In case the network operator would like to advise the subscriber to attach instead to the CS domain then the warn-code 312 should be inserted in the warning header.

   When the information received as a response to the Cx-Query indicates that the subscriber is unknown to the network or the subscriber does not have a valid subscription, the I-CSCF needs to send a 403 Forbidden response back to the UE. I-CSCF will insert a warning header in the response, indicating to the UE the reason of refusing the Registration request. Warning header should contain the name of the network inserting the warning header (warn-agent = icscf1.home1.net) and optionally a warn-text.

8. **403 Forbidden (I-CSCF to P-CSCF) - see example in table 6.9.2-8**

Table 6.9.2-8: 403 Forbidden (I-CSCF to P-CSCF)

```
SIP/2.0 403 Forbidden
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Warning: 312 home1.net "Roaming not allowed from this network"
From:
To:
Call-ID:
Cseq:
Content-Length:
```

9. **403 Forbidden (P-CSCF to UE) - see example in table 6.9.2-9**

Table 6.9.2-9: 403 Forbidden (P-CSCF to UE)

```
SIP/2.0 403 Forbidden
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Warning: 312 home1.net "Roaming not allowed from this network"
From:
To:
Call-ID:
Cseq:
Content-Length:
```

6.9.3 Registration failure – user authentication failure

This clause (see figure 6.9.3-1) shows the signalling flow with user authentication failure at step 19 of subclause 6.2 "Signalling flows for REGISTER" and a final failure of the authentication at step 30.

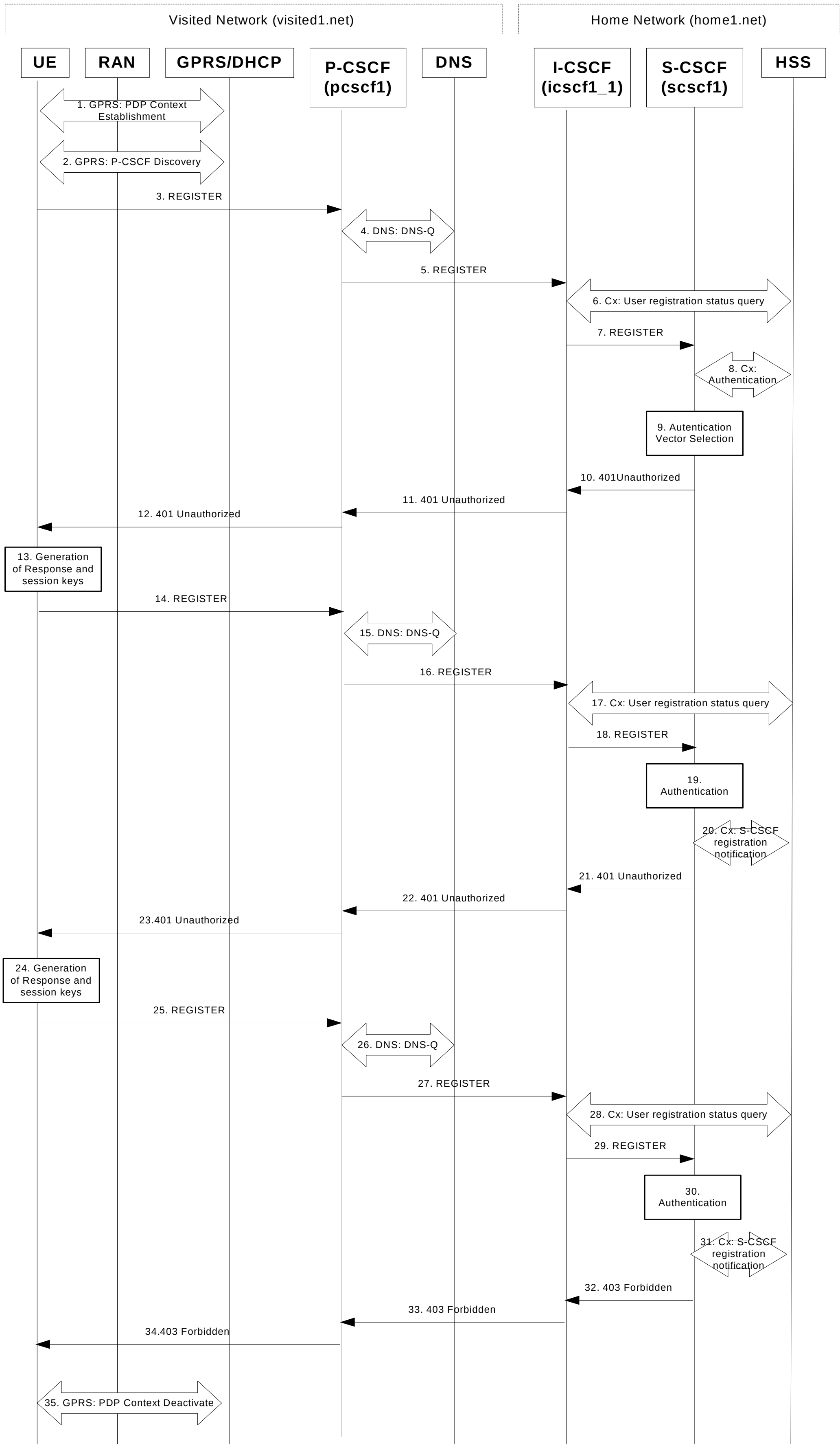


Figure 6.9.3-1: User Authentication Failure

Steps 1 through 18 are the same as the signalling flow in subclause 6.2.

19. **Authentication: User authentication fails**

Upon receiving the REGISTER request carrying the authentication response, RES, the S-CSCF checks that the user's active, XRES matches the received RES. If the check is unsuccessful then this authentication challenge fails and the public user identity is not yet registered in the S-CSCF.

At this point the S-CSCF has the option of repeating a number of authentication challenges as given in step 19 through 29. For the purposes of this flow, only one repetition is shown.

20. **Cx. SCGF registration notification**

The S-CSCF selects new authentication vectors as specified in step 9, either from the list already within the S-CSCF, or by requesting new vectors from the HSS.

21. **401 Unauthorized response (S-CSCF to I-CSCF) - see example in table 6.9.3-21**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.9.3-21: 401 Unauthorized response (S-CSCF to I-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Call-ID: apb03a0s09dkjdfglkj49111
WWW-Authenticate: eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)
CSeq: 2 REGISTER
Content-Length: 0
```

NOTE: The actual WWW-Authenticate header value may look like this as it is in base64 form: WWW-Authenticate: eap eap-p=QWxh4ZGRpb2jpvcGVuNlctZQ==

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

22. **401 Unauthorized response(I-CSCF to P-CSCF) - see example in table 6.9.3-22**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.9.3-22: 401 Unauthorized response (I-CSCF to P-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate:
CSeq:
Content-Length:
```

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

23. **401 Unauthorized response (P-CSCF to UE) - see example in table 6.9.3-23**

The P-CSCF removes any keys received in the 401 Unauthorized response and forwards the rest of the response to the UE.

Table 6.9.3-23: 401 Unauthorized response (P-CSCF to UE)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate: eap eap-p=base64(user1_private1.home1.net, RAND, AUTN)
CSeq:
Content-Length:
```

24. **Generation of response and session keys at UE**

Upon receiving the Unauthorised response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in the REGISTER request.

25. **REGISTER request (UE to P-CSCF) - see example in table 6.9.3-25**

Table 6.9.3-25: REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49112
Authorization: eap eap-p=base64(user1_private1@home1.net, RES)
CSeq: 3 REGISTER
Expires: 7200
Content-Length: 0
```

Authorization: This carries the response to the authentication challenge received in step 12 along with the private user identity both encoded in base64 format.

26. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify the transport protocol the, P-CSCF selects the UDP.

Table 6.9.3-26a: DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 6.9.3-26b: DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net        0 IN SRV 1 10 5060 icscf1_p.home1.net
                                        0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                  0 IN AAAA     5555::aba:dab:aaa:daa
```

```
icscf7_p.home1.net                 0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

27. **REGISTER request (P-CSCF to I-CSCF) - see example in table 6.9.3-27**

This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.

Table 6.9.3-27: REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

28. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF required capabilities and the I-CSCF uses this information to select a suitable S-CSCF.

For detailed message flows see 3GPP TS 29.228.

Table 6.9.3-28a provides the parameters in the REGISTER request (flow 5) which need to be sent to HSS.

Table 6.9.3-28a Cx: User registration status query procedure (I-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
I-CSCF to HSS	Private User Identity	Authorization:	The Private User Identity is encoded according to the Authorization protocol.
	Public User Identity	To:	Identity which is used to communicate with other users
	Visited Network Identifier	Roaming-Info: vnid	This information indicates the network identifier of the visited network

29. **REGISTER request (I-CSCF to S-CSCF) - see example in table 6.9.3-29**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 6.9.3-29: REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

30. **Authentication**

Upon receiving the REGISTER request carrying the authentication response, RES, the S-CSCF checks that the user's active, XRES matches the received RES. If the check is unsuccessful, and no more authentication challenges are to be made, then the authentication has failed and the public user identity is not registered in the S-CSCF.

31. Cx: S-CSCF registration notification procedure

Upon user authentication failure the S-CSCF informs the HSS that the user has not been registered at this instance. The HSS clears the S-CSCF name for that subscriber.

For detailed message flows see 3GPP TS 29.229.

Table 6.9.3-31 provides the parameters in the REGISTER request (flow 18) which need to be sent to HSS.

Table 6.9.3-31 Cx: S-CSCF registration notification procedure (S-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
S-CSCF to HSS	Public User Identify	To:	Identity which is used to communicate with other users
	Private User Identity	Authorization:	The Private User Identity is encoded according to the Authorization protocol. Unique identity in IMS which is used by network to authenticate this user
	S-CSCF name	Request-URI:	This information indicates the serving CSCF's name of that user

32. **403 Forbidden response (S-CSCF to I-CSCF) - see example in table 6.9.3-32**

The S-CSCF sends an 403 Forbidden response to the I-CSCF indicating that authentication failed. No security parameters are included in this message.

Table 6.9.3-32: 403 Forbidden (S-CSCF to I-CSCF)

```
SIP/2.0 403 Forbidden
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Call-ID: apb03a0s09dkjdfglkj49111
CSeq: 3 REGISTER
Content-Length: 0
```

33. **403 Forbidden response (I-CSCF to P-CSCF) - see example in table 6.9.3-33**

    The I-CSCF forwards the 403 Forbidden response from the S-CSCF to the P-CSCF indicating that authentication was unsuccessful.

Table 6.9.3-33: 403 Forbidden response (I-CSCF to P-CSCF)

```
SIP/2.0 403 Forbidden
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

34. **403 Forbidden response (P-CSCF to UE) - see example in table 6.9.3-33**

    The P-CSCF forwards the 403 Forbidden response to the UE.

Table 6.9.3-34: 403 Forbidden response (P-CSCF to UE)

```
SIP/2.0 403 Forbidden
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

35. **PDP Context Deactivate**

    On receiving the 403 Forbidden response the UE ceases registration and authentication attempts. In this case, if the PDP context on which the SIP signalling was being conducted is not being used for other purposes, the UE deactivates the signalling PDP context.

NEXT MODIFICATION

16 Signalling flows for REGISTER (hiding)

16.1 Introduction

See subclause 6.1.

16.2 Registration signalling: user not registered

Figure 16.2-1 shows the registration signalling flow for the scenario when the user is not registered. For the purpose of this signalling flow, the subscriber is considered to be roaming. This flow also shows the authentication of the private user identity. In this signalling flow, the home network has network configuration hiding active.

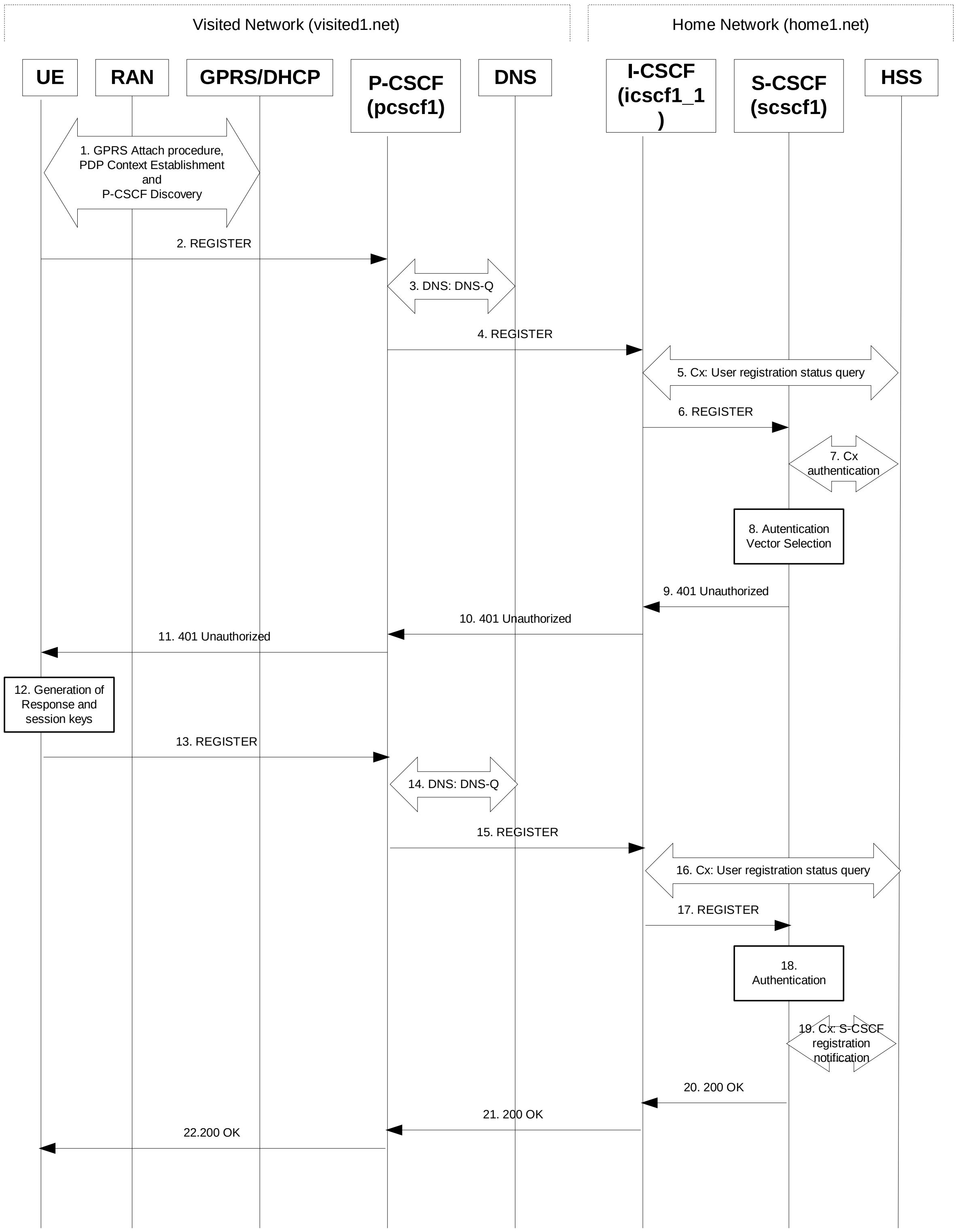


Figure 16.2-1: Registration when UE roaming

1. **GPRS Attach / PDP Context Establishment and P-CSCF Discovery (UE to GPRS)**

   This signalling flow is shown to indicate prerequisites for the registration signalling.

See subclause 5.2 for details.

2. **REGISTER request (UE to P-CSCF) – see example in table 16.2-2**

The purpose of this request is to register the user's SIP URI with a S-CSCF in the home network. This request is routed to the P-CSCF because it is the only SIP server known to the UE. In the following SIP request, the Contact field contains the user's host address.

The P-CSCF will perform two actions, binding and forwarding. The binding is between the User's SIP address (user1_public1@home1.net) and the host (terminal) address ([5555::aaa:bbb:ccc:ddd]) which was acquired during PDP context activation process.

Editor's note: The security mode set-up procedure supports the negotiation of different protection mechanisms. This will involve the addition of a "security-setup" field to the SIP REGISTER request and the REGISTER response performing the authentication challenge containing the parameters:

list of Authentication (integrity} algorithms, and optionally list of encryption (confidentiality) algorithms

SA-ID that is used to uniquely identify the SA at the receiving side.

Key length: the length of encryption and authentication (integrity) keys is 128 bits.

The exact format and use for the security mode setup is being worked through IETF and is FFS

Table 16.2-2 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: eap eap-p=base64(user1_private1@home1.net)
CSeq: 1 REGISTER
Expires: 7200
Content-Length: 0
```

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Via: IPv6 PDP address of the SIP session allocated during the PDP Context Activation process.

Max-Forwards**:** Set to 70 by the UE and used to prevent loops.

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates the public user identity being registered. This is the identity by which other parties know this subscriber. It may be obtained from the USIM.

Contact: This indicates the point-of-presence for the subscriber – the IP address of the UE. This is the temporary point of contact for the subscriber that is being registered. Subsequent requests destined for this subscriber will be sent to this address. This information is stored in the P-CSCF and S-CSCF.

Editor's note: It is for further study whether this information is stored in the HSS and the S-CSCF for the subscriber in order to support multiple registrations.

Authorization: It carries authentication information. The private user identity (user1_private1@home1.net) is carried in the user ID field of the extensible authentication protocol (EAP).

Upon receiving this request the P-CSCF will set it's SIP registration timer for this UE to the Expires time in this request.

3. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify the transport protocol the, P-CSCF selects the UDP.

Table 16.2-3a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=_sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 16.2-3b DNS: DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=_sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net           0 IN SRV 1 10 5060 icscf1_p.home1.com
                                        0 IN SRV 1  0 5060 icscf7_p.home1.com

icscf1_p.home1.net                      0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                      0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

4. **REGISTER request (P-CSCF to I-CSCF) – see example in table 16.2-4**

The P-CSCF needs to be in the path for all mobile originated and mobile terminated requests for this user. To ensure this, the P-CSCF adds itself to the path for future requests.

The P-CSCF binds the public user identity under registration to the Contact header supplied by the user.

The P-CSCF adds also the Roaming-Info header (if not present). The P-CSCF adds the *vnid* parameter with the contents of the identifier of the P-CSCF network. This may be the visited network domain name or any other identifier that identifies the visited network at the home network.

This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 16.2-4 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

Require:/Proxy-Require: These headers are included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating "path". Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

5. **Cx: User registration status query procedure**

   The I-CSCF makes a request for information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF required capabilities and the I-CSCF uses this information to select a suitable S-CSCF.

   For detailed message flows see 3GPP TS 29.228.

   Table 6.2-5a provides the parameters in the REGISTER request (flow 4) which need to been sent to HSS.

6. **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.2-6**

   I-CSCF adds a proper I-CSCF name to the Path header.

   This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected. The Request-URI is changed to the address of the S-CSCF.

Table 16.2-6 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
        pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Path: <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

Upon receiving this request the S-CSCF will set it's SIP registration timer for this UE to the Expires time in this request.

7. **Cx: S-CSCF authentication procedure**

   On receiving a REGISTER request from an unauthenticated user, the S-CSCF requires at least one authentication vector to be used in the challenge to the user. If a valid AV is not available, then the S-CSCF requests at least one AV from the HSS.

   For detailed message flows see 3GPP TS 29.228.

   Table 6.2-7a provides the parameters in the REGISTER request (flow 6) which need to been sent to HSS.

8. **Authentication vector selection**

   The S-CSCF selects an authentication vector for use in the authentication challenge. For detailed description of the authentication vector, see 3GPP TS 33.203.

NOTE 1: The authentication vector may be of the form 3GPP TS 33.203 (if IMS AKA is the selected authentication scheme):

$AV = RAND_n||AUTN_n||XRES_n||CK_n||IK_n$ where:

- RAND: random number used to generate the XRES, CK, IK, and part of the AUTN. It is also used to generate the RES at the UE.
- AUTN: Authentication token (including MAC and SQN).
- XRES: Expected (correct) result from the UE.
- CK: Cipher key (optional).
- IK: Integrity key.

9. **401 Unauthorized response (S-CSCF to I-CSCF) – see example in table 16.2-9**

   The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 16.2-9: 401 Unauthorized response (S-CSCF to I-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To: <sip:user1_public1@home1.net>; tag=5ef4
Call-ID:
WWW-Authenticate: eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)
CSeq:
Content-Length:
```

NOTE 2: The actual WWW-Authenticate header value may look like this as it is in base64 form:

- WWW-Authenticate: eap eap-p=QWxh4ZGRpb2jpvcGVuNlctZQ==

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

10. **401 Unauthorized response (I-CSCF to P-CSCF) – see example in table 16.2-10**

    The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 16.2-10: 401 Unauthorized response (I-CSCF to P-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
```

```
WWW-Authenticate:
CSeq:
Content-Length:
```

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

11. **401 Unauthorized response (P-CSCF to UE) – see example in table 16.2-11**

The P-CSCF removes any keys received in the 401 Unauthorized response and forwards the rest of the response to the UE.

Table 16.2-11: 401 Unauthorized response (P-CSCF to UE)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate:
CSeq:
Content-Length:
```

12. **Generation of response and session keys at UE**

Upon receiving the Unauthorized response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in the REGISTER request.

13. **REGISTER request (UE to P-CSCF) – see example in table 16.2-13**

Table 16.2-13 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49112
Authorization: eap eap-p=base64(user1_private1@home1.net, RES)
CSeq: 2 REGISTER
Expires: 7200
Content-Length: 0
```

Authorization: This carries the response to the authentication challenge received in step 11 along with the private user identity both encoded in base64 format.

14. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify the transport protocol the, P-CSCF selects the UDP.

Table 16.2-14a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 16.2-14b DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net           0 IN SRV 1 10 5060 icscf1_p.home1.net
                                        0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                 0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                 0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

15. **REGISTER request (P-CSCF to I-CSCF) – see example in table 16.2-15**

This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.

Table 16.2-15 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

16. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF required capabilities and the I-CSCF uses this information to select a suitable S-CSCF.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-16a provides the parameters in the REGISTER request (flow 15) which need to been sent to HSS.

17. **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.2-17**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 16.2-17 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Path: <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

18. **Authentication**

Upon receiving the REGISTER request, carrying the authentication response, RES, the S-CSCF checks that the user's active XRES matches the received RES. If the check is successful then the user has been authenticated and the public user identity is registered in the S-CSCF.

19. **Cx: S-CSCF registration notification procedure**

On registering a user the S-CSCF informs the HSS that the user has been registered at this instance. The HSS stores the S-CSCF name for that subscriber. For a positive response, the HSS will include the user profile in the response sent to the S-CSCF.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-19a provides the parameters in the SIP REGISTER request (flow 17) which need to been sent to HSS.

20. **200 OK response (S-CSCF to I-CSCF) – see example in table 16.2-20**

The S-CSCF sends acknowledgement to the I-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.2-20 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net>, <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact: sip:[5555::aaa:bbb:ccc:ddd]
CSeq:
Date: Wed, 11 July 2001 08:49:37 GMT
Expires: 7200
Content-Length:
```

Path: The S-CSCF inserts its own name to the front of the list.

21. **200 OK response (I-CSCF to P-CSCF) – see example in table 16.2-21**

The I-CSCF translates the S-CSCF name in the Path header. The I-CSCF forwards acknowledgement from the S-CSCF to the P-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.2-21 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:token(scscf1.home1.net)>, <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

22. **200 OK response (P-CSCF to UE) – see example in table 16.2-22**

The P-CSCF removes its address from the Path header, reverses the order of the fields, saves the resulting Path header and associates it with the UE. The P-CSCF then removes the Path header from the 200 OK response. The P-CSCF then forwards acknowledgement from the I-CSCF to the UE indicating that Registration was successful.

Table 16.2-22 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

16.3 Registration signalling: reregistration – user currently registered

For the purpose of the reregistration signalling flow shown in figure 16.3-1, the subscriber is considered to be roaming. This flow also shows the authentication of the private user identity. In this signalling flow, the home network has network configuration hiding active.

This signalling flow assumes:

1. That the same PDP Context allocated during the initial registration scenario is still used for reregistration. For the case when the UE does not still have an active PDP context then PDP context procedures from subclause 16.2 is completed first.

Editor's Note: If the same PDP-Context is not available, is it guaranteed that the UE will get back the same IP address at this point? If this is not possible, would there be a problem with the binding in the P-CSCF (user_public1@home1.net and [5555::aaa:bbb:ccc:ddd])?2. The DHCP procedure employed for P-CSCF discovery is not needed.

2. The S-CSCF selection procedure invoked by the I-CSCF is not needed.

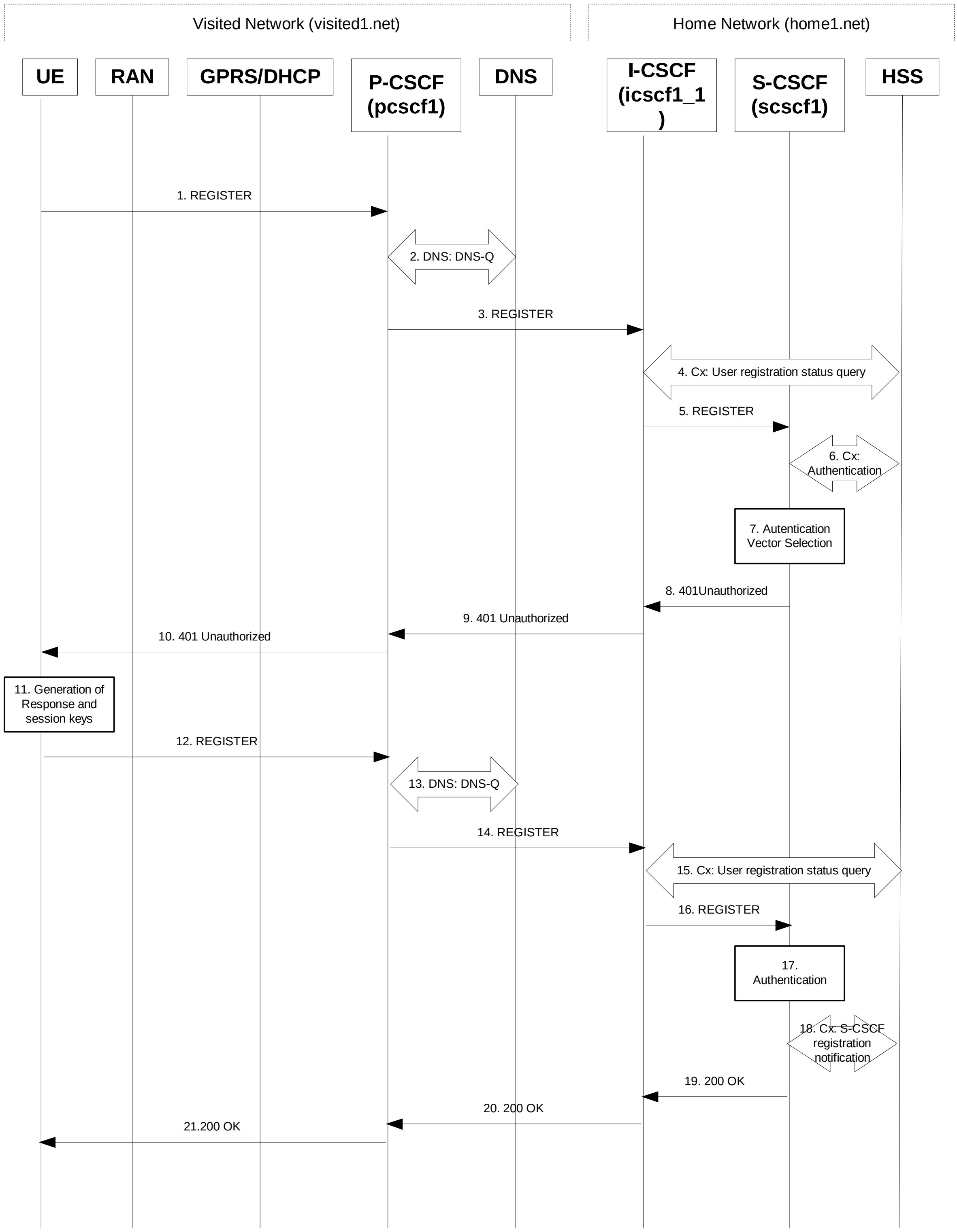


Figure 16.3-1: Reregistration when UE roaming

1. **REGISTER request (UE to P-CSCF) – see example in table 16.3-1**

   The registration expires in the UE. The UE reregisters by sending a new REGISTER request. This request is sent to the same P-CSCF with which the UE initially registered. The P-CSCF maintains the same binding between the User's SIP public address (user1_public1@home1.net) and the host (terminal) address ([5555::aaa:bbb:ccc:ddd]) which it established during the original registration.

Table 16.3-1 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: eap eap-p=base64(user1_private1@home1.net)
CSeq: 3 REGISTER
Expires: 7200
Content-Length: 0
```

The header field usage is the same as for the initial registration scenario:

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates public user identity being registered. This is the identity by which other parties know this subscriber.

Contact: This indicates the point-of-presence for the subscriber – the IP address of the UE. This is the temporary identifier for the subscriber that is being registered. Subsequent requests destined for this subscriber will be sent to this address. This information is stored in the P-CSCF.

Editor's note: It is for further study whether this information is stored in the HSS and the S-CSCF for the subscriber in order to support multiple registrations.

Authorization: It carries authentication information. The private user identity (user1_private1@home1.net) is carried in the user ID field of the extensible authentication protocol (EAP).

NOTE 1: The actual Authorization header value may look like this as it is in base64 form:

- Authorization: eap eap-p=QWxhZGRpbjpvcGVuIHNlc2FtZQ==

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Upon receiving this request the P-CSCF will detect that it already has a registration record for this UE and will reset it's SIP registration timer for this UE to the Expires time in this request.

2. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI. The DNS provides the P-CSCF with an address of the I-CSCF in the home network. The P-CSCF must not use the I-CSCF address cached as a result of the previous registration.

3. **REGISTER request (P-CSCF to I-CSCF) – see example in table 16.3-3**

This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 16.3-3 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:Call-ID:
Authorization: eap eap-p=base64(user1_private1@home1.net)
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

Require:/Proxy-Require: These headers are included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating "path". Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

4. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. Because the user has registered, the HSS returns the I-CSCF with the S-CSCF address for the subscriber

For detailed message flows see 3GPP TS 29.228.

For the parameters in the REGISTER request (flow 3), which are sent to the HSS, see table 6.2-5a.

Table 6.3-4a provides the parameters in the SIP REGISTER request (flow 5), which are obtained from the information sent back from the HSS.

5. **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.3-5**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected. The Request-URI is changed to the address of the S-CSCF.

I-CSCF adds a proper I-CSCF name to the Path header.

Table 16.3-5 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Path: <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Authorization: eap eap-p=base64(user1_private1@home1.net)
Call-ID:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

Upon receiving this request the S-CSCF will detect that it already has a registration record for this UE and will reset it's SIP registration timer for this UE to the Expires time in this request.

6. **Cx: Authentication procedure**

On receiving a REGISTER request from a registered user, the S-CSCF requires at least one authentication vector to be used in the challenge to the user. If a valid AV is not available, then the S-CSCF requests at least one AV from the HSS.

For detailed message flows see 3GPP TS 29.228.

Table 6.3-6a provides the parameters in the REGISTER request (flow 5), which are sent to the HSS.

7. **Authentication vector selection**

The S-CSCF selects an authentication vector for use in the authentication challenge. For detailed description of the authentication vector, see 3GPP TS 33.203.

NOTE 2: The authentication vector may be of the form 3GPP TS 33.203 (if IMS AKA is the selected authentication scheme):

AV = RANDn||AUTNn||XRESn||CKn||IKn where:

- RAND: random number used to generate the XRES, CK, IK, and part of the AUTN. It is also used to generate the RES at the UE.
- AUTN: Authentication token (including MAC and SQN).
- XRES: Expected (correct) result from the UE.
- CK: Cipher key (optional).
- IK: Integrity key.

8. **401 Unauthorized response (S-CSCF to I-CSCF) – see example in table 16.3-8**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 16.3-8: 401 Unauthorized response (S-CSCF to I-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate: eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)
CSeq:
Content-Length:
```

NOTE 3: The actual WWW-Authenticate header value may look like this as it is in base64 form:

- WWW-Authenticate: eap eap-p=QWxh4ZGRpb2jpvcGVuNlctZQ==

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

9. **401 Unauthorized response (I-CSCF to P-CSCF) – see example in table 16.3-9**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 16.3-9: 401 Unauthorized response (I-CSCF to P-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate: eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)
CSeq:
Content-Length:
```

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

10. **401 Unauthorized response (P-CSCF to UE) – see example in table 16.3-10**

    The P-CSCF removes any keys received in the 401 Unauthorized response and forwards the rest of the response to the UE.

Table 16.3-10: 401 Unauthorized response (P-CSCF to UE)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate:
CSeq:
Content-Length:
```

11. **Generation of response and session keys at UE**

    Upon receiving the Unauthorised response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in the REGISTER request.

12. **REGISTER request (UE to P-CSCF) – see example in table 16.3-12**

Table 16.3-12 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49112
Authorization: eap eap-p=base64(user1_private1@home1.net, RES)
CSeq: 4 REGISTER
Expires: 7200
Content-Length: 0
```

Authorization: This carries the response to the authentication challenge received in step 10 along with the private user identity both encoded in base64 format.

13. **DNS: DNS-Q**

    Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

    The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify the transport protocol the, P-CSCF selects the UDP.

Table 16.3-13a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC2782 [4].

Table 16.3-13b DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net           0 IN SRV 1 10 5060 icscf1_p.home1.net
                                        0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                 0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                 0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

14. **REGISTER request (P-CSCF to I-CSCF) – see example in table 16.3-14**

This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.

Table 16.3-14 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

15. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. Because the user has registered, the HSS returns the I-CSCF with the S-CSCF address for the subscriber.

For detailed message flows see 3GPP TS 29.228.

For the parameters in the REGISTER request (flow 14), which are sent to the HSS, see table 6.2-16a.

Table 6.3-15a provides the parameters in the REGISTER request (flow 16), which are obtained from the information sent back from the HSS.

16. **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.3-16**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 16.3-16 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

17. **Authentication**

Upon receiving the REGISTER request, carrying the authentication response, RES, the S-CSCF checks that the user's active XRES matches the received RES. If the check is successful then the user has been authenticated and the public user identity is registered in the S-CSCF.

18. **Cx: S-CSCF registration notification procedure**

On registering a user the S-CSCF informs the HSS that the user has been registered at this instance. The HSS stores the S-CSCF name for that subscriber. For a positive response, the HSS will include the user profile in the response sent to the S-CSCF.

For detailed message flows see 3GPP TS 29.228.

For the parameters in the REGISTER request (flow 16), which are sent to HSS, see table 6.2-19a.

19. **200 OK response (S-CSCF to I-CSCF) – see example in table 16.3-19**

The S-CSCF sends acknowledgement to the I-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.3-19 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net>, <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact: sip:[5555::aaa:bbb:ccc:ddd]
CSeq:
Date: Wed, 11 July 2001 08:49:37 GMT
Expires: 7200
Content-Length:
```

Path: The S-CSCF inserts its own name to the front of the list.

20. **200 OK response (I-CSCF to P-CSCF) – see example in table 16.3-20**

    The I-CSCF translates the S-CSCF name in the Path header. The I-CSCF forwards acknowledgement from the S-CSCF to the P-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.3-20 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:token(scscf1.home1.net)>, <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

21. **200 OK response (P-CSCF to UE) – see example in table 16.3-21**

    The P-CSCF removes its address from the Path header, reverses the order of the fields, saves the resulting Path header and associates it with the UE. The P-CSCF then removes the Path header from the 200 OK response. The P-CSCF then forwards acknowledgement from the I-CSCF to the UE indicating that Registration was successful.

Table 16.3-21 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

16.4 Registration signalling: mobile initiated deregistration

Figure 16.4-1 shows a signalling flow for mobile initiated deregistration. For the purposes of this deregistration signalling flow, the subscriber is considered to be roaming. In this signalling flow, the home network has configuration hiding active.

This signalling flow assumes:

1. That the same PDP Context allocated during the initial registration scenario is still used for deregistration. For the case when the UE does not still have an active PDP context then PDP context procedures from subclause 16.2 must first be completed.

Editor's Note: If the same PDP-Context is not available, is it guaranteed that the UE will get back the same IP address at this point? If this is not possible, would there be a problem with the binding in the P-CSCF (user_public1@home1.net and [5555::aaa:bbb:ccc:ddd])?

2. The procedure employed for P-CSCF discovery is not needed.

3. The S-CSCF selection procedure invoked by the I-CSCF is not needed.

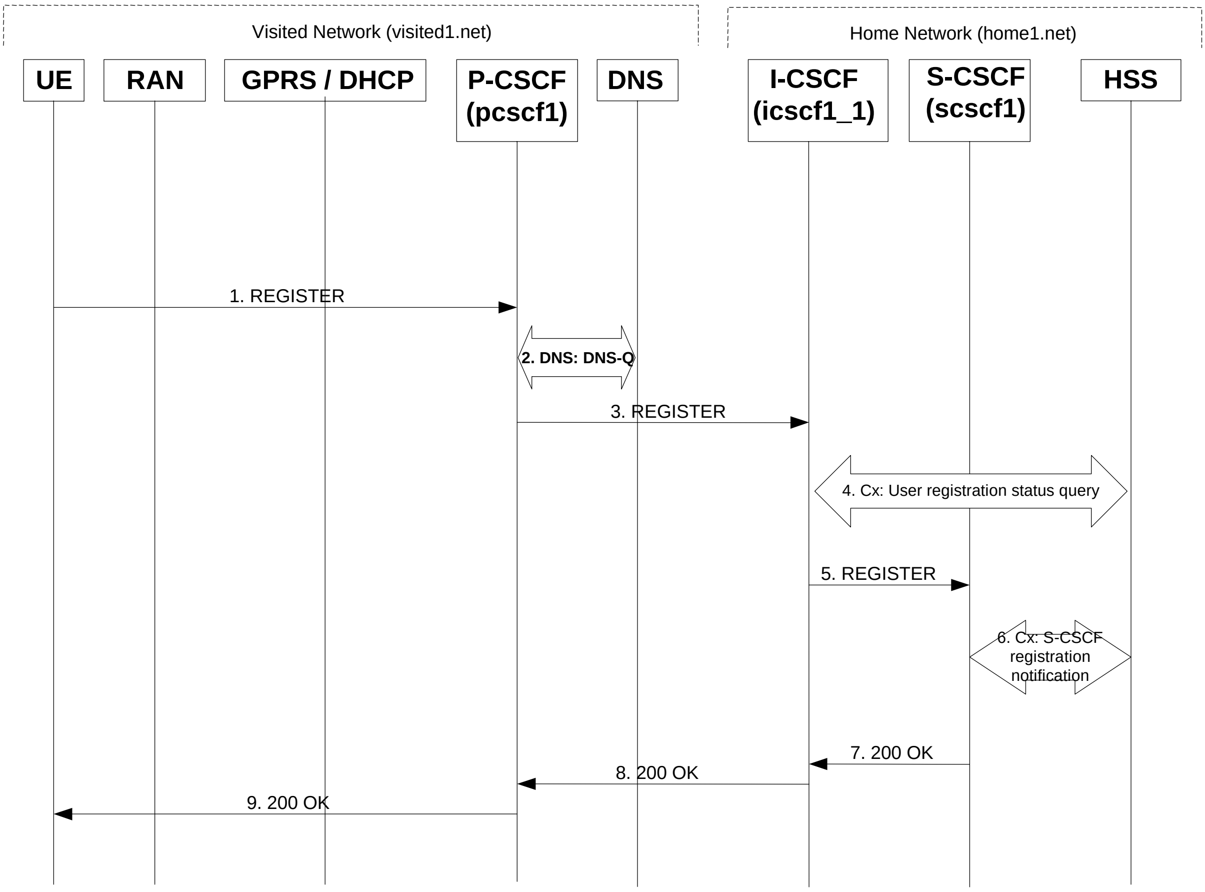


Figure 16.4-1: Registration signalling: mobile initiated deregistration

1. **REGISTER request (UE to P-CSCF) – see example in table 16.4-1**

   The UE intends to de-register itself. It does so by sending a new REGISTER request. This request looks similar as in reregister case, but the Expires header contains zero. This request is sent to the same P-CSCF with which the UE initially registered.

Table 16.4-1 REGISTER (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: eap eap-p=AQAAEwFqYXJpQGFya2tvLmNvbQ==
CSeq: 7 REGISTER
Expires: 0
Content-Length: 0
```

The header field usage is the same as for the initial registration scenario:

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates public user identity. This is the identity by which other parties know this subscriber.

Contact: This indicates the point-of-presence for the subscriber – the IP address of the UE. This is the temporary identifier for the subscriber that is being de-registered.

Authorization: It carries authentication information. The private user identity is carried in the user ID field of the authentication protocol.

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Expires: The 0 value indicates the registration is being cancelled.

Upon receiving this request the P-CSCF will reset the SIP registration timer for this UE to 0.

2. **DNS: DNS-Q**

   Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI. The DNS provides the P-CSCF with an address of the I-CSCF in the home network. The P-CSCF must not use the I-CSCF address cached as a result of the previous registration.

3. **REGISTER request (P-CSCF to I-CSCF) – see example in table 16.4-3**

   This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 16.4-3 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

Require:/Proxy-Require: These headers are included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating "path". Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

4. **Cx: User registration status query procedure**

   The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. Because the user has registered, the HSS returns the I-CSCF with the S-CSCF address for the subscriber

   For detailed message flows see 3GPP TS 29.228.

   For the parameters in the SIP REGISTER request (flow 3) which are sent to the HSS, see table 6.2-5a.

   Table 6.3-4a provides the parameters in the SIP REGISTER request (flow 5) which are obtained from the information sent back from the HSS.

5. **REGISTER (I-CSCF to S-CSCF) – see example in table 16.4-5**

   I-CSCF adds a proper I-CSCF name to the Path header.

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected. The Request-URI is changed to the address of the S-CSCF.

Table 16.4-5 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Path: <sip:icscf1_p.home1.net> <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Upon receiving this request the S-CSCF will reset the SIP registration timer for this UE to 0.

6. **Cx: S-CSCF registration notification procedure**

   The S-CSCF shall notify the HSS to clear its location information for that subscriber. The HSS deletes the S-CSCF name for that subscriber. The HSS sends a response to the S-CSCF to acknowledge the clearing of location information.

   For detailed message flows see 3GPP TS 29.228.

   For the parameters in the SIP REGISTER request (flow 5), which are sent to the HSS, see table 6.2-7a.

7. **200 OK (S-CSCF to I-CSCF) – see example in table 16.4-7**

   The S-CSCF sends acknowledgement to the I-CSCF indicating that deregistration was successful. This request will traverse the path that the REGISTER request took as described in the Via list. The S-CSCF clears its information for that subscriber.

Table 16.4-7 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net>, <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
From:
To: <sip:user1_public1@home1.net>
Call-ID: apb03a0s09dkjdfglkj49111
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
CSeq: 3 REGISTER
Date: Wed, 11 July 2001 08:49:37 GMT
Expires: 0
Content-Length: 0
```

Path: The S-CSCF inserts its own name to the front of the list.

8. **200 OK (I-CSCF to P-CSCF) – see example in table 16.4-8**

   The I-CSCF forwards acknowledgement from the S-CSCF to the P-CSCF indicating that deregistration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.4-8 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:token(scscf1.home1.net)>, <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

9. **200 OK (P-CSCF to UE) – see example in table 16.4-9**

The P-CSCF forwards the acknowledgement from the I-CSCF to the UE indicating that deregistration was successful. The P-CSCF clears its information for that subscriber after sending the acknowledgement to the UE.

Table 16.4-9 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

16.5 UE subscription for the registration state event package

This section describes the subscription procedure for the registration states event package, whereby the UE requests to be notified by the S-CSCF when the event has occurred. This is done using the information structure specified for the 'presence' package.

It is assumed that the user has registered prior to initiating subscription of an event. Also, the subscriber is considered to be roaming and the home network has network configuration hiding active. For this example the trigger point at the UE for sending out the SUBSCRIBE request is the 200 OK response of the users registration.

Editor's Note: The interaction between the explicit subscription procedure for the `Event: registration-state event package` and the registration procedures needs further consideration. For example: What are the appropriate timer values of Expires header for these procedures considering the signalling is over the radio interface? What is the status of the ongoing explicit subscription procedure `(Event: registration-state event package)` when the registration timer has expired? etc.

Editor's Note: Further clarification with IETF on the setting of Request URI, Remote-Party-ID and To header has to be done. The values of these headers in the SUBSCRIBE and NOTIFY messages, as well as in their responses, as indicated in sections 16.5, 6.5, 16.6 and 6.6 of 24.228 has to be aligned to the outcome of this clarification.

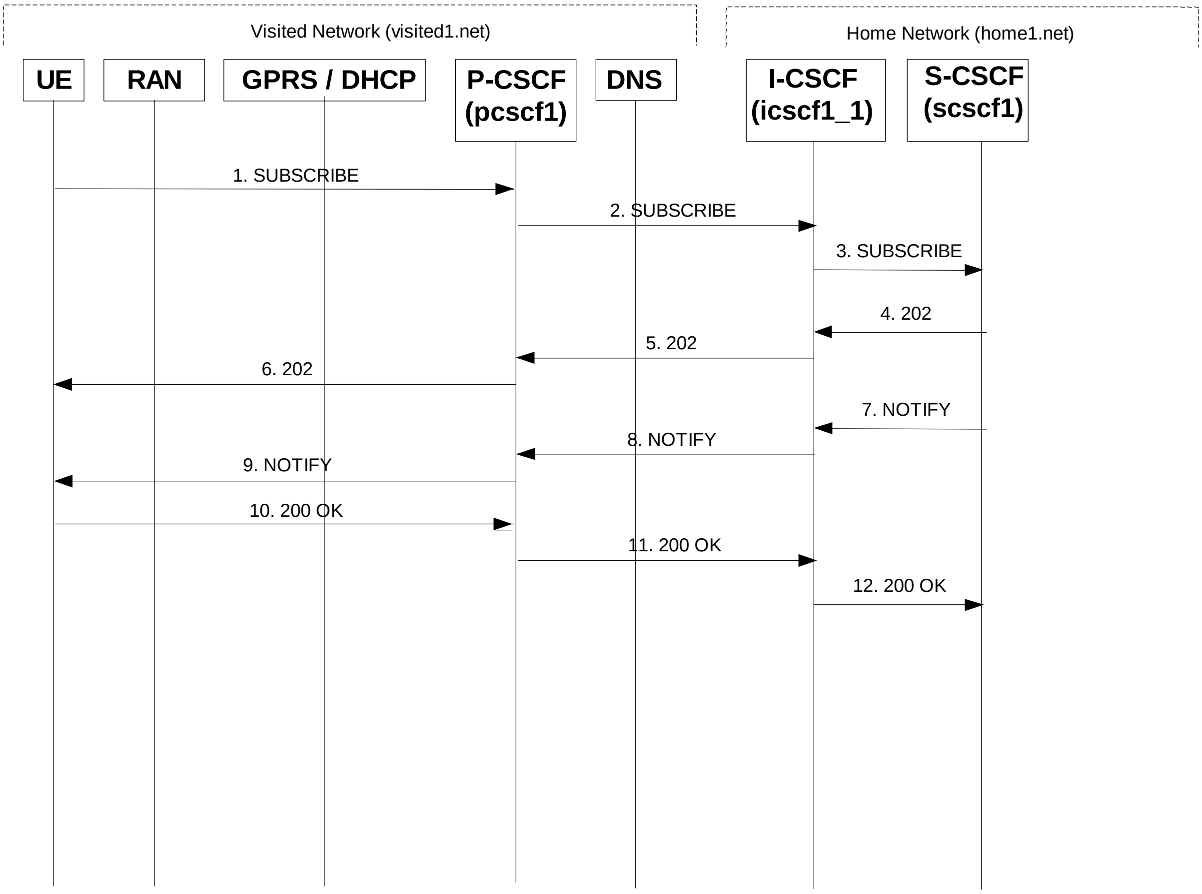


Figure 16.5-1: UE subscription for the registration state event package (with I-CSCF providing configuration independence)

1. **SUBSCRIBE request (UE to P-CSCF) – see example in table 16.5-1**

   The UE generates a SUBSCRIBE request in order to subscribe for the registration-state event package.

   The From and To fields both will contain the UE's public address.

Table 16.5-1 SUBSCRIBE request (UE to P-CSCF)

```
SUBSCRIBE sip:user1_public1@home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: <sip:user1_public1@home1.net>;tag=31415
To: <sip: user1_public1@home1.net>
Call-ID: b89rjhnedlrfjflslj40a222
CSeq: 61 SUBSCRIBE
Event:  presence
Expires: 7200
Accept: application/cpim-pidf+xml
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Content-Length: 0
```

Request URI: Public user identity whose events the subscriber subscribes to˝ . In this case the subscribing user and the monitored user are identical.

From: This field is populated with logical representation (FQDN) for the entity sending the SUBSCRIBE.

Event: This field is populated with the value 'presence' to specify the use of the presence package.

Accept: This field is populated with the value 'application/cpim-pidf+xml' in keeping with the use of the 'presence' package.

To: Same as the Request-URI.

Contact: The contact information of the subscribing user.

2. **SUBSCRIBE request (P-CSCF to I-CSCF) – see example in table 16.5-2**

P-CSCF looks up the serving network information for the public user identity that was stored during the registration procedure. The SUBSCRIBE request is forwarded to I-CSCF. A Route header is inserted into SUBSCRIBE request. The information for the Route header is taken from the path header as gathered during registration.

Table 16.5-2 SUBSCRIBE request (P-CSCF to I-CSCF)

```
SUBSCRIBE sip:icscf1_p.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip: token(scscf1.home1.net), sip:user1_public1@home1.net
Record-Route: sip:240f34.1@pcscf1.visited1.net
From:
To:
Call-ID:
CSeq:
Event:
Expires:
Accept:
Contact:
Content-Length:
```

Route: The Route: header is populated with the remaining elements from the Path header from Registration, with the initial Request-URI (received from the UE) appended as the final component.

3. **SUBSCRIBE (I-CSCF to S-CSCF) – see example in table 16.5-3**

I-CSCF determines the S-CSCF name in the Route header field to retrieve the routing information. I-CSCF then forwards the SUBSCRIBE request to S-CSCF.

Table 16.5-3 SUBSCRIBE (I-CSCF to S-CSCF)

```
SUBSCRIBE sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:user1_public1@home1.net
Record-Route: sip:351g45.1@icscf1_p.home1.net, sip:240f34.1@pcscf1.visited1.net
From:
To:
Call-ID:
CSeq:
Event:
Expires:
Accept:
Contact:
Content-Length:
```

4. **202 Accepted response (S-CSCF to I-CSCF) – see example in table 16.5-4**

The S-CSCF sends an acknowledgement towards the UE indicating that the subscription was successful. This response will traverse the path that the SUBSCRIBE request took as described in the Via list.

NOTE 1: If the S-CSCF can process the SUBSCRIBE request and send the NOTIFY request immediately, it can send a 200 OK response instead of a 202 Accepted response.

Table 16.5-4 202 Accepted response (S-CSCF to I-CSCF)

```
SIP/2.0 202 Accepted
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:332b23.1@scscf1.home1.net, sip:351g45.1@icscf1_p.home1.net,
    sip:240f34.1@pcscf1.visited1.net
From:
To: <sip:user1_public1@home1.net>;tag=151170
Call-ID:
CSeq:
Contact: sip:user1_public1@scscf1.home1.net
Event:
Expires:
Content-Length:
```

Expires: If value of the Expires header in SUBSCRIBE request is different from the one received in REGISTER method, then the value of Expires header in 202 Accepted is set to match the value of Expires header in REGISTER method.

Contact: This is populated with a identifier generated within the S-CSCF that will help it correlate refreshes for the SUBSCRIBE. It is assumed to be the public-id 'user1_public1' in this case.

5. **202 Accepted response (I-CSCF to P-CSCF) – see example in table 16.5-5**

   I-CSCF forwards 202 Accepted response to P-CSCF.

Table 16.5-5 202 Accepted response (I-CSCF to P-CSCF)

```
SIP/2.0 202 Accepted
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:token(scscf1.home1.net), sip:351g45.1@icscf1_p.home1.net,
    sip:240f34.1@pcscf1.visited1.net
From:
To:
Call-ID:
CSeq:
Event:
Contact: sip:token(user1_public1@scscf1.home1.net)Expires:
Content-Length:
```

6. **202 Accepted response (P-CSCF to UE) – see example in table 16.5-6**

   P-CSCF sends the response to UE.

Table 16.5-6 202 Accepted response (P-CSCF to UE)

```
SIP/2.0 202 Accepted
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Event:
Contact
Expires:
Content-Length:
```

7. **NOTIFY request (S-CSCF to I-CSCF) – see example in table 16.5-7**

   The S-CSCF sends a first NOTIFY request towards the UE in order to inform the UE about the registration status of the monitored user.

   In the example below, the NOTIFY specifies the following public user identities as registered (i.e. status=open): sip:user1_public1@home1.net, tel: +498972233114;

   The following public user identity has been de-registered (i.e. status=closed) sip:user1_public2@home1.net. They are arranged in the preferred order of priority in this example.

The Route header is constructed from the information saved at registration.

Table 16.5-7 NOTIFY request (S-CSCF to I-CSCF)

```
NOTIFY sip:icscf1_p.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
Max-Forwards: 70
Route: sip:240f34.1@pcscf1.visited1.net, sip:[5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=151170
To: <sip:user1_public1@home1.net>;tag=31415
Call-ID:
CSeq: 42 NOTIFY
Contact: sip:user1_public1@scscf1.home1.netExpires:
Event: presence
Content-Type: application/cpim-pidf+xml
Content-Length: (...)

<presence xmlns="http://www.ietf.org/ns/cpim-pidf-xml-1.0">

        <tuple name="sip:user1_public1@home1.net">
          <status><value>open</value></status>
        </tuple>

        <tuple name="sip:user1_public2@home1.net">
          <status> <value>closed</value> </status>
        </tuple>

        <tuple name="tel:+498972233114">
          <status><value>open</value></status>
        </tuple>

      </presence>
```

From: The tag of this field matches that of the To; field in the received 200/202 for the SUBSCRIBE

Content-Type: Set to the value of the Accept: header received in the subscribe or 'application/cpim-pidf+xml' if Accept: was not present in the SUBSCRIBE:

- The message body in the NOTIFY request that carries the subscriber's registration state is of the following form.

- The registration state is expressed in XML with the information enclosed in the root <presence> element, enclosed between <presence> and </presence> tags.

- The <presence> element consist of one or more <tuple> elements and an optional <timestamp>. It contains a mandatory xmlns attribute that specifies the namespace for this version of the registration-information payload.

- Each <tuple> element carries the registration state of a single public-id and carries a mandatory 'name' attribute. The <tuple> element carries mandatory <status> element and optional <contact> and <note> elements.

- The <status> element carries a mandatory <value> = open|closed and an optional <detail> element. The <contact> element carries any updated contact information (with priority). The <note> is human-readable for extra details.

NOTE 2: The registration states in 3GPP are mapped as follows to the status values in the presence-package:

- Open (status value) is mapped to Registered (3GPP).

- Closed (status value) is mapped to De-Registered (3GPP).

Editor's Note: further mappings of status values to 3GPP are for future study

- The optional <detail> element carries a mandatory 'type' attribute and an optional schema that is usually a DTD related to the specified 'type'.

8. **NOTIFY request (I-CSCF to P-CSCF) – see example in table 16.5-8**

I-CSCF translates the S-CSCF address in the Via header and forwards NOTIFY to P-CSCF.

Table 16.5-8 NOTIFY request (I-CSCF to P-CSCF)

```
NOTIFY sip:pcscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP token(scscf1.home1.net)
Max-Forwards: 69
Route: sip:[5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Cseq:
Contact: sip:token(user1_public1@scscf1.home1.net)Expires:
Event:
Content-Type:
Content-Length:
```

9. **NOTIFY request (P-CSCF to UE) – see example in table 16.5-9**

   P-CSCF sends NOTIFY to the user.

Table 16.5-9 NOTIFY request (P-CSCF to UE)

```
NOTIFY sip:[5555::aaa:bbb:ccc:ddd] SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1
Max-Forwards: 68
From:
To:
Call-ID:
CSeq: Contact:
Expires:
Event:
Content-Type:
Content-Length:
```

10. **200 OK response (UE to P-CSCF) – see example in table 16.5-10**

    UE responds with 200 OK.

Table 16.5-10 200 OK response (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

11. **200 OK response (P-CSCF to I-CSCF) – see example in table 16.5-11**

    P-CSCF forwards the 200 OK to I-CSCF.

Table 16.5-11 200 OK response (P-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP token(scscf1.home1.net)
From:
To:
Call-ID:
CSeq:
Content-Length:
```

12. **200 OK response (I-CSCF to S-CSCF) – see example in table 16.5-12**

    I-CSCF determines the request and forwards response to S-CSCF. This confirms that notification is reached to the user.

Table 16.5-12 200 OK response (I-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
From:
To:
Call-ID:
CSeq:
Content-Length:
```

16.6 P-CSCF subscription for the registration state event package

This subclause describes the subscription procedure for the registration state event package, whereby the P-CSCF requests to be notified by the S-CSCF when the event has occurred. This is done using the 'presence' package.

It is assumed that the user has registered prior to initiating subscription of an event. Also, the subscriber is considered to be roaming and the home network has network configuration hiding active. For this example the trigger point at the P-CSCF for sending out the SUBSCRIBE request is the 200 OK response of the users registration.

Editor's Note: The interaction between the explicit subscription procedure for the `Event: registration-state event package` and the registration procedures needs further consideration. For example: What are the appropriate timer values of Expires header for these procedures considering the signalling is over the radio interface? What is the status of the ongoing explicit subscription procedure (`Event: registration-state event package)` when the registration timer has expired? etc.

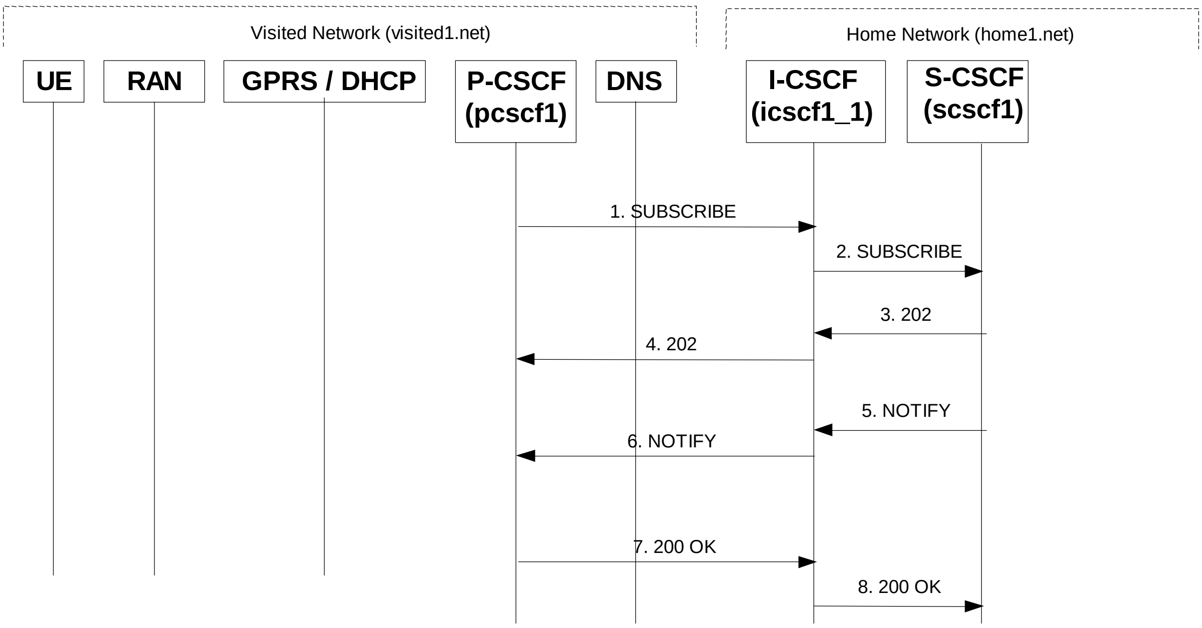


Figure 16.6-1: P-CSCF subscription for the registration state event package (with I-CSCF providing configuration independence)

1. **SUBSCRIBE request (P-CSCF to S-CSCF) – see example in table 16.6-1**

   The P-CSCF generates a SUBSCRIBE request in order to subscribe for the registration-state event package.

   The route is constructed from the monitored users path header as constructed during registration.

Table 16.6-1 SUBSCRIBE request (P-CSCF to I-CSCF)

```
SUBSCRIBE sip:icscf1_p.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1
Max-Forwards: 70
Route: sip:token(scscf1.home1.net)
From: <sip:pcscf1.visited1.net>;tag=31415
To: <sip:user1_public1@home1.net>
Call-ID: 223456789@pcscf1.visited1.net
CSeq: 61 SUBSCRIBE
Event: presence
Expires: 7200
Accept: application/cpim-pidf+xml
Contact: <sip:user1_public1%40home1.net@pcscf1.visited1.net>
Content-Length: 0
```

Request URI: The next hop on the route to the destination as recorded in the path information for the monitored user during registration.

Max-Forwards**:** Set to 70 by the P-CSCF and used to prevent loops.

Route: The token containing a representation of the S-CSCF allocated to this user, based on the registration information.

From: This header is populated with the SIP URI that identifies the P-CSCF.

To: The SIP-URI of the entity which provides information about the monitored users registration states. In this case this is the address of the registrar of user1_public1.

Contact: This is where the NOTIFY requests for this subscription will be sent. It consists of the SIP URL-escaped public user identity at the P-CSCF.

Event: This field shall be set to the value 'presence' to specify the use of the presence package

Accept: This field shall be set to the value 'application/cpim-pidf+xml' in keeping with the use of the 'presence' package.

2. **SUBSCRIBE (I-CSCF to S-CSCF) – see example in table 16.6-2**

   I-CSCF determines the S-CSCF name in the Route header field to retrieve the routing information. I-CSCF then forwards the SUBSCRIBE request to S-CSCF.

Table 16.6-2 SUBSCRIBE (I-CSCF to S-CSCF)

```
SUBSCRIBE sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1
Max-Forwards: 69
Record-Route: sip:351g45.1@icscf1_p.home1.net
From:
To:
Call-ID:
CSeq:
Event:
Expires:
Accept:
Contact:
Content-Length:
```

Record-Route: The ICSCF adds a route header as it wants to stay on the routing path for network hiding purposes.

3. **202 Accepted response (S-CSCF to I-CSCF) – see example in table 16.6-3**

   The S-CSCF sends an acknowledgement towards the P-CSCF indicating that the subscription was successful. This response will traverse the path that the SUBSCRIBE request took as described in the Via list.

NOTE 1: If the S-CSCF can process the SUBSCRIBE request and send the NOTIFY request immediately, it can send a 200 OK response instead of a 202 Accepted response.

Table 16.6-3 202 Accepted response (S-CSCF to I-CSCF)

```
SIP/2.0 202 Accepted
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1
Record-Route: sip:332b23.1@scscf1.home1.net, sip:351g45.1@icscf1_p.home1.net,
    sip:240f34.1@pcscf1.visited1.net
From:
To: <sip:user1_public1@home1.net>;tag=151170
Call-ID:
CSeq:
Contact: sip:user1_public1@scscf1.home1.netEvent:
Expires:
Content-Length:
```

4. **202 Accepted response (I-CSCF to P-CSCF) – see example in table 16.6-4**

   I-CSCF forwards 202 Accepted response to P-CSCF.

Table 16.6-4 202 Accepted response (I-CSCF to P-CSCF)

```
SIP/2.0 202 Accepted
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1
Record-Route: sip:token(scscf1.home1.net), sip:351g45.1@icscf1_p.home1.net
From:
To:
Call-ID:
CSeq:
Contact: sip:token(user1_public1@scscf1.home1.net)Event:
Expires:
Content-Length:
```

5. **NOTIFY request (S-CSCF to I-CSCF) – see example in table 16.6-5**

   The S-CSCF sends a first NOTIFY request towards the P-CSCF in order to inform the P-CSCF about the registration status of the monitored user.

   The Route header is constructed from the Record-Route header as constructed during subscription.

Table 16.6-5 NOTIFY request (S-CSCF to I-CSCF)

```
NOTIFY sip:user1_public1%40home1.net@pcscf1.visited1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
Max-Forwards: 70
Route: sip:240f34.1@pcscf1.visited1.net
From: <sip:user1_public1@home1.net>;tag=151170
To: <sip:user1_public1@pcscf1.visited1.net>;tag=31415
Call-ID:
CSeq: 42 NOTIFY
Contact: sip:user1_public1@scscf1.home1.netExpires:
Event: presence
Content-Type: application/cpim-pidf+xml
Content-Length: (...)

<presence xmlns="http://www.ietf.org/ns/cpim-pidf-xml-1.0">

        <tuple name="sip:user1_public1@home1.net">
          <status><value>closed</value></status>
        </tuple>

</presence>
```

Request-URI: The contents are the same as the Contact header in the SUBSCRIBE.

From: The tag of this field matches that of the To; field in the received 200/202 for the SUBSCRIBE

Content-Type: Set to the value of the Accept: header received in the subscribe or 'application/cpim-pidf+xml' if Accept: was not present in the SUBSCRIBE

The message body in the NOTIFY request that carries the subscriber's registration state is of the following form:

- The registration state is expressed in XML with the information enclosed in the root <presence> element, enclosed between <presence> and </presence> tags.
- The <presence> element consist of one or more <tuple> elements and an optional <timestamp>. It contains a mandatory xmlns attribute that specifies the namespace for this version of the registration-information payload.
- Each <tuple> element carries the registration state of a single public-id and carries a mandatory 'name' attribute. The <tuple> element carries mandatory <status> element and optional <contact> and <note> elements.
- The <status> element carries a mandatory <value> = open|closed and an optional <detail> element. The <contact> element carries any updated contact information (with priority). The <note> is human-readable for extra details.

NOTE 2: the registration states in 3GPP are mapped as follows to the status values in the presence-package:

- Open (status value) is mapped to Registered (3GPP).
- Closed (status value) is mapped to De-Registered (3GPP).

Editor's Note: further mappings of status values to 3GPP are for future study

- The optional <detail> element carries a mandatory 'type' attribute and an optional schema that is usually a DTD related to the specified 'type'.

6. **NOTIFY request (I-CSCF to P-CSCF) – see example in table 16.6-6**

   I-CSCF translates the S-CSCF address in the Via header and forwards NOTIFY to P-CSCF.

Table 16.6-6 NOTIFY request (I-CSCF to P-CSCF)

```
NOTIFY sip:user1_public1%40home1.net@pcscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP token(scscf1.home1.net)
Max-Forwards: 69
From:
To:
Call-ID:
Cseq:
Contact:
Expires:
Event:
Content-Type:
Content-Length:
```

7. **200 OK response (P-CSCF to I-CSCF) – see example in table 16.6-7**

   P-CSCF forwards the 200 OK to I-CSCF.

Table 16.6-7 200 OK response (P-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP token(scscf1.home1.net)
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

8. **200 OK response (I-CSCF to S-CSCF) – see example in table 16.6-8**

   I-CSCF determines the request and forwards response to S-CSCF. This confirms that notification is reached to the user.

Table 16.6-8 200 OK response (I-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
From:
To:
Call-ID:
CSeq:
Content-Length:
```

16.7 Notifying of the network initiated deregistration event (not provided)

16.8 Network initiated re-authentication

This subclause describes the notification of a user about the re-authentication event that occurs at the S-CSCF assigned to that user in the case where the users home network provides network configuration hiding.

It is assumed that user has registered and also subscribed to the registration state event before. Also, the subscriber is considered to be roaming and the home network operator does not desire to keep its internal configuration hidden from the visited network.

After this procedure the users UE might automatically initiated re-registration procedures.

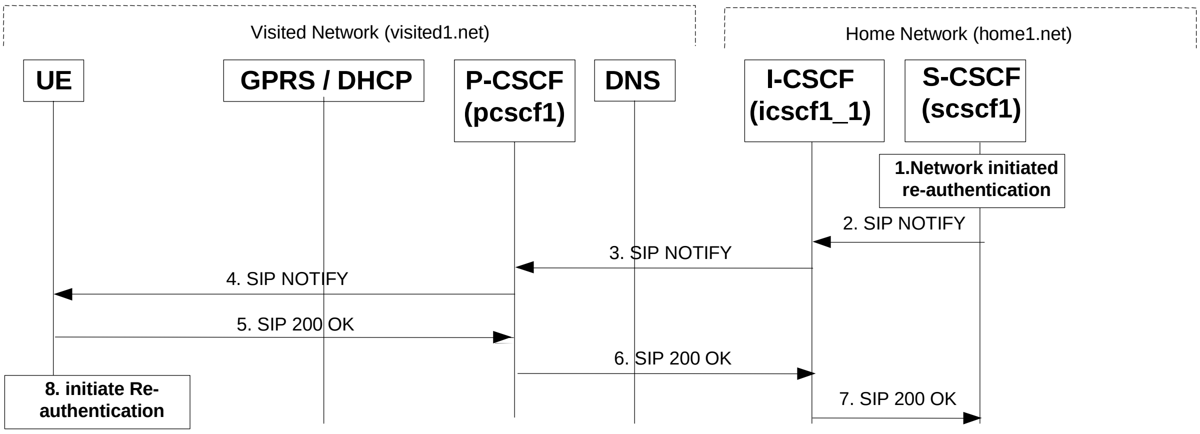


Figure 16.8-1: S-CSCF informs UE that network initiated re-authentication is needed (with I-CSCF providing configuration independence)

1. **Network initiated re-authentication (S-CSCF)**

   The network-initiated re-authentication event for the private user identity user occurs at the S-CSCF. As the user has subscribed to the registration state event package this is the trigger point for the S-CSCF to notify the user about the event occurrence.

2. **SIP NOTIFY request (S-CSCF to I-CSCF) – see example in table 16.8-2**

   The S-CSCF sends a NOTIFY request towards the UE in order to inform the UE about the occurrence of the network initiated re-authentication event.

   The Route header is constructed from the information saved at registration.

Table 16.8-2 SIP NOTIFY request (S-CSCF to I-CSCF)

```
NOTIFY sip:icscf1_p.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
Max-Forwards: 70
Route: sip:240f34.1@pcscf1.visited1.net, sip:[5555::aaa:bbb:ccc:ddd]
Remote-Party-ID:
From: <sip:user1_public1@home1.net>;tag=151170
To: <sip:user1_public1@home1.net>;tag=31415
Call-ID: 223456789@[5555::aaa:bbb:ccc:ddd]
CSeq: 43 NOTIFY
Expires: 7200
Event:  presence
Content-Type:  application/cpim-pidf+xml
Content-Length: (...)

<presence xmlns="http://www.ietf.org/ns/cpim-pidf-xml-1.0">

        <tuple name="sip:user1_public1@home1.net">
          <status><value>re-authenticate</value></status>
        </tuple>
      </presence>
```

From: The tag of this field matches that of the To; field in the received 200/202 for the SUBSCRIBE

Content-Type: Set to the value of the Accept: header received in the subscribe or 'application/cpim-pidf+xml' if Accept: was not present in the SUBSCRIBE

The message body in the NOTIFY request that carries the subscriber's registration state is of the following form:

- The registration state is expressed in XML with the information enclosed in the root <presence> element, enclosed between <presence> and </presence> tags.
- The <presence> element consist of only one <tuple> element and an optional <timestamp>. It contains a mandatory xmlns attribute that specifies the namespace for this version of the registration-information payload.
- The <tuple> element carries the registration state the public-id and carries a mandatory 'name' attribute. The <tuple> element carries mandatory <status> element and optional <contact> and <note> elements.
- The <status> element carries the <value> = re-authenticate and an optional <detail> element. The <contact> element carries any updated contact information (with priority). The <note> is human-readable for extra details.
- The optional <detail> element carries a mandatory 'type' attribute and an optional schema that is usually a DTD related to the specified 'type'.

3. **SIP NOTIFY request (I-CSCF to P-CSCF) – see example in table 16.8-3**

   I-CSCF translates the S-CSCF address in the Via header and forwards NOTIFY to P-CSCF.

Table 16.8-3 SIP NOTIFY request (I-CSCF to P-CSCF)

```
NOTIFY sip:pcscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP token(SIP/2.0/UDP
    scscf1.home1.net;branch=332b23.1)
Max-Forwards: 69
Route: sip:[5555::aaa:bbb:ccc:ddd]
Remote-Party-ID:
From:
To:
Call-ID:
Cseq:
Expires:
Event:
Content-Type:
Content-Length:
```

4. **SIP NOTIFY request (P-CSCF to UE) – see example in table 16.8-4**

   P-CSCF sends NOTIFY to the user.

Table 16.8-4 SIP NOTIFY request (P-CSCF to UE)

```
NOTIFY sip:[5555::aaa:bbb:ccc:ddd] SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1
Max-Forwards: 68
From:
To:
Call-ID:
CSeq: Expires:
Event:
Content-Type:
Content-Length:
```

5. **SIP 200 OK response (UE to P-CSCF) – see example in table 16.8-5**

   UE responds with 200 OK.

Table 16.8-5 SIP 200 OK response (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

6. **SIP 200 OK response (P-CSCF to I-CSCF) – see example in table 16.8-6**

   P-CSCF forwards the 200 OK to I-CSCF.

Table 16.8-6 SIP 200 OK response (P-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP token(SIP/2.0/UDP
    scscf1.home1.net;branch=332b23.1)
From:
To:
Call-ID:
CSeq:
Content-Length:
```

7. **SIP 200 OK response (I-CSCF to S-CSCF) – see example in table 16.8-7**

   I-CSCF determines the request and forwards response to S-CSCF. This confirms that notification is reached to the user.

Table 16.8-7 SIP 200 OK response (I-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
From:
To:
Call-ID:
CSeq:
Content-Length:
```

8. **Re-authentication (UE)**

   The UE shall now initiate the re-authentication procedures.

16.9 Registration error conditions

16.9.1 Reregistration – failure of reregistration

This signalling flow (see figure 16.9.1-1) is a continuation of the signalling flow in subclause 16.3 after reception of signalling flow 4. This signalling flow shows the recovery after a failure of the S-CSCF that had been assigned to the subscriber in a previous registration.

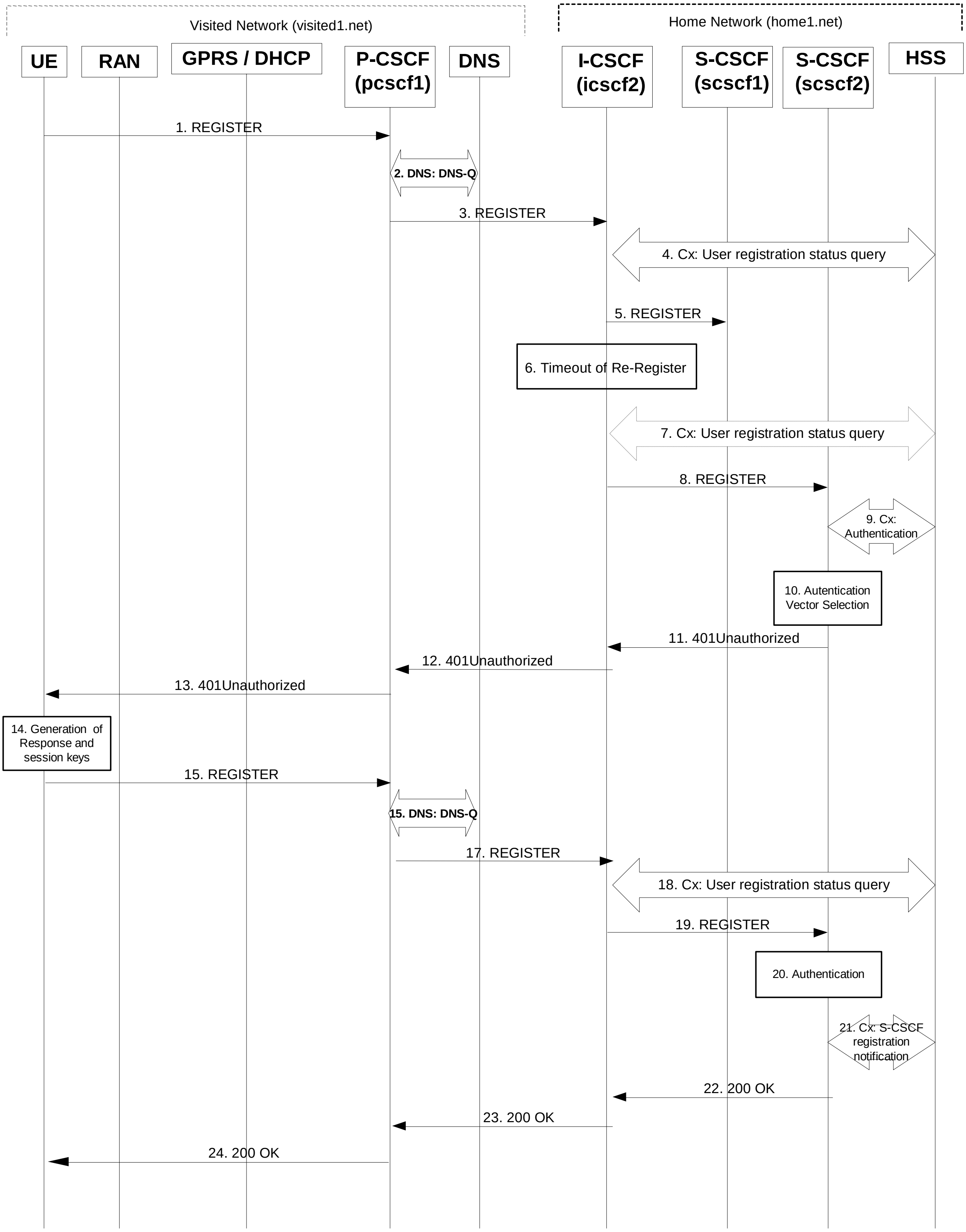


Figure 16.9.1-1: Failure of previous S-CSCF during reregistration

Steps 1 through 4 are the same as the signalling flow in subclause 16.3.

5 **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.9.1-5**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected. The Request-URI is changed to the address of the S-CSCF.

I-CSCF adds a proper I-CSCF name to the Path header.

Table 16.9.1-5 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Path: <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: eap eap-p=AQAAEwFqYXJpQGFya2tvLmNvbQ==
CSeq: 10 REGISTER
Expires: 7200
Content-Length: 0
```

6 **Timeout of reregister**

The I-CSCF times out, waiting for the response from the S-CSCF.

Editor's Note: The value of the timer in this particular instance is FFS. Clearly the value of the timers in the P-CSCF and UE waiting for the response must be considered when choosing this value.

7 **Cx: User registration status query (Optional)**

The I-CSCF informs the HSS that the S-CSCF for the subscriber is unreachable and requests information related to the required S-CSCF capabilities from the HSS, The HSS sends the capability information required for S-CSCF selection. The I-CSCF uses this information to select a suitable S-CSCF.

This step is optional. Depending on implementation, sufficient information may be available to the I-CSCF from Step 4, to allow the I-CSCF select an alternate S-CSCF. Alternative mechanisms (for example a CSCF management plane) would be used to enable the HSS learn of S-CSCF failure. In addition, the HSS will learn about the assignment of a new S-CSCF in Step 9.

8 **REGISTER (I-CSCF to S-CSCF) – see example in table 16.9.1-8**

This signalling flow forwards the REGISTER request from the I-CSCF to the newly selected S-CSCF. The Request-URI is changed to the address of the new S-CSCF.

Table 16.9.1-8 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf2.home1.net SIP/2.0
Via:
Via:
Via:
Max-Forwards: 67
Path:
Path:
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
```

```
Content-Length:
```

The next ten steps (9 to18) are the same as in the normal reregistration case (steps 6 to 12 in subclause 16.3).

19. **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.9.1-9**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 16.9.1-9 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf2.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

The remaining steps (20-25) are the same as in the normal reregistration case (steps 17-22 in subclause 16.3)

END OF MODIFICATION

CR-Form-v5

CHANGE REQUEST

⌘	**24.228**	**CR**	**010**	⌘ **rev**	**1**	⌘	Current version:	**5.0.0**	⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [ ] Radio Access Network [ ] Core Network [X]

Title:	⌘ Integrity protection signalling from the P-CSCF to the S-CSCF		
Source:	⌘ Nokia		
Work item code:	⌘ IMS-CCR	***Date:*** ⌘	11-04-2002
Category:	⌘ **F**	***Release:*** ⌘	REL-5
	Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.	*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*	

Reason for change: ⌘	There is not yet mechanism defined to signal from the P-CSCF to the S-CSCF the integrity protection of the REGISTER request
Summary of change: ⌘	Defining a way to signal the integrity protection of the REGISTER request
Consequences if not approved: ⌘	Lack of a security mechanism in IMS

Clauses affected: ⌘	5.2, 5.4	
Other specs affected: ⌘	[ ] Other core specifications [ ] Test specifications [ ] O&M Specifications	⌘
Other comments: ⌘		

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

Proposal

6 SIGNALLING FLOWS FOR REGISTER (NON HIDING)

6.1 Introduction

In IMS Authentication is performed at registration time. The following sections show examples of SIP registration and UMTS AKA authentication. It is possible for the home to require other types of authentication.
In the example below, Extensible Authentication Protocol (EAP). is used within SIP headers to carry the information related to the authentication-challenge and response.

6.2 Registration signalling: user not registered

Figure 6.2-1 shows the registration signalling flow for the scenario when the user is not registered. For the purpose of this registration signalling flow, the subscriber is considered to be roaming. This flow also shows the authentication of the private user identity. In this signalling flow, the home network does not have network configuration hiding active.

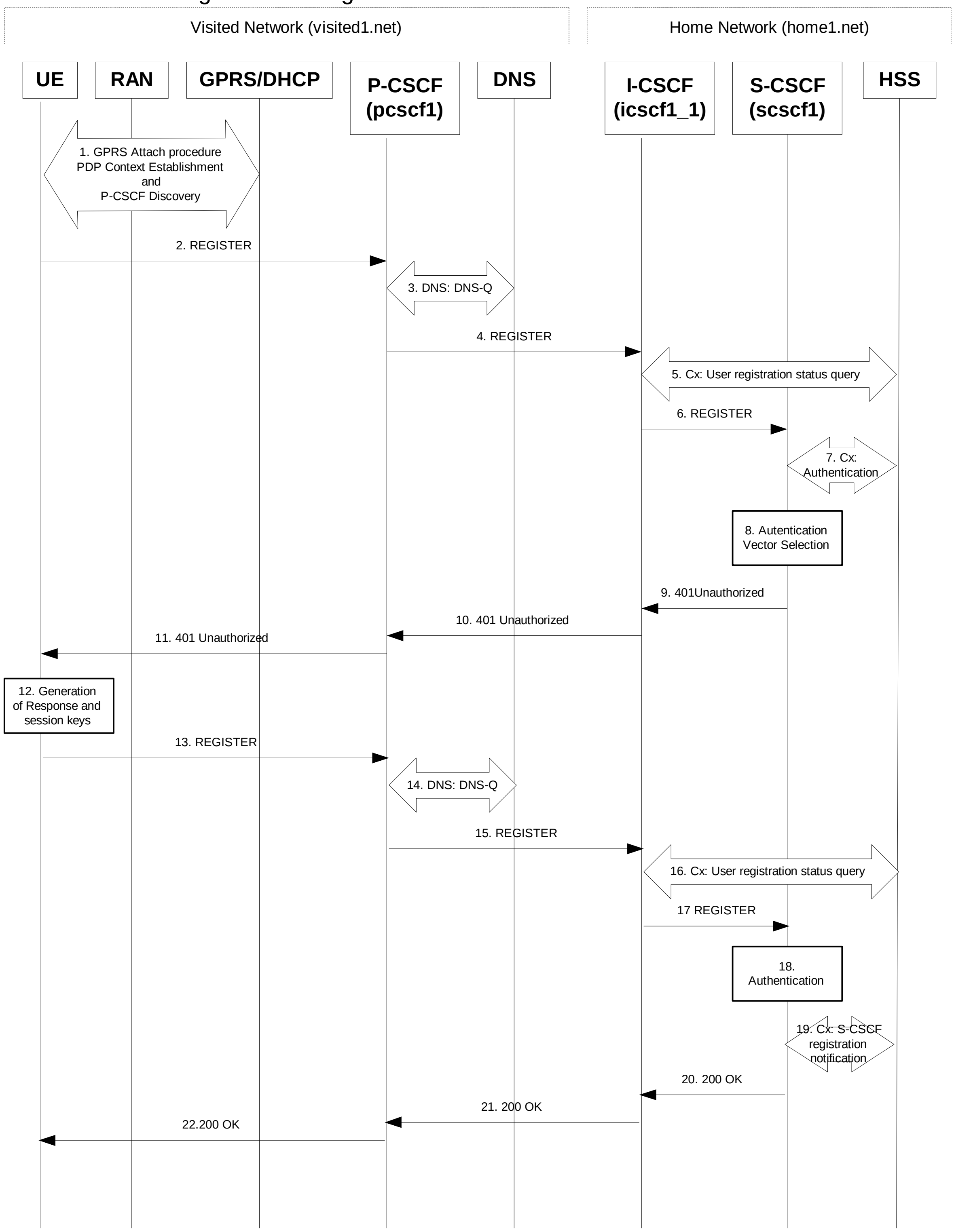


Figure 6.2-1: Registration signalling: user not registered

1. **GPRS Attach / PDP Context Establishment and P-CSCF Discovery (UE to GPRS)**

   This signalling flow is shown to indicate prerequisites for the registration signalling.

   See Section 5.2 for details.

2. **REGISTER request (UE to P-CSCF) – see example in Table 6.2-2**

The purpose of this request is to register the user's SIP URI with a S-CSCF in the home network. This request is routed to the P-CSCF because it is the only SIP server known to the UE. In the following SIP request, the Contact field contains the user's host address.

The P-CSCF will perform two actions, binding and forwarding. The binding is between the User's SIP address (user1_public1@home1.net) and the host (terminal) address ([5555::aaa:bbb:ccc:ddd]) which was acquired during PDP context activation process.

[Editor's note: The security mode set-up procedure supports the negotiation of different protection mechanisms. This will involve the addition of a "security-setup" field to the SIP REGISTER request and the REGISTER response performing the authentication challenge containing the parameters:

- list of Authentication (integrity} algorithms, and optionally list of encryption (confidentiality) algorithms
- SA-ID that is used to uniquely identify the SA at the receiving side.
- Key length: the length of encryption and authentication (integrity) keys is 128 bits.

The exact format and use for the security mode setup is being worked through IETF and is FFS]

Table 6.2-2 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: eap eap-p=base64(user1_private1@home1.net)
CSeq: 1 REGISTER
Expires: 7200
Content-Length: 0
```

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Via: IPv6 address of the SIP session allocated during the PDP Context Activation process.

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates the public user identity being registered. This is the identity by which other parties know this subscriber. It may be obtained from the USIM.

Contact: This indicates the point-of-presence for the subscriber – the IP address of the UE. This is the temporary point of contact for the subscriber that is being registered. Subsequent requests destined for this subscriber will be sent to this address. This information is stored in the P-CSCF and S-CSCF..

Authorization: It carries authentication information. The private user identity (user1_private1@home1.net) is carried in the user ID field of the extensible authentication protocol (EAP).

NOTE: The actual Authorization header value may look like this as it is in base64 form:
Authorization: eap eap-p=QWxhZGRpbjpvcGVuIHNlc2FtZQ==

Upon receiving this request the P-CSCF will set it's SIP registration timer for this UE to the Expires time in this request.

3. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-

CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify the transport protocol, the P-CSCF selects the UDP.

Table 6.2-3a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=_sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC2782 [4].

Table 6.2-3b DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=_sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net           0 IN SRV 1 10 5060 icscf1_p.home1.net
                                        0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                 0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                 0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC2782 [4] is used to select the I-CSCF (i.e., the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e., 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e., 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

4. **REGISTER request (P-CSCF to I-CSCF) – see example in Table 6.2-4**

The P-CSCF needs to be in the path for all mobile originated and mobile terminated requests for this user. To ensure this, the P-CSCF adds itself to the Path header value for future requests.

The P-CSCF binds the public user identity under registration to the Contact header supplied by the user.

The P-CSCF adds also the Roaming-Info header (if not present). The P-CSCF adds the *vnid* parameter with the contents of the identifier of the P-CSCF network. This may be the visited network domain name or any other identifier that identifies the visited network at the home network.

This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 6.2-4 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization: Integrity-protected=no
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

Require, Proxy-Require: These headers are included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating “path”. Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

5. **Cx: User registration status query procedure**

The I-CSCF makes a request for information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF required capabilities and the I-CSCF uses this information to select a suitable S-CSCF.

For detailed message flows see [29.228].

Table 6.2-5a provides the parameters in the REGISTER request (flow 4) which are sent to the HSS.

Table 6.2-5a Cx: User registration status query procedure (I-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
I-CSCF to HSS	Private User Identity	Authorization:	The Private User Identity is encoded according to the Authorization protocol.
	Public User Identity	To:	Identity which is used to communicate with other users
	Visited Network Identifier	Roaming Info: vnid	This information indicates the network identifier of the visited network

6. **REGISTER request (I-CSCF to S-CSCF) – see example in Table 6.2-6**

I-CSCF does not modify the Path header.

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 6.2-6 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

Upon receiving this request the S-CSCF may set its SIP registration timer for this UE to the Expires time in this request or the S-CSCF may assign another registration timer for this registration

7. **Cx: Authentication procedure**

~~On receiving a REGISTER request from an unauthenticated user~~As the REGISTER request arrived without integrity protection to the P-CSCF, the S-CSCF shall challenge it. For this, the S-CSCF requires at least one authentication vector to be used in the challenge to the user. If a valid AV is not available, then the S-CSCF requests at least one AV from the HSS.

The S-CSCF indicates to the HSS that it has been assigned to serve this user.

For detailed message flows see [29.228].

Table 6.2-7a provides the parameters in the REGISTER request (flow 6) which are sent to the HSS.

Table 6.2-7a Cx: S-CSCF authentication information procedure (S-CSCF to HSS)

Message source &	Cx Information element name	Information Source in	Description

destination		REGISTER	
S-CSCF to HSS	Public User Identify	To:	Identity which is used to communicate with other users
	Private User Identity	Authorization:	The Private User Identity is encoded according to the Authorization protocol.
	S-CSCF Name	Request-URI:	This information element contains the name of the S-CSCF. The presence of this IE indicates that the user has not been authenticated yet by the S-CSCF

8. Authentication vector selection

The S-CSCF selects an authentication vector for use in the authentication challenge. For detailed description of the authentication vector, see [33.203].

NOTE: The authentication vector may be of the form [33.203] (if IMS AKA is the selected authentication scheme):
AV = $RAND_n||AUTN_n||XRES_n||CK_n||IK_n$ where
RAND: random number used to generate the XRES, CK, IK, and part of the AUTN. It is also used to generate the RES at the UE.
AUTN: Authentication token (including MAC and SQN)
XRES: Expected (correct) result from the UE
CK: Cipher key (optional)
IK: Integrity key

9. **401 Unauthorized response (S-CSCF to I-CSCF) – see example in Table 6.2-9**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.2-9: 401 Unauthorized response (S-CSCF to I-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Call-ID: apb03a0s09dkjdfglkj49111
WWW-Authenticate: eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)
CSeq: 1 REGISTER
Content-Length: 0
```

NOTE: The actual WWW-Authenticate header value may look like this as it is in base64 form:
WWW-Authenticate: eap eap-p=QWxh4ZGRpb2jpvcGVuNlctZQ==

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

10. **401 Unauthorized response (I-CSCF to P-CSCF) – see example in Table 6.2-10**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.2-10: 401 Unauthorized response (I-CSCF to P-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate:
CSeq:
Content-Length:
```

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

11. **401 Unauthorized response (P-CSCF to UE) – see example in Table 6.2-11**

The P-CSCF removes any keys received in the 401 Unauthorized response and forwards the rest of the response to the UE.

Table 6.2-11: 401 Unauthorized response (P-CSCF to UE)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate: eap eap-p=base64(user1_private1.home1.net, RAND, AUTN)
CSeq:
Content-Length:
```

12. **Generation of response and session keys at UE**

Upon receiving the Unauthorised response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in the REGISTER request

13. **REGISTER request (UE to P-CSCF) – see example in Table 6.2-13**

Table 6.2-13 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49112
Authorization: eap eap-p=base64(user1_private1@home1.net, RES)
CSeq: 2 REGISTER
Expires: 7200
Content-Length: 0
```

Authorization: This carries the response to the authentication challenge received in step 11 along with the private user identity both encoded in base64 format.

14. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify the transport protocol the, P-CSCF selects the UDP.

Table 6.2-14a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC2782 [4].

Table 6.2-14b DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net           0 IN SRV 1 10 5060 icscf1_p.home1.net
                                        0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                 0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                 0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC2782 [4] is used to select the I-CSCF (i.e., the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e., 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e., 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

15. **REGISTER request (P-CSCF to I-CSCF) – see example in Table 6.2-15**

This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.

Table 6.2-15 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization: Integrity-protected=no
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

16. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF name which was previously selected in step 5 (Cx: User registration status query procedure). For detailed message flows see [29.228].

Table 6.2-16a provides the parameters in the REGISTER request (flow 15), which are sent to the HSS.

Table 6.2-16a Cx: User registration status query procedure (I-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description

I-CSCF to HSS	Private User Identity	Authorization:	The Private User Identity is encoded according to the Authorization protocol.
	Public User Identity	To:	Identity which is used to communicate with other users
	Visited Network Identifier	Roaming-Info: vnid	This information indicates the network identifier of the visited network

17. **REGISTER request (I-CSCF to S-CSCF) – see example in Table 6.2-17**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF.

Table 6.2-17 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

18. **Authentication**

Upon receiving ~~the~~ an integrity protected REGISTER request carrying the authentication response, RES, the S-CSCF checks that the user's active, XRES matches the received RES. If the check is successful then the user has been authenticated and the public user identity is registered in the S-CSCF.

19. **Cx: S-CSCF registration notification procedure**

On registering a user the S-CSCF informs the HSS that the user has been registered at this instance.. Upon being requested by the S-CSCF , the HSS will also include the user profile in the response sent to the S-CSCF.

For detailed message flows see [29.228].

Table 6.2-19a provides the parameters in the REGISTER request (flow 17), which are sent to the HSS.

Table 6.2-19a Cx: S-CSCF registration notification procedure (S-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
S-CSCF to HSS	Public User Identify	To:	Identity which is used to communicate with other users

	Private User Identity	Authorization:	The Private User Identity is encoded according to the Authorization protocol. Unique identity in IMS which is used by network to authenticate this user
	S-CSCF name	Request-URI:	This information indicates the serving CSCF's name of that user

20. **200 OK response (S-CSCF to I-CSCF) – see example in Table 6.2-20**

The S-CSCF sends acknowledgement to the I-CSCF indicating that Registration was successful.

Table 6.2-20 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact: sip:[5555::aaa:bbb:ccc:ddd]
CSeq:
Date: Wed, 11 July 2001 08:49:37 GMT
Expires: 7200
Content-Length:
```

Path: The S-CSCF inserts its own name to the front of the list.

21. **200 OK response (I-CSCF to P-CSCF) – see example in Table 6.2-21**

The I-CSCF forwards acknowledgement from the S-CSCF to the P-CSCF indicating that Registration was successful.

Table 6.2-21 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

22. **200 OK response (P-CSCF to UE) – see example in Table 6.2-22**

The P-CSCF removes its address from the Path header, reverses the order of the fields, saves the resulting Path header and associates it with the UE. The P-CSCF then removes the Path header from the 200 OK response. The P-CSCF then forwards acknowledgement from the I-CSCF to the UE indicating that Registration was successful.

Table 6.2-22 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

6.3 Registration signalling: reregistration – user currently registered

For the purpose of the reregistration signalling flow shown in figure 6.3-1, the subscriber is considered to be roaming. The HSS information indicates that the subscriber is registered and authenticated, and that the S-CSCF has been allocated to this subscriber. In this signalling flow, the home network does not have network configuration hiding active. This flow also shows the authentication of the private user identity.

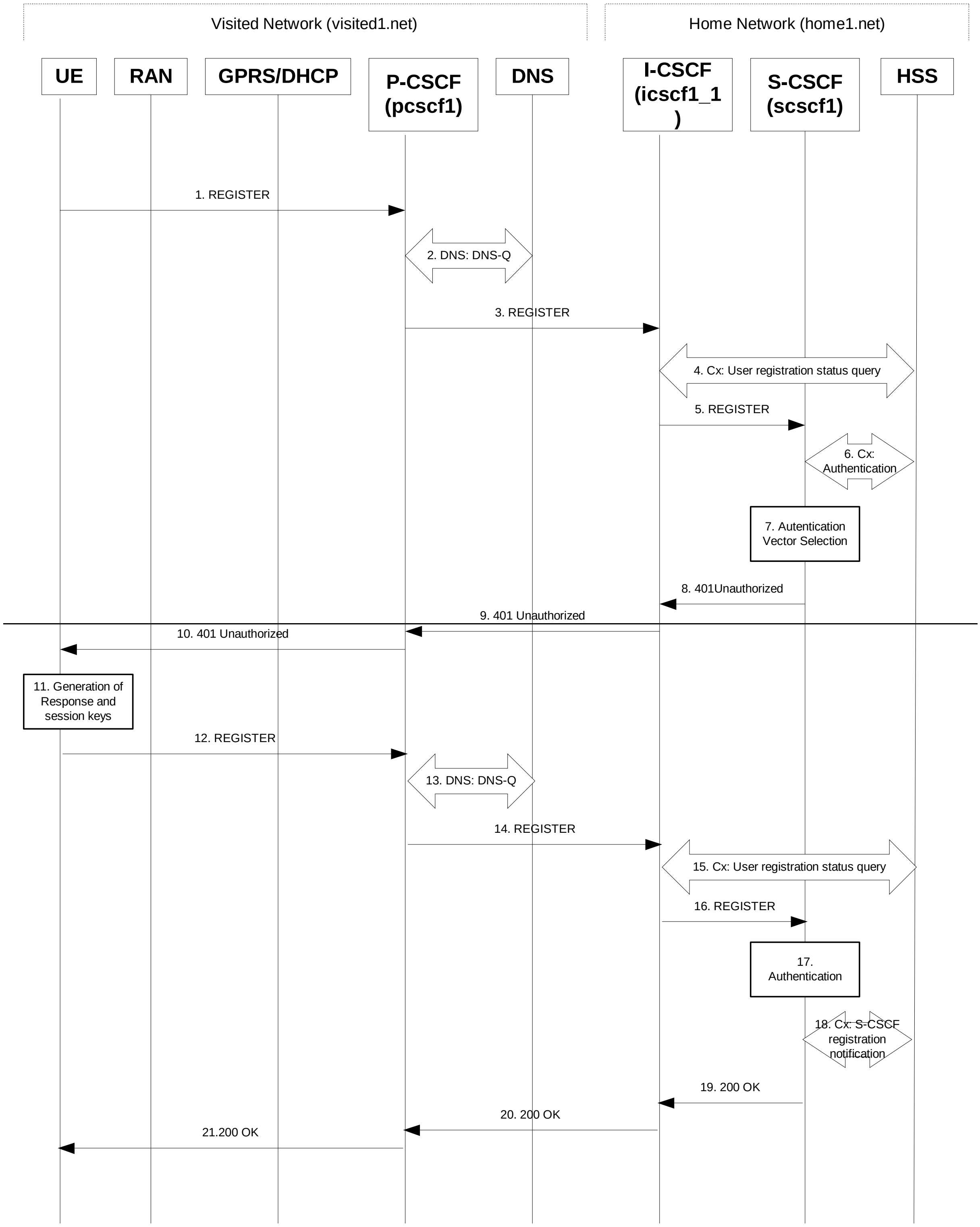
This signalling flow assumes:

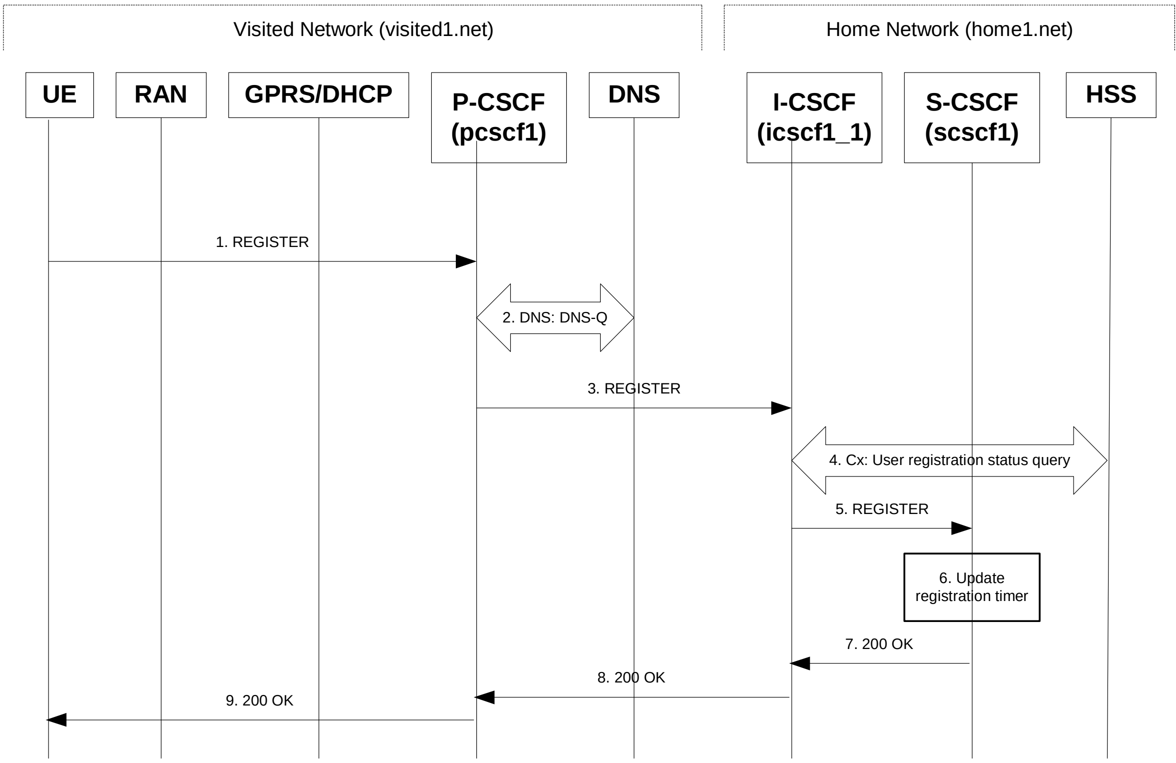
1. That the same PDP Context allocated during the initial registration scenario is still used for reregistration. For the case when the UE does not still have an active PDP context then PDP context procedures from subclause 16.2 is completed first.

   Editor's Note: If the same PDP-Context is not available, is it guaranteed that the UE will get back the same IP address at this point? If this is not possible, would there be a problem with the binding in the P-CSCF (user_public1@home1.net and [5555::aaa:bbb:ccc:ddd])?

2. The DHCP procedure employed for P-CSCF discovery is not needed.

3. The S-CSCF selection procedure invoked by the I-CSCF is not needed.





4.

Figure 6.3-1: Reregistration when UE roaming

1. **REGISTER request (UE to P-CSCF) – see example in Table 6.3-1**

   The registration expires in the UE. The UE reregisters by sending a new REGISTER request. This request is sent to the same P-CSCF with which the UE initially registered. The P-CSCF maintains the same binding between the public user address (user1_public1@home1.net) and the host (terminal) address ([5555::aaa:bbb:ccc:ddd]) which it established during the original registration.

Table 6.3-1 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: eap eap-p=base64(user1_private1@home1.net)
               Integrity-protected=yes
CSeq: 3 REGISTER
Expires: 7200
Content-Length: 0
```

The header field usage is the same as for the initial registration scenario:

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates public user identity being registered. This is the identity by which other parties know this subscriber.

Contact: This indicates the point-of-presence for the subscriber – the IP address of the UE. This is the temporary identifier for the subscriber that is being registered. Subsequent requests destined for this subscriber will be sent to this address. This information is stored in the P-CSCF and the S-CSCF.

Authorization: It carries authentication information. The private user identity (user1_private1@home1.net) is carried in the user ID field of the extensible authentication protocol (EAP).

NOTE: The actual Authorization header value may look like this as it is in base64 form:
Authorization: eap eap-p=QWxhZGRpbjpvcGVuIHNlc2FtZQ==

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Upon receiving this request the P-CSCF will detect that it already has a registration record for this UE and will reset it's SIP registration timer for this UE to the Expires time in this request.

2. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI. The DNS provides the P-CSCF with an address of the I-CSCF in the home network. The P-CSCF must not use the I-CSCF address cached as a result of the previous registration.

3. **REGISTER request (P-CSCF to I-CSCF) – see example in Table 6.3-3**

This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 6.3-3 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

Require, Proxy-Require: These headers are included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating "path". Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

4. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. Because the user has registered, the HSS returns the I-CSCF with the S-CSCF address for the subscriber.

For detailed message flows see [29.228].

For the parameters in the REGISTER request (flow 3) which need to be sent to HSS, see table 6.2-5a.

Table 6.3-4a provides the parameters in the REGISTER request (flow 5), which are obtained from the information sent back from the HSS.

Table 6.3-4a Cx: User registration status query procedure (HSS to I-CSCF)

Message source & destination	Cx Information element name	Mapping to SIP header in REGISTER	Description

HSS to I-CSCF	S-CSCF name	Request-URI:	This information indicates the serving CSCF's name of that user

5. **REGISTER request (I-CSCF to S-CSCF) – see example in Table 6.3-5**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected. The Request-URI is changed to the address of the S-CSCF.

Table 6.3-5 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming_Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

Upon receiving this request the S-CSCF will detect that it already has a registration record for this UE and will reset it's SIP registration timer for this UE to the Expires time in this request.

6. ~~**Cx: Authentication procedure**~~**Update registration timer**

As the REGISTER request arrived integrity protected, the S-CSCF does not need to challenge the user, but just update the registration timer to the value requested by the user (if the policy of the network allows it).

NOTE: The S-CSCF is allowed to challenge the user. If S-CSCF decides to challenge the user, the call flow will be similar to the one presented in section 6.2.

~~On receiving a REGISTER request from a registered user, the S-CSCF requires at least one authentication vector to be used in the challenge to the user. If a valid AV is not available, then the S-CSCF requests at least one AV from the HSS.~~

~~For detailed message flows see [29.228].~~

~~Table 6.3-6a provides the parameters in the REGISTER request (flow 5) which need to been sent to HSS.~~

~~**Table 6.3-6a Cx: S-CSCF authentication information procedure (S-CSCF to HSS)**~~

~~Message source & destination~~	~~Cx Information element name~~	~~Information Source in REGISTER~~	~~Description~~
~~S-CSCF to HSS~~	~~Public User Identify~~	~~To:~~	~~Identity which is used to communicate with other users~~

	~~Private User Identity~~	~~Authorization:~~	~~The Private User Identity is encoded according to the Authorization protocol.~~
	~~S-CSCF name~~	~~Request-URI:~~	~~This information indicates the serving CSCF's name of that user~~

~~7. **Authentication vector selection**~~

~~The S-CSCF selects an authentication vector for use in the authentication challenge. For detailed description of the authentication vector, see [33.203].~~

~~NOTE: The authentication vector may be of the form [33.203] (if IMS AKA is the selected authentication scheme):~~
~~AV = $RAND_n \| AUTN_n \| XRES_n \| CK_n \| IK_n$ where~~
~~RAND: random number used to generate the XRES, CK, IK, and part of the AUTN. It is also used to generate the RES at the UE.~~
~~AUTN: Authentication token (including MAC and SQN)~~
~~XRES: Expected (correct) result from the UE~~
~~CK: Cipher key (optional)~~
~~IK: Integrity key~~

~~8. **401 Unauthorized response (S-CSCF to I-CSCF) – see example in Table 6.3-8**~~

~~The authentication challenge is sent in the 401 Unauthorized response towards the UE.~~

~~**Table 6.3-8: 401 Unauthorized response (S-CSCF to I-CSCF)**~~

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49111
WWW-Authenticate: eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)
CSeq: 1 REGISTER
Expires: 7200
Content-Length: 0
```

~~NOTE: The actual WWW-Authenticate header value may look like this as it is in base64 form:~~
~~WWW-Authenticate: eap eap-p=QWxh4ZGRpb2jpvcGVuNlctZQ==~~

~~Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.~~

~~9. **401 Unauthorized response (I-CSCF to P-CSCF) – see example in Table 6.3-9**~~

~~The authentication challenge is sent in the 401 Unauthorized response towards the UE.~~

~~**Table 6.3-9: 401 Unauthorized response (I-CSCF to P-CSCF)**~~

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Contact:
Call-ID:
WWW-Authenticate:
CSeq:
Expires:
Content-Length:
```

~~Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS~~

~~10. **401 Unauthorized response (P-CSCF to UE) – see example in Table 6.3-10**~~

~~The P-CSCF removes any keys received in the 401 Unauthorized response and forwards the rest of the response to the UE.~~

~~Table 6.3-10: 401 Unauthorized response (P-CSCF to UE)~~

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Contact:
Call-ID:
WWW-Authenticate: eap eap-p=base64(user1_private1.home1.net, RAND, AUTN)
CSeq:
Expires:
Content-Length:
```

~~11. **Generation of response and session keys at UE**~~

~~Upon receiving the Unauthorised response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in a REGISTER request.~~

~~12. **REGISTER request (UE to P-CSCF) – see example in Table 6.3-12**~~

~~Table 6.3-12 REGISTER request (UE to P-CSCF)~~

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49112
Authorization: eap eap-p=base64(user1_private1@home1.net, RES)
CSeq: 4 REGISTER
Expires: 7200
Content-Length: 0
```

~~**Authorization:** This carries the response to the authentication challenge received in step 10 along with the private user identity both encoded in base64 format.~~

~~13. **DNS: DNS-Q**~~

~~Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.~~

~~The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify the transport protocol the, P-CSCF selects the UDP.~~

~~Table 6.3-13a DNS: DNS Query (P-CSCF to DNS)~~

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

~~The DNS records are retrieved according to RFC2782 [4].~~

~~Table 6.3-13b DNS Query Response (DNS to P-CSCF)~~

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net             0 IN SRV 1 10 5060 icscf1_p.home1.net
                                          0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                 0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                 0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

~~In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC2782 [4] is used to select the I-CSCF (i.e., the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e., 5555::aba:dab:aaa:daa), a new query to the DNS is not required.~~

~~Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e., 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.~~

~~14.~~ **~~REGISTER request (P-CSCF to I-CSCF) – see example in Table 6.2-14~~**

~~This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.~~

~~Table 6.3-14 REGISTER request (P-CSCF to I-CSCF)~~

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

~~Path~~~~: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.~~

~~Roaming-Info:~~ ~~The *vnid* parameter contains the identifier of the P-CSCF network at the home network.~~

~~15.~~ **~~Cx: User registration status query procedure~~**

~~The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. Because the user has registered, the HSS returns the I-CSCF with the S-CSCF address for the subscriber.~~

~~For detailed message flows see [29.228].~~

~~For the parameters in the REGISTER request (flow 14) which need to be sent to HSS, see table 6.2-16a.~~

~~Table 6.3-15a provides the parameters in the REGISTER request (flow 16), which are obtained from the information sent back from the HSS~~

~~Table 6.3-15a User registration status query response (HSS to I-CSCF)~~

~~Message source & destination~~	~~Cx Information element name~~	~~Mapping to SIP header in REGISTER~~	~~Description~~

~~HSS to I-CSCF~~	~~S-CSCF name~~	~~Request-URI:~~	~~This information indicates the serving CSCF's name of that user~~

~~16. **REGISTER request (I-CSCF to S-CSCF) – see example in Table 6.3-16**~~

~~This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.~~

~~**Table 6.3-16 REGISTER request (I-CSCF to S-CSCF)**~~

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: ~~The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.~~

~~17. **Authentication**~~

~~Upon receiving the REGISTER request, carrying the authentication response, RES, the S-CSCF checks that the user's active, XRES matches the received RES. If the check is successful then the user has been authenticated and the public user identity is registered in the S-CSCF.~~

~~18. **Cx: S-CSCF registration notification procedure**~~

~~On registering a user the S-CSCF informs the HSS that the user has been re-registered at this instance. For detailed message flows see [29.228].~~

~~19~~7. **200 OK response (S-CSCF to I-CSCF) – see example in Table 6.3-~~19~~7**

The S-CSCF sends acknowledgement to the I-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 6.3-~~19~~ 7 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact: sip:[5555::aaa:bbb:ccc:ddd]
CSeq:
Date: Wed, 11 July 2001 08:49:37 GMT
Expires: 7200
Content-Length:
```

Path: The S-CSCF inserts its own name to the front of the list.

~~20~~8. **200 OK response (I-CSCF to P-CSCF) – see example in Table 6.3-~~20~~8**

The I-CSCF forwards acknowledgement from the S-CSCF to the P-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 6.3-~~20~~ 8 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

~~21~~9. 200 OK response (P-CSCF to UE) – see example in Table 6.3-~~21~~9

The P-CSCF removes its address from the Path header, reverses the order of the fields, saves the resulting Path header and associates it with the UE. The P-CSCF then removes the Path header from the 200 OK response. The P-CSCF then forwards acknowledgement from the I-CSCF to the UE indicating that Registration was successful.

Table 6.3-~~21~~ 9 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

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1. 16 SIGNALLING FLOWS FOR REGISTER (HIDING)

1.1 16.1 Introduction (see 6.1)

16.2 Registration signalling: user not registered

Figure 16.2-1 shows the registration signalling flow for the scenario when the user is not registered. For the purpose of this signalling flow, the subscriber is considered to be roaming. This flow also shows the authentication of the private user identity. In this signalling flow, the home network has network configuration hiding active.

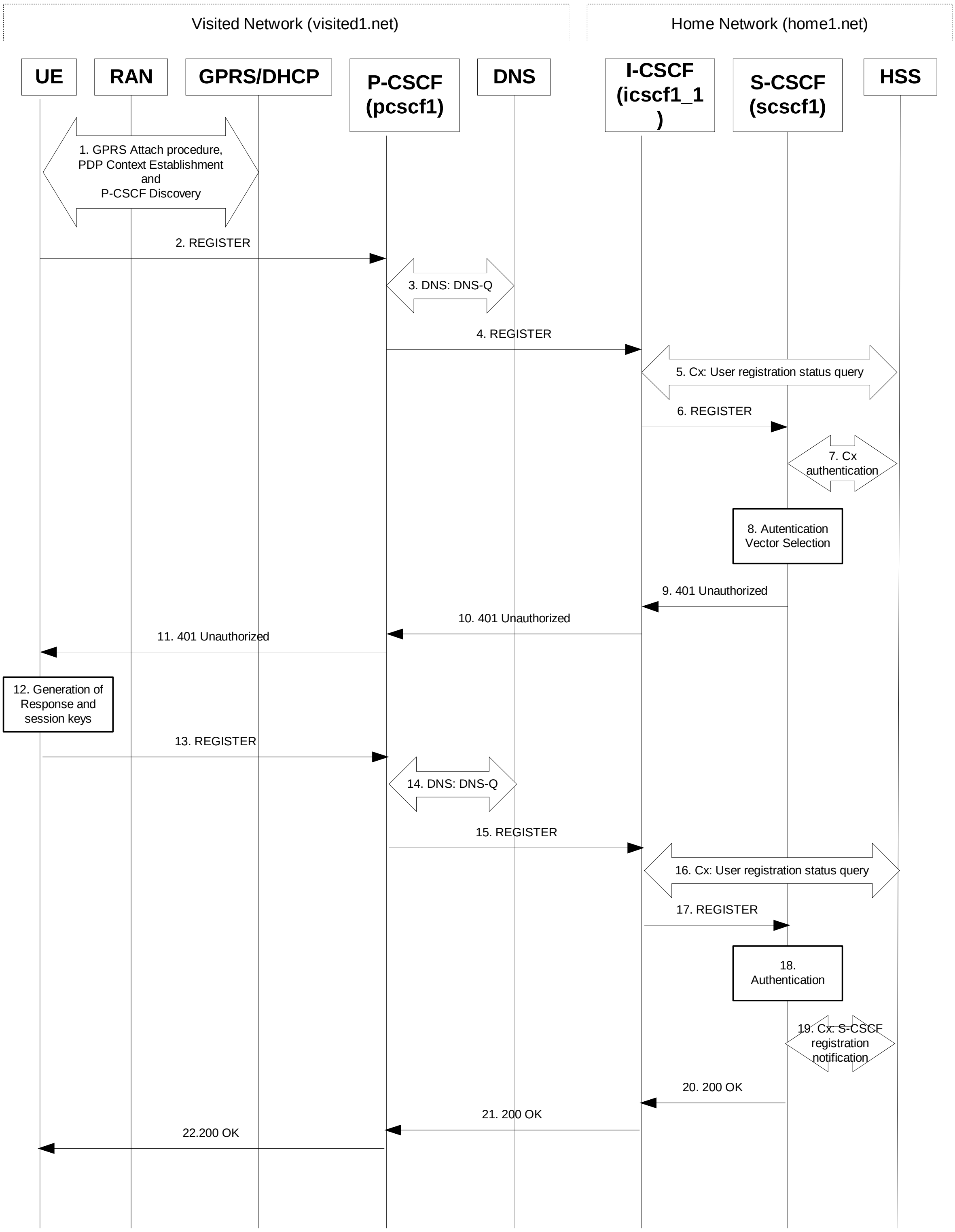


Figure 16.2-1: Registration when UE roaming

1. **GPRS Attach / PDP Context Establishment and P-CSCF Discovery (UE to GPRS)**

   This signalling flow is shown to indicate prerequisites for the registration signalling.

   See Section 5.2 for details.

2. **REGISTER request (UE to P-CSCF) – see example in Table 16.2-2**

   The purpose of this request is to register the user's SIP URI with a S-CSCF in the home network. This request is routed to the P-CSCF because it is the only SIP server known to the UE. In the following SIP request, the Contact field contains the user's host address.

   The P-CSCF will perform two actions, binding and forwarding. The binding is between the User's SIP address (user1_public1@home1.net) and the host (terminal) address ([5555::aaa:bbb:ccc:ddd]) which was acquired during PDP context activation process.

[Editor's note: The security mode set-up procedure supports the negotiation of different protection mechanisms. This will involve the addition of a "security-setup" field to the SIP REGISTER request and the REGISTER response performing the authentication challenge containing the parameters:

list of Authentication (integrity} algorithms, and optionally list of encryption (confidentiality) algorithms

SA-ID that is used to uniquely identify the SA at the receiving side.

Key length: the length of encryption and authentication (integrity) keys is 128 bits.

The exact format and use for the security mode setup is being worked through IETF and is FFS]

Table 16.2-2 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: eap eap-p=base64(user1_private1@home1.net)
CSeq: 1 REGISTER
Expires: 7200
Content-Length: 0
```

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Via: IPv6 PDP address of the SIP session allocated during the PDP Context Activation process.

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM .

To: This indicates the public user identity being registered. This is the identity by which other parties know this subscriber. It may be obtained from the USIM.

Contact: This indicates the point-of-presence for the subscriber – the IP address of the UE. This is the temporary point of contact for the subscriber that is being registered. Subsequent requests destined for this subscriber will be sent to this address. This information is stored in the P-CSCF and S-CSCF.

Editor's note: It is for further study whether this information is stored in the HSS and the S-CSCF for the subscriber in order to support multiple registrations.

Authorization: It carries authentication information. The private user identity (user1_private1@home1.net) is carried in the user ID field of the extensible authentication protocol (EAP).

Upon receiving this request the P-CSCF will set it's SIP registration timer for this UE to the Expires time in this request.

3. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify the transport protocol the, P-CSCF selects the UDP.

Table 16.2-3a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=_sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC2782 [4].

Table 16.2-3b DNS: DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=_sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net           0 IN SRV 1 10 5060 icscf1_p.home1.com
                                        0 IN SRV 1  0 5060 icscf7_p.home1.com

icscf1_p.home1.net                      0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                      0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e., 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e., 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

4. **REGISTER request (P-CSCF to I-CSCF) – see example in Table 16.2-4**

The P-CSCF needs to be in the path for all mobile originated and mobile terminated requests for this user. To ensure this, the P-CSCF adds itself to the path for future requests.

The P-CSCF binds the public user identity under registration to the Contact header supplied by the user.

The P-CSCF adds also the Roaming-Info header (if not present). The P-CSCF adds the *vnid* parameter with the contents of the identifier of the P-CSCF network. This may be the visited network domain name or any other identifier that identifies the visited network at the home network.

This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 16.2-4 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization: Integrity-protected=no
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

Require, Proxy-Require: These headers are included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating "path". Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

5. **Cx: User registration status query procedure**

The I-CSCF makes a request for information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF required capabilities and the I-CSCF uses this information to select a suitable S-CSCF.

For detailed message flows see [29.228].

Table 6.2-5a provides the parameters in the REGISTER request (flow 4) which need to been sent to HSS.

6. **REGISTER request (I-CSCF to S-CSCF) – see example in Table 16.2-6**

I-CSCF adds a proper I-CSCF name to the Path header.

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected. The Request-URI is changed to the address of the S-CSCF.

Table 16.2-6 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
        SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

Upon receiving this request the S-CSCF will set it's SIP registration timer for this UE to the Expires time in this request.

7. **Cx: S-CSCF authentication procedure**

As the REGISTER request arrived without integrity protection to the P-CSCF, the S-CSCF shall challenge it. For this~~On receiving a REGISTER request from an unauthenticated user~~, the S-CSCF requires at least one authentication vector to be used in the challenge to the user. If a valid AV is not available, then the S-CSCF requests at least one AV from the HSS.

For detailed message flows see [29.228].

Table 6.2-7a provides the parameters in the REGISTER request (flow 6) which need to been sent to HSS.

8. **Authentication vector selection**

The S-CSCF selects an authentication vector for use in the authentication challenge. For detailed description of the authentication vector, see [33.203].

NOTE: The authentication vector may be of the form [33.203] (if IMS AKA is the selected authentication scheme):

$$AV = RAND_n||AUTN_n||XRES_n||CK_n||IK_n \text{ where:}$$

RAND: random number used to generate the XRES, CK, IK, and part of the AUTN. It is also used to generate the RES at the UE.
AUTN: Authentication token (including MAC and SQN)
XRES: Expected (correct) result from the UE
CK: Cipher key (optional)
IK: Integrity key

9. **401 Unauthorized response (S-CSCF to I-CSCF) – see example in Table 16.2-9**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 16.2-9: 401 Unauthorized response (S-CSCF to I-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To: <sip:user1_public1@home1.net>; tag=5ef4
Call-ID:
WWW-Authenticate: eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)
CSeq:
Content-Length:
```

NOTE: The actual WWW-Authenticate header value may look like this as it is in base64 form: WWW-Authenticate: eap eap-p=QWxh4ZGRpb2jpvcGVuNlctZQ==

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

10. **401 Unauthorized response (I-CSCF to P-CSCF) – see example in Table 16.2-10**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 16.2-10: 401 Unauthorized response (I-CSCF to P-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate:
CSeq:
Content-Length:
```

Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.

11. **401 Unauthorized response (P-CSCF to UE) – see example in Table 16.2-11**

The P-CSCF removes any keys received in the 401 Unauthorized response and forwards the rest of the response to the UE.

Table 16.2-11: 401 Unauthorized response (P-CSCF to UE)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate:
CSeq:
Content-Length:
```

12. **Generation of response and session keys at UE**

    Upon receiving the Unauthorized response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in the REGISTER request.

13. **REGISTER request (UE to P-CSCF) – see example in Table 16.2-13**

Table 16.2-13 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49112
Authorization: eap eap-p=base64(user1_private1@home1.net, RES)
CSeq: 2 REGISTER
Expires: 7200
Content-Length: 0
```

Authorization: This carries the response to the authentication challenge received in step 11 along with the private user identity both encoded in base64 format.

14. **DNS: DNS-Q**

    Based on the user’s URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

    The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify the transport protocol the, P-CSCF selects the UDP.

Table 16.2-14a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC2782 [4].

Table 16.2-14b DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net          0 IN SRV 1 10 5060 icscf1_p.home1.net
                                       0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC2782 [4] is used to select the I-CSCF (i.e., the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e., 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e., 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

15. **REGISTER request (P-CSCF to I-CSCF) – see example in Table 16.2-15**

This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.

Table 16.2-15 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization: Integrity-protected=yes
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

16. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF required capabilities and the I-CSCF uses this information to select a suitable S-CSCF.

For detailed message flows see [29.228].

Table 6.2-16a provides the parameters in the REGISTER request (flow 15) which need to been sent to HSS.

17. **REGISTER request (I-CSCF to S-CSCF) – see example in Table 16.2-17**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 16.2-17 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

18. **Authentication**

Upon receiving ~~the~~ an integrity protected REGISTER request, carrying the authentication response, RES, the S-CSCF checks that the user's active XRES matches the received RES. If the check is successful then the user has been authenticated and the public user identity is registered in the S-CSCF.

19. **Cx: S-CSCF registration notification procedure**

On registering a user the S-CSCF informs the HSS that the user has been registered at this instance. The HSS stores the S-CSCF name for that subscriber. For a positive response, the HSS will include the user profile in the response sent to the S-CSCF.

For detailed message flows see [29.228].

Table 6.2-19a provides the parameters in the SIP REGISTER request (flow 17) which need to been sent to HSS.

20. **200 OK response (S-CSCF to I-CSCF) – see example in Table 16.2-20**

The S-CSCF sends acknowledgement to the I-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.2-20 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net>, <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact: sip:[5555::aaa:bbb:ccc:ddd]
CSeq:
Date: Wed, 11 July 2001 08:49:37 GMT
Expires: 7200
Content-Length:
```

Path: The S-CSCF inserts its own name to the front of the list.

21. **200 OK response (I-CSCF to P-CSCF) – see example in Table 16.2-21**

The I-CSCF translates the S-CSCF name in the Path header. The I-CSCF forwards acknowledgement from the S-CSCF to the P-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.2-21 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:token(scscf1.home1.net)>, <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

22. **200 OK response (P-CSCF to UE) – see example in Table 16.2-22**

    The P-CSCF removes its address from the Path header, reverses the order of the fields, saves the resulting Path header and associates it with the UE. The P-CSCF then removes the Path header from the 200 OK response. The P-CSCF then forwards acknowledgement from the I-CSCF to the UE indicating that Registration was successful.

Table 16.2-22 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

16.3 Registration signalling: reregistration – user currently registered

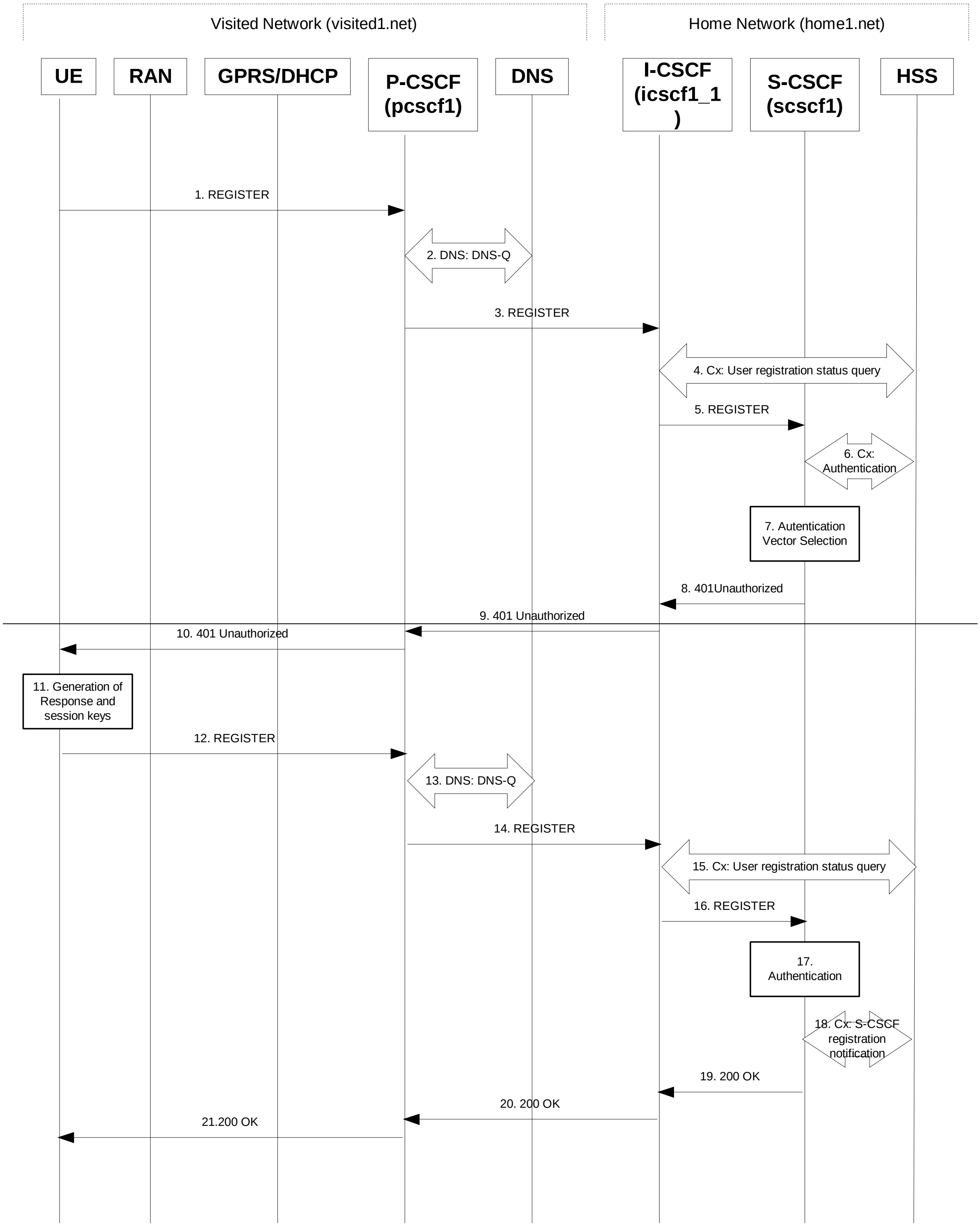
For the purpose of the reregistration signalling flow shown in figure 16.3-1, the subscriber is considered to be roaming. This flow also shows the authentication of the private user identity. In this signalling flow, the home network has network configuration hiding active.

This signalling flow assumes:

1. That the same PDP Context allocated during the initial registration scenario is still used for reregistration. For the case when the UE does not still have an active PDP context then PDP context procedures from subclause 16.2 is completed first.

   Editor's Note: If the same PDP-Context is not available, is it guaranteed that the UE will get back the same IP address at this point? If this is not possible, would there be a problem with the binding in the P-CSCF (user_public1@home1.net and [5555::aaa:bbb:ccc:ddd])?2. The DHCP procedure employed for P-CSCF discovery is not needed.

2. The S-CSCF selection procedure invoked by the I-CSCF is not needed.


Visited Network (visited1.net)
Home Network (home1.net)
UE
RAN
GPRS/DHCP
P-CSCF (pcscf1)
DNS
I-CSCF (icscf1_1)
S-CSCF (scscf1)
HSS
1. REGISTER
2. DNS: DNS-Q
3. REGISTER
4. Cx: User registration status query
5. REGISTER
6. Cx: Authentication
7. Autentication Vector Selection
8. 401Unauthorized
9. 401 Unauthorized
10. 401 Unauthorized
11. Generation of Response and session keys
12. REGISTER
13. DNS: DNS-Q
14. REGISTER
15. Cx: User registration status query
16. REGISTER
17. Authentication
18. Cx: S-CSCF registration notification
19. 200 OK
20. 200 OK
21.200 OK

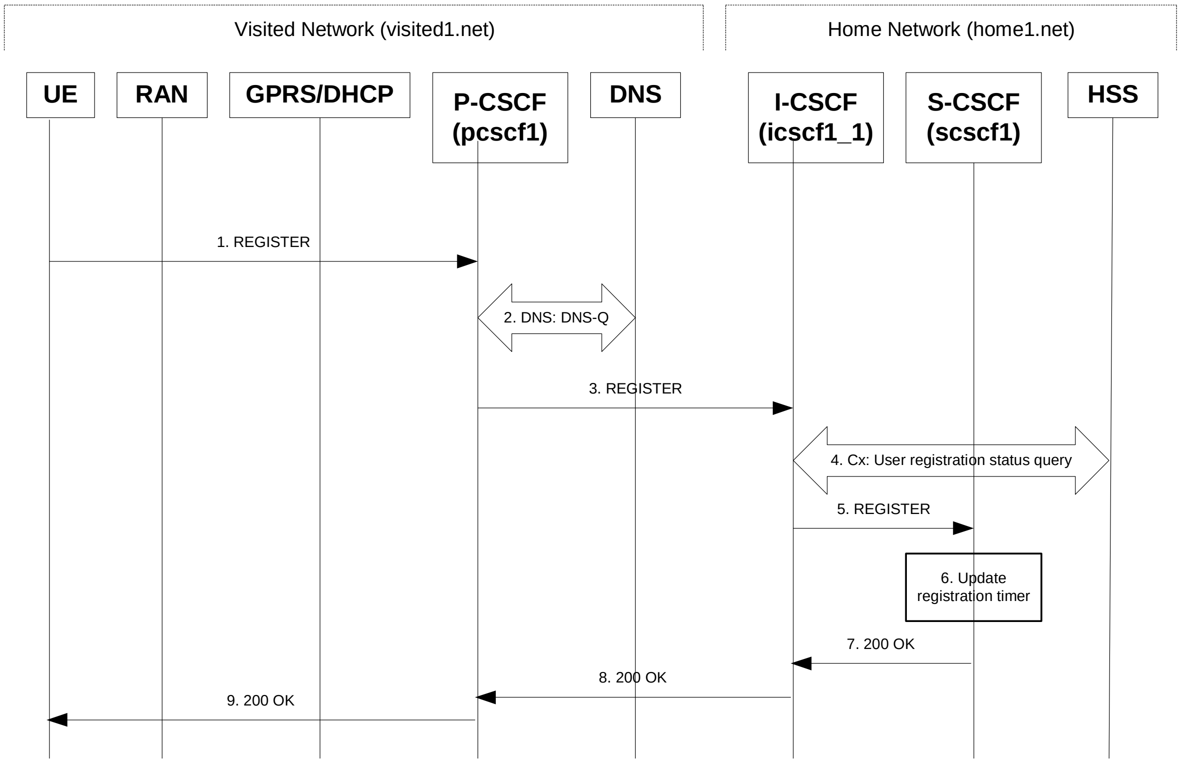


Figure 16.3-1: Reregistration when UE roaming

1. **REGISTER request (UE to P-CSCF) – see example in Table 16.3-1**

   The registration expires in the UE. The UE reregisters by sending a new REGISTER request. This request is sent to the same P-CSCF with which the UE initially registered. The P-CSCF maintains the same binding between the User's SIP public address (user1_public1@home1.net) and the host (terminal) address ([5555::aaa:bbb:ccc:ddd]) which it established during the original registration.

Table 16.3-1 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: eap eap-p=base64(user1_private1@home1.net)
CSeq: 3 REGISTER
Expires: 7200
Content-Length: 0
```

The header field usage is the same as for the initial registration scenario:

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates public user identity being registered. This is the identity by which other parties know this subscriber.

Contact: This indicates the point-of-presence for the subscriber – the IP address of the UE. This is the temporary identifier for the subscriber that is being registered. Subsequent requests destined for this subscriber will be sent to this address. This information is stored in the P-CSCF.

Editor's note: It is for further study whether this information is stored in the HSS and the S-CSCF for the subscriber in order to support multiple registrations.

Authorization: It carries authentication information. The private user identity (user1_private1@home1.net) is carried in the user ID field of the extensible authentication protocol (EAP).

NOTE: The actual Authorization header value may look like this as it is in base64 form:
Authorization: eap eap-p=QWxhZGRpbjpvcGVuIHNlc2FtZQ==

Request-URI: The Request-URI (the URI that follows the method name, “REGISTER”, in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name (“home1.net”) into an address or entry point into the home operator’s network (the I-CSCF). This information is stored in the USIM.

Upon receiving this request the P-CSCF will detect that it already has a registration record for this UE and will reset it’s SIP registration timer for this UE to the Expires time in this request.

2. **DNS: DNS-Q**

Based on the user’s URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI. The DNS provides the P-CSCF with an address of the I-CSCF in the home network. The P-CSCF must not use the I-CSCF address cached as a result of the previous registration.

3. **REGISTER request (P-CSCF to I-CSCF) – see example in Table 16.3-3**

This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 16.3-3 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:Call-ID:
Authorization: ~~eap eap-p=base64(user1_private1@home1.net)~~integrity-protected=yes
CSeq:
Expires:
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.

Require, Proxy-Require: These headers are included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating “path”. Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

4. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. Because the user has registered, the HSS returns the I-CSCF with the S-CSCF address for the subscriber

For detailed message flows see [29.228].

For the parameters in the REGISTER request (flow 3), which are sent to the HSS, see table 6.2-5a.

Table 6.3-4a provides the parameters in the SIP REGISTER request (flow 5), which are obtained from the information sent back from the HSS.

5. **REGISTER request (I-CSCF to S-CSCF) – see example in Table 16.3-5**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected. The Request-URI is changed to the address of the S-CSCF.

I-CSCF adds a proper I-CSCF name to the Path header.

Table 16.3-5 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Authorization: eap eap-p=base64(user1_private1@home1.net)
Call-ID:
CSeq:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.

Roaming-Info: The *vnid* parameter contains the identifier of the P-CSCF network at the home network.

Upon receiving this request the S-CSCF will detect that it already has a registration record for this UE and will reset it's SIP registration timer for this UE to the Expires time in this request.

6. Update registration timer~~Cx: Authentication procedure~~

As the REGISTER request arrived integrity protected, the S-CSCF does not need to challenge the user, but just update the registration timer to the value requested by the user (if the policy of the network allows it).

NOTE: The S-CSCF is allowed to challenge the user. If S-CSCF decides to challenge the user, the call flow will be similar to the one presented in section 16.2.

~~On receiving a REGISTER request from a registered user, the S-CSCF requires at least one authentication vector to be used in the challenge to the user. If a valid AV is not available, then the S-CSCF requests at least one AV from the HSS.~~

~~For detailed message flows see [29.228].~~

~~Table 6.3-6a provides the parameters in the REGISTER request (flow 5), which are sent to the HSS.~~

~~7. **Authentication vector selection**~~

~~The S-CSCF selects an authentication vector for use in the authentication challenge. For detailed description of the authentication vector, see [33.203].~~

~~NOTE 1: The authentication vector may be of the form [33.203] (if IMS AKA is the selected authentication scheme):~~
~~AV = RANDn||AUTNn||XRESn||CKn||IKn where:~~
~~RAND: random number used to generate the XRES, CK, IK, and part of the AUTN. It is also used to generate the RES at the UE~~
~~AUTN: Authentication token (including MAC and SQN)~~
~~XRES: Expected (correct) result from the UE~~
~~CK: Cipher key (optional)~~
~~IK: Integrity key~~

~~8. **401 Unauthorized response (S-CSCF to I-CSCF) – see example in Table 16.3-8**~~

~~The authentication challenge is sent in the 401 Unauthorized response towards the UE.~~

~~**Table 16.3-8: 401 Unauthorized response (S-CSCF to I-CSCF)**~~

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate: eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)
CSeq:
Content-Length:
```

~~NOTE 2: The actual WWW-Authenticate header value may look like this as it is in base64 form:~~
~~WWW-Authenticate: eap eap-p=QWxh4ZGRpb2jpvcGVuNlctZQ==~~

~~Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.~~

~~9. **401 Unauthorized response (I-CSCF to P-CSCF) – see example in Table 16.3-9**~~

~~The authentication challenge is sent in the 401 Unauthorized response towards the UE.~~

~~**Table 16.3-9: 401 Unauthorized response (I-CSCF to P-CSCF)**~~

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate: eap eap-p=base64(user1_private1@home1.net, RAND, AUTN)
CSeq:
Content-Length:
```

~~Editor's Note: The mechanism to transport the session keys (IK and optionally, CK) from the S-CSCF to the P-CSCF is FFS.~~

~~10. **401 Unauthorized response (P-CSCF to UE) – see example in Table 16.3-10**~~

~~The P-CSCF removes any keys received in the 401 Unauthorized response and forwards the rest of the response to the UE.~~

~~**Table 16.3-10: 401 Unauthorized response (P-CSCF to UE)**~~

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
WWW-Authenticate:
CSeq:
Content-Length:
```

~~11. **Generation of response and session keys at UE**~~

~~Upon receiving the Unauthorised response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in the REGISTER request.~~

~~12. **REGISTER request (UE to P-CSCF) – see example in Table 16.3-12**~~

~~**Table 16.3-12 REGISTER request (UE to P-CSCF)**~~

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>
Call-ID: apb03a0s09dkjdfglkj49112
Authorization: eap eap-p=base64(user1_private1@home1.net, RES)
CSeq: 4 REGISTER
Expires: 7200
Content-Length: 0
```

~~**Authorization:** This carries the response to the authentication challenge received in step 10 along with the private user identity both encoded in base64 format.~~

~~13. **DNS: DNS-Q**~~

- ~~Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.~~

- ~~The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify the transport protocol the, P-CSCF selects the UDP.~~

~~Table 16.3-13a DNS: DNS Query (P-CSCF to DNS)~~

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

~~The DNS records are retrieved according to RFC2782 [4].~~

~~Table 16.3-13b DNS Query Response (DNS to P-CSCF)~~

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net             0 IN SRV 1 10 5060 icscf1_p.home1.net
                                          0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                   0 IN AAAA      5555::aba:dab:aaa:daa
icscf7_p.home1.net                   0 IN AAAA      5555::a1a:b2b:c3c:d4d
```

- ~~In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC2782 [4] is used to select the I-CSCF (i.e., the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e., 5555::aba:dab:aaa:daa), a new query to the DNS is not required.~~

- ~~Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e., 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.~~

14. **~~REGISTER request (P-CSCF to I-CSCF) – see example in Table 16.3-14~~**

- ~~This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.~~

~~Table 16.3-14 REGISTER request (P-CSCF to I-CSCF)~~

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require: path
Require: path
Roaming-Info: vnid="Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: ~~This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating sessions.~~

15. **~~Cx: User registration status query procedure~~**

~~The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. Because the user has registered, the HSS returns the I-CSCF with the S-CSCF address for the subscriber.~~

~~- For detailed message flows see [29.228].~~

~~- For the parameters in the REGISTER request (flow 14), which are sent to the HSS, see table 6.2-16a.~~

~~- Table 6.3-15a provides the parameters in the REGISTER request (flow 16), which are obtained from the information sent back from the HSS.~~

~~16. **REGISTER request (I-CSCF to S-CSCF) – see example in Table 16.3-16**~~

~~- This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.~~

~~Table 16.3-16 REGISTER request (I-CSCF to S-CSCF)~~

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:pcscf1.visited1.net>
Proxy-require:
Require:
Roaming-Info:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Expires:
Content-Length:
```

Path: ~~The S-CSCF stores the contents of the Path headers and uses these addresses for routing mobile terminated sessions.~~

~~17. **Authentication**~~

~~Upon receiving the REGISTER request, carrying the authentication response, RES, the S-CSCF checks that the user's active XRES matches the received RES. If the check is successful then the user has been authenticated and the public user identity is registered in the S-CSCF.~~

~~18. **Cx: S-CSCF registration notification procedure**~~

~~On registering a user the S-CSCF informs the HSS that the user has been registered at this instance. The HSS stores the S-CSCF name for that subscriber. For a positive response, the HSS will include the user profile in the response sent to the S-CSCF.~~

~~- For detailed message flows see [29.228]~~

~~- For the parameters in the REGISTER request (flow 16), which are sent to HSS, see table 6.2-19a.~~

7~~19~~. **200 OK response (S-CSCF to I-CSCF) – see example in Table 16.3-7~~19~~**

The S-CSCF sends acknowledgement to the I-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.3-7~~19~~ 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=351g45.1, SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:scscf1.home1.net>, <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact: sip:[5555::aaa:bbb:ccc:ddd]
CSeq:
Date: Wed, 11 July 2001 08:49:37 GMT
Expires: 7200
Content-Length:
```

Path: The S-CSCF inserts its own name to the front of the list.

8~~20~~. **200 OK response (I-CSCF to P-CSCF) – see example in Table 16.3-8~~20~~**

The I-CSCF translates the S-CSCF name in the Path header. The I-CSCF forwards acknowledgement from the S-CSCF to the P-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.3-8~~20~~ 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Path: <sip:token(scscf1.home1.net)>, <sip:icscf1_p.home1.net>, <sip:pcscf1.visited1.net>
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

9~~21~~. 200 OK response (P-CSCF to UE) – see example in Table 16.3-9~~21~~

The P-CSCF removes its address from the Path header, reverses the order of the fields, saves the resulting Path header and associates it with the UE. The P-CSCF then removes the Path header from the 200 OK response. The P-CSCF then forwards acknowledgement from the I-CSCF to the UE indicating that Registration was successful.

Table 16.3-9~~21~~ 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Contact:
CSeq:
Date:
Expires:
Content-Length:
```

3GPP TSG-CN1 Meeting #24 ***Tdoc N1-021416***
Budapest, Hungary, 13. – 17. May 2002

CR-Form-v5

CHANGE REQUEST

⌘	**24.228**	**CR**	**18**	⌘ **rev**	**3**	⌘	Current version:	**5.0.0**	⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [X] Radio Access Network [ ] Core Network [X]

Title:	⌘	General update of sections 10.1, 10.2 and 10.3		
Source:	⌘	Ericsson		
Work item code:	⌘	IMS-CCR	***Date:*** ⌘	14-May-02
Category:	⌘	**F** *Use one of the following categories:* ***F** (correction)* ***A** (corresponds to a correction in an earlier release)* ***B** (addition of feature),* ***C** (functional modification of feature)* ***D** (editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.	***Release:*** ⌘	REL-5 *Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change:	⌘	Changes within RFC 3261 and to the Privacy and Manyfolks drafts require correction of flows in 24.228
Summary of change:	⌘	Update based on latest IETF RFCs and I-Ds, correction of mistakes
Consequences if not approved:	⌘	24.228 call flows are not standard compliant

Clauses affected:	⌘	10.1, 10.2, 10.3		
Other specs affected:	⌘	[X] Other core specifications	⌘	24.229
		[ ] Test specifications		
		[ ] O&M Specifications		
Other comments:	⌘	The updated flow contains the following major changes: - Loose routing adopted (change of Request-URI, Route header fields) - UPDATE method + Manyfolks-05 adopted (change of the figures, SDP, Require, Supported header fields, place of the Resource Reservation box, Content-disposition header field removed) - Max-Forwards header field added to every request - Branch parameters deleted from Route and Record-Route header fields - Anonymity header fields deleted (privacy-04) - RPID-Privacy header field added (privacy-04) - Media-Authorization header field changed to P-Media-Authorization (call-auth-04) - Putting streams on hold follows the procedures in draft-ietf-mmusic-sdp-new-07 (a=inactive) - editorial corrections mistakes update of the description text update of the header descriptions SDP update (missing parameters added)		

	- Hold/Resume procedures are implemented with the UPDATE method

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

10 Procedures to enable enhanced multimedia services (non hiding)

10.1 Session hold and resume procedures

10.1.1 Introduction

This subclause gives signalling flows for the procedures for placing sessions on hold that were previously established by the mechanisms of clause 8, and resuming the session afterwards. Two cases are presented: mobile-to-mobile (UE-UE), and a UE-initiated hold of a UE-PSTN session.

For a multimedia session, it is possible to place a subset of the media streams on hold while maintaining the others.

10.1.2 Mobile-to-mobile session hold and resume procedures

An IM session was previously established between an initiating UE and a terminating UE. Each of these UEs has an associated P-CSCF in the same network where they are currently located (either home or roaming), and a S-CSCF assigned in their home network . These functional elements co-operate to clear the session, and the procedures are independent of whether they are located in the home or visited networks.

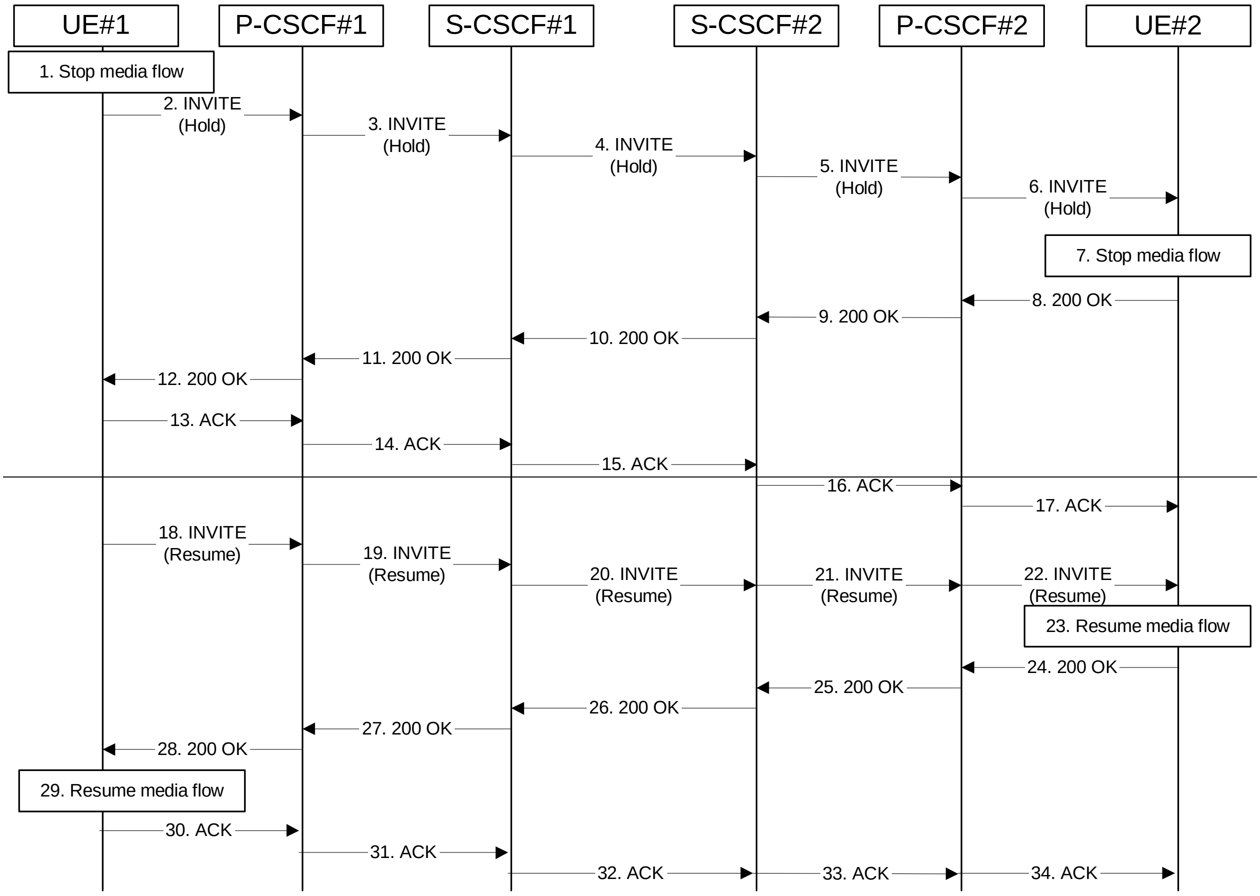
The hold and resume procedures are identical whether the UE that initiated the session also initiates the session-hold, or whether the UE that terminated the session initiates the session-hold.

When a media stream has been placed on hold, it ~~shall~~ should not be resumed by any endpoint other than the one that placed it on hold.

These procedures show only one combination of Mobile-Originated, Serving-to-Serving, and Mobile-Terminated procedures, MO#2, S-S#2, and MT#2. These procedures do not show the use of optional I-CSCFs. If an I-CSCF was included in the signalling path during the session establishment procedure, it would continue to be used in any subsequent signalling flows such as the ones described in this clause. Procedures at the I-CSCFs are identical to those described for the BYE, PRACK, and ~~COMET~~ UPDATE requests and responses described in other clauses.

As this flow does not require a user interaction at the remote end, it is realized with an UPDATE request.

The procedures for placing a media stream on hold, and later resuming the media stream, are as shown in figure 10.1.2-1:.


UE#1
P-CSCF#1
S-CSCF#1
S-CSCF#2
P-CSCF#2
UE#2
1. Stop media flow
2. INVITE (Hold)
3. INVITE (Hold)
4. INVITE (Hold)
5. INVITE (Hold)
6. INVITE (Hold)
7. Stop media flow
8. 200 OK
9. 200 OK
10. 200 OK
11. 200 OK
12. 200 OK
13. ACK
14. ACK
15. ACK
16. ACK
17. ACK
18. INVITE (Resume)
19. INVITE (Resume)
20. INVITE (Resume)
21. INVITE (Resume)
22. INVITE (Resume)
23. Resume media flow
24. 200 OK
25. 200 OK
26. 200 OK
27. 200 OK
28. 200 OK
29. Resume media flow
30. ACK
31. ACK
32. ACK
33. ACK
34. ACK

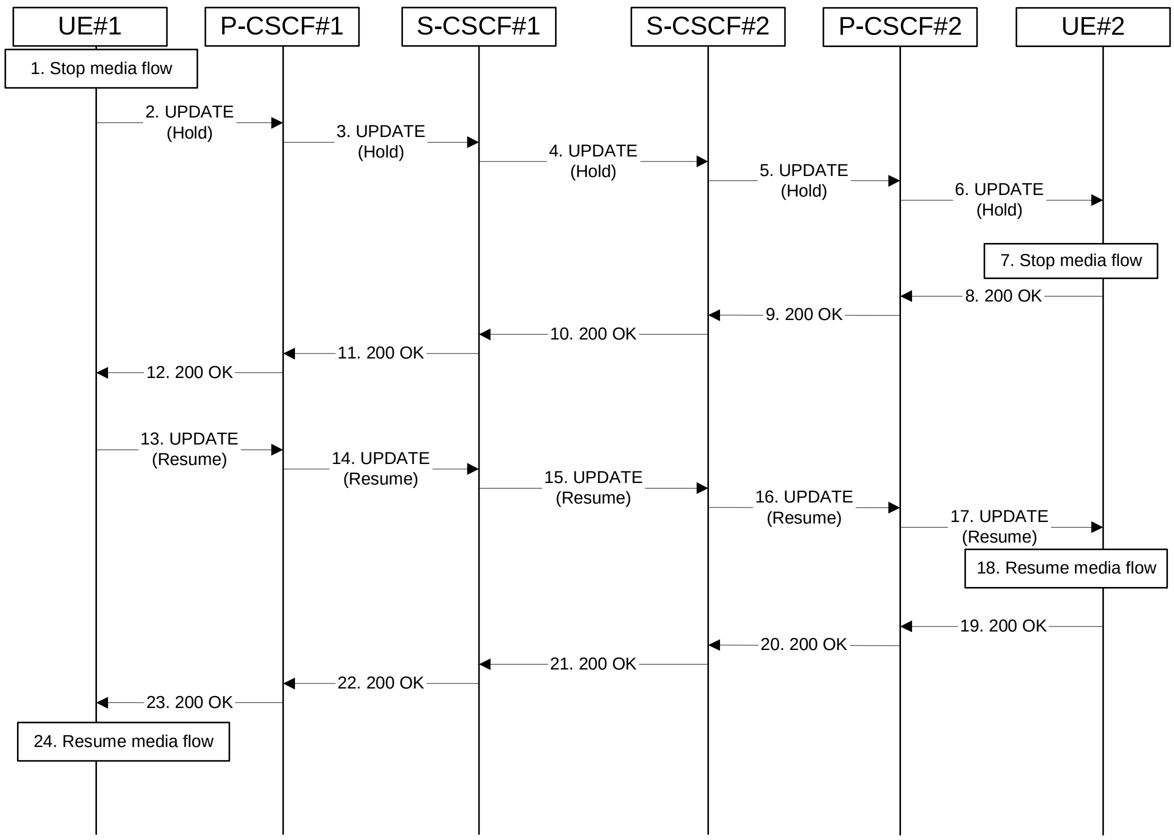

UE#1
P-CSCF#1
S-CSCF#1
S-CSCF#2
P-CSCF#2
UE#2
1. Stop media flow
2. UPDATE (Hold)
3. UPDATE (Hold)
4. UPDATE (Hold)
5. UPDATE (Hold)
6. UPDATE (Hold)
7. Stop media flow
8. 200 OK
9. 200 OK
10. 200 OK
11. 200 OK
12. 200 OK
13. UPDATE (Resume)
14. UPDATE (Resume)
15. UPDATE (Resume)
16. UPDATE (Resume)
17. UPDATE (Resume)
18. Resume media flow
19. 200 OK
20. 200 OK
21. 200 OK
22. 200 OK
23. 200 OK
24. Resume media flow

Figure 10.1.2-1: Mobile to mobile session hold and resume

Signalling flow procedures are as follows:

1. **Stop Media Flow**

   UE#1 detects a request from the subscriber to place a media stream on hold. UE#1 stops sending the media stream to the remote endpoint, but keeps the resources for the session reserved.

2. **~~INVITE~~UPDATE(Hold) (UE to P-CSCF) – see example in table 10.1.2-2**

   UE#1 sends a Hold request to its proxy, P-CSCF#1.

Table 10.1.2-2: ~~INVITE~~UPDATE(Hold) (UE to P-CSCF)

```
INVITEUPDATE sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwads:Max-Forwards: 70
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>
RPID-Rpivacy:off;party=calling
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
    seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 130 INVITEUPDATE
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933616 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=audio 3456 RTP/AVP 97
b=AS:25.4
a=sendonlyinactive
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
```

Request-URI:	Contains the value of the Contact header from the 200 (-OK) response to the initial INVITE.
Via:	Contains the IP address or FQDN of the originating UE.
From:/To:/Call-ID:	Contain the values previously used to establish the session, including the tag value from the response.
Cseq:	Next higher sequential value.
Contact:	Is the SIP URL that contains the IP address or FQDN of the originating UE.
SDP	The sendrecv media stream is placed on hold by changing it to ~~sendonly~~ inactive media stream, and no media is sent to the far end.

3. **~~INVITE~~UPDATE (Hold) (P-CSCF to S-CSCF) – see example in table 10.1.2-3**

   P-CSCF adds a Route header, with the saved value from the previous ~~200 OK~~ 200 (OK) response. ~~P-CSCF identifies the proper saved value by the Request-URI.~~

   P-CSCF#1 forwards the Hold request to S-CSCF#1.

Table 10.1.2-3: ~~INVITE~~UPDATE(Hold) (P-CSCF to S-CSCF)

```
INVITEUPDATE sip:[5555::eee:fff:aaa:bbb]sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-forwards: 69


Record-Route: sip:240f34.1@pcscf1.visited1.net;lr
```

```
Route: sip:scscf1.home1.net;lr, sip:764z87.1@scscf2.home2.net;lr, sip:876t12.1@pcscf2.home2.net;lr,
sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

~~Request-URI:~~ ~~The first component of the saved Route header.Kept unchanged from the Incoming Invite~~

Route: Saved from the ~~200 OK~~ 200 (OK) response to the initial INVITE ~~(with first element moved to Request-URI).~~

4. **~~INVITE~~UPDATE(Hold) (S-CSCF to S-CSCF) – see example in table 10.1.2-4**

S-CSCF#1 forwards the Hold request to S-CSCF#2.

Table 10.1.2-4: ~~INVITE~~UPDATE(Hold) (S-CSCF to S-CSCF)

```
INVITEUPDATE sip:[5555::eee:fff:aaa:bbb] sip:scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-forwards: 68
Route: sip:@scscf2.home2.net–;lr, sip:876t12.1@pcscf2.home2.net;lr, sip:[5555::eee:fff:aaa:bbb]
Record-Route: sip:332b23.1@scscf1.home1.net;lr, sip:240f34.1@pcscf1.visited1.net;lr
From:
To:
Call-ID:
Cseq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

5. **~~INVITE~~UPDATE(Hold) (S-CSCF to P-CSCF) – see example in table 10.1.2-5**

S-CSCF#2 forwards the Hold request to P-CSCF#2.

Table 10.1.2-5: ~~INVITE~~UPDATE(Hold) (S-CSCF to P-CSCF)

```
INVITEUPDATE sip:[5555::eee:fff:aaa:bbb] sip:pcscf2.home2.net
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-forwards: 67

Route: sip:pcscf2.home2.net;lrsip:[5555::eee:fff:aaa:bbb]
Record-Route: sip:764z87.1@scscf2.home2.net;lr, sip:332b23.1@scscf1.home1.net;lr,
    sip:240f34.1@pcscf1.visited1.net;lr
From:
```

```
To:
Call-ID:
Cseq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

6. **~~INVITE~~UPDATE(Hold) (P-CSCF to UE) – see example in table 10.1.2-6**

P-CSCF#2 forwards the Hold request to UE#2.

Table 10.1.2-6: ~~INVITE~~UPDATE(Hold) (P-CSCF to UE)

```
INVITEUPDATE sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=token3
Max-forwards: 66


From:
To:
Call-ID:
Cseq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

~~P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.~~

~~Contact:~~ ~~A locally unique token to identify the saved routing information.~~

Via: P-CSCF removes the Via headers~~, and generates a locally unique token to identify the saved values~~. It inserts this as a branch value on its Via header.

7. **Stop Media flow**

UE#2 stops sending the media stream to the remote endpoint, but keeps the resources for the session reserved.

8. **200-OK (UE to P-CSCF) – see example in table 10.1.2-8**

UE#2 acknowledges receipt of the Hold request (6) with a ~~200-OK~~ 200 (OK) final response, sent to P-CSCF#2.

Table 10.1.2-8: 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via:: SIP/2.0/UDP pcscf2.home2.net;branch=token3
```

```
From:
To:
Call-ID:
CSeq:
Contact: sip:[5555::eee:fff:aaa:bbb]
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615– 2987933616 IN IP6 5555::eee:fff:aaa:bbb
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=audio 6402 RTP/AVP 97
b=AS:25.4
a=recvonlyinactive
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
```

SDP: Since the media stream was offered as ~~sendonly~~inactive, it is marked as ~~recvonly~~ inactive in the response.

9. **200-OK (P-CSCF to S-CSCF) – see example in table 10.1.2-9**

P-CSCF#2 forwards the 200 OK final response to S-CSCF#2.

Table 10.1.2-9: 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:pcscf2.visited2.net;lr, sip:764z87.1@scscf2.home2.net;lr,
    sip:332b23.1@scscf1.home1.net;lr, sip:240f34.1@pcscf1.visited1.net;lr
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

P-CSCF restores the Via headers and Record-Route headers from the branch value in its Via.

~~**Contact:** A locally defined value that identifies the UE.~~

10. **200-OK (S-CSCF to S-CSCF) – see example in table 10.1.2-10**

S-CSCF#2 forwards the 200 OK final response to S-CSCF#1.

Table 10.1.2-10: 200 OK (S-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
```

```
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

11. **200-OK (S-CSCF to P-CSCF) – see example in table 10.1.2-11**

S-CSCF#1 forwards the 200 OK final response to P-CSCF#1.

Table 10.1.2-11: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

12. **200-OK (P-CSCF to UE) – see example in table 10.1.2-12**

P-CSCF#1 forwards the 200 OK final response to UE#1.

Table 10.1.2-12: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.

~~**Contact:** A locally unique token to identify the saved routing information~~

~~13. **ACK (UE to P-CSCF) – see example in table 10.1.2-13**~~

~~Table 10.1.2-13: ACK (UE to P-CSCF)~~

```
ACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 130 ACK
Content-Length: 0
```

~~**Cseq:** Is required to be the same value as Cseq contained in original INVITE request.~~

~~14. **ACK (P-CSCF to S-CSCF) – see example in table 10.1.2-14**~~

~~Table 10.1.2-14: ACK (P-CSCF to S-CSCF)~~

```
ACK sip:[5555::eee:fff:aaa:bbb] sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards :69
Route: sip:scscf1.home1.net;lr, sip:764z87.1@scscf2.home2.net;lr,
sip:361k21.1@pcscf2.visited2.net;lr, sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:

Content-Length:
```

~~15. **ACK (S-CSCF to S-CSCF) – see example in table 10.1.2-15**~~

~~Table 10.1.2-15: ACK (S-CSCF to S-CSCF)~~

```
ACK sip:[5555::eee:fff:aaa:bbb] sip:scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd
Max-Forwards:68
Route: sip:361k21.1@pcscf2.visited2.net;lr, sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Content-Length:
```

~~16. **ACK (S-CSCF to P-CSCF) – see example in table 10.1.2-16**~~

~~Table 10.1.2-16: ACK (S-CSCF to P-CSCF)~~

```
ACK sip:[5555::eee:fff:aaa:bbb] sip:pcscf2.visited2.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards : 67
Route: sip:@pcscf2.visited2.net;lrsip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Content-Length:
```

~~17. **ACK (P-CSCF to UE) – see example in table 10.1.2-17**~~

~~S-CSCF forwards the ACK request to the terminating endpoint, per the S-CSCF to S-CSCF procedure.~~

~~Table 10.1.2-17: ACK (P-CSCF to UE)~~

```
ACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=token3
From:
To:
Call-ID:
Cseq:
Content-Length:
```

~~18~~13. ~~INVITE~~UPDATE(Resume) (Ue to P-CSCF) – see example in table 10.1.2-~~18~~13

UE#1 detects a request from the subscriber to resume the media stream previously placed on hold. UE#1 sends a Resume request to its proxy, P-CSCF#1.

Table 10.1.2-~~18~~13: ~~INVITE~~UPDATE(Resume) (UE to P-CSCF)

```
INVITEUPDATE sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70

From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
    seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 131 INVITEUPDATE
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615– 2987933617  IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=audio 3456 RTP/AVP 97
b=AS:25.4
a=sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
```

Request-URI: Contains the value of the Contact header from the ~~200 OK~~ 200 (OK) response to the initial INVITE.

Via: Contains the IP address or FQDN of the originating UE.

From:/To:/Call-ID: Contain the values previously used to establish the session, including the tag value from the response.

Cseq: Next higher sequential value.

Contact: The IP address or FQDN of the originating UE.

SDP: Same SDP as negotiated during the session setup, restores the sendrecv media stream.

~~19~~14. ~~INVITE~~UPDATE(Resume) (P-CSCF to S-CSCF) – see example in table 10.1.2-14

P-CSCF adds a Route header, with the saved value from the previous ~~200 OK~~ 200 (OK) response. ~~P-CSCF identifies the proper saved value by the Request-URI.~~

P-CSCF#1 forwards the Resume request to S-CSCF#1.

Table 10.1.2-~~19~~14: ~~INVITE~~UPDATE(Resume) (P-CSCF to S-CSCF)

```
INVITEUPDATE sip:[5555::eee:fff:aaa:bbb]sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-forwards: 69
Record-Route: sip:240f34.1@pcscf1.visited1.net;lr
Route: sip:scscf1.home1.net;lr, sip:764z87.1@scscf2.home2.net;lr, sip:876t12.1@pcscf2.home2.net;lr,
sip:[5555::eee:fff:aaa:bbb]
```

```
From:
To:
Call-ID:
Cseq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

~~Request-URI:~~ ~~The first component of the saved Route header.Kept unchanged from the Incoming Invite~~

Route: Saved from the ~~200 OK~~ 200 (OK) response to the initial INVITE ~~(with first element moved to Request-URI).~~

~~Contact:~~ ~~A locally defined value that identifies the UE.~~

~~20~~15. **~~INVITE~~UPDATE(Resume) (S-CSCF to S-CSCF) – see example in table 10.1.2-~~20~~15**

S-CSCF#1 forwards the Resume request to S-CSCF#2.

Table 10.1.2-~~20~~15: ~~INVITE~~UPDATE(Resume) (S-CSCF to S-CSCF)

```
INVITEUPDATE sip:[5555::eee:fff:aaa:bbb]sip:scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-forwards: 68

Route: sip:scscf2.home2.net—;lr, sip:876t12.1@pcscf2.home2.net;lr, sip:[5555::eee:fff:aaa:bbb]
Record-Route: sip:332b23.1@scscf1.home1.net;lr, sip:240f34.1@pcscf1.visited1.net;lr
From:
To:
Call-ID:
Cseq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

~~21~~16. **~~INVITE~~UPDATE(Resume) (S-CSCF to P-CSCF) – see example in table 10.1.2-~~21~~16**

S-CSCF#2 forwards the Resume request to P-CSCF#2.

Table 10.1.2-~~21~~16: ~~INVITE~~UPDATE(Resume) (S-CSCF to P-CSCF)

```
INVITEUPDATE sip:[5555::eee:fff:aaa:bbb]sip:pcscf2.home2.net
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-forwards: 67

Route: sip:pcscf2.visited2home2.net;lr, sip:[5555::eee:fff:aaa:bbb]
Record-Route: sip:764z87.1@scscf2.home2.net;lr, sip:332b23.1@scscf1.home1.net;lr,
    sip:240f34.1@pcscf1.visited1.net
```

```
From:
To:
Call-ID:
Cseq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

~~22~~17. **~~INVITE~~UPDATE(Resume) (P-CSCF to UE) – see example in table 10.1.2-~~22~~17**

P-CSCF#2 forwards the Resume request to UE#2.

Table 10.1.2-~~22~~17: ~~INVITE~~UPDATE(Resume) (P-CSCF to UE)

```
INVITEUPDATE sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=token3
Max-forwards: 66
From:
To:
Call-ID:
Cseq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

~~P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.~~

~~**Contact:** A locally unique token to identify the saved routing information.~~

Via: P-CSCF removes the Via headers~~, and generates a locally unique token to identify the saved values~~. It inserts this as a branch value on its Via header.

~~23~~18. **Resume media flow**

UE#2 resumes sending the media stream to the remote endpoint.

~~24~~19. **200-OK (UE to P-CSCF) – see example in table 10.1.2-~~24~~19**

UE#2 acknowledges receipt of the Resume request (17) with a~~ 200-OK~~ 200 (OK) final response, sent to P-CSCF#2.

Table 10.1.2-~~24~~19: 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf2.home2.net;branch=token3
From:
To:
Call-ID:
```

```
CSeq:
Contact: sip:[5555::eee:fff:aaa:bbb]
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615  2987933617 IN IP6 5555::eee:fff:aaa:bbb
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=audio 6402 RTP/AVP 97
b=AS:25.4
a=sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
```

~~25~~20. **200-OK (P-CSCF to S-CSCF) – see example in table 10.1.2-~~25~~20**

P-CSCF#2 forwards the 200 OK final response to S-CSCF#2.

Table 10.1.2-~~25~~20: 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:pcscf2.visited2.net;lr, sip:764z87.1@scscf2.home2.net;lr,
    sip:332b23.1@scscf1.home1.net;lr, sip:240f34.1@pcscf1.visited1.net;lr
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

~~**Contact:** A locally defined value that identifies the UE.~~

P-CSCF restores the Via headers ~~and Record-Route headers~~ from the branch value in its Via.

~~26~~21. **200-OK (S-CSCF to S-CSCF) – see example in table 10.1.2-~~26~~21**

S-CSCF#2 forwards the 200 OK final response to S-CSCF#1.

Table 10.1.2-~~26~~21: 200 OK (S-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
```

```
t=
m=
b=
a=
a=
a=
```

~~27~~22. **200-OK (S-CSCF to P-CSCF) – see example in table 10.1.2-~~27~~22**

S-CSCF#1 forwards the 200 OK final response to P-CSCF#1.

Table 10.1.2-~~27~~22: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

~~28~~23. **200-OK (P-CSCF to UE) – see example in table 10.1.2-~~28~~23**

P-CSCF#1 forwards the 200 OK final response to UE#1.

Table 10.1.2-~~28~~23: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

~~P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.~~

~~**Contact:** A locally unique token to identify the saved routing information~~

~~29~~24. **UE Resume Media Flow**

~~30. **ACK (UE to P-CSCF) – see example in table 10.1.2-30**~~

~~Table 10.1.2-30: ACK (UE to P-CSCF)~~

```
ACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-forwards: 70
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 131 ACK
Content-Length: 0
```

~~**Cseq:** Is required to be the same value as Cseq contained in original INVITE request~~

~~31. **ACK (P-CSCF to S-CSCF) – see example in table 10.1.2-31**~~

~~Table 10.1.2-31: ACK (P-CSCF to S-CSCF)~~

```
ACK sip:[5555::eee:fff:aaa:bbb]sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Route: sip:scscf1.home1.net ;lr, sip:764z87.1@scscf2.home2.net;lr,
sip:361k21.1@pcscf2.visited2.net;lr, sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:

Content-Length:
```

~~32. **ACK (S-CSCF to S-CSCF) – see example in table 10.1.2-32**~~

~~Table 10.1.2-32: ACK (S-CSCF to S-CSCF)~~

```
ACK sip:[5555::eee:fff:aaa:bbb]sip:scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scscf2.home2.net;lr, sip:361k21.1@pcscf2.visited2.net;lr, sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Content-Length:
```

~~33. **ACK (S-CSCF to P-CSCF) – see example in table 10.1.2-33**~~

~~Table 10.1.2-33: ACK (S-CSCF to P-CSCF)~~

```
ACK sip:[5555::eee:fff:aaa:bbb]sip:pcscf2.visited2.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:pcscf2.visited2.net;lr sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Content-Length:
```

~~34. **ACK (P-CSCF to UE) – see example in table 10.1.2-34**~~

~~Table 10.1.2-34: ACK (P-CSCF to UE)~~

```
ACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=token3
Max-Forwards: 66
```

```
~~From:~~
~~To:~~
~~Call-ID:~~
~~Cseq:~~
~~Content-Length:~~
```

10.1.3 Mobile-initiated hold and resume of a mobile-PSTN session

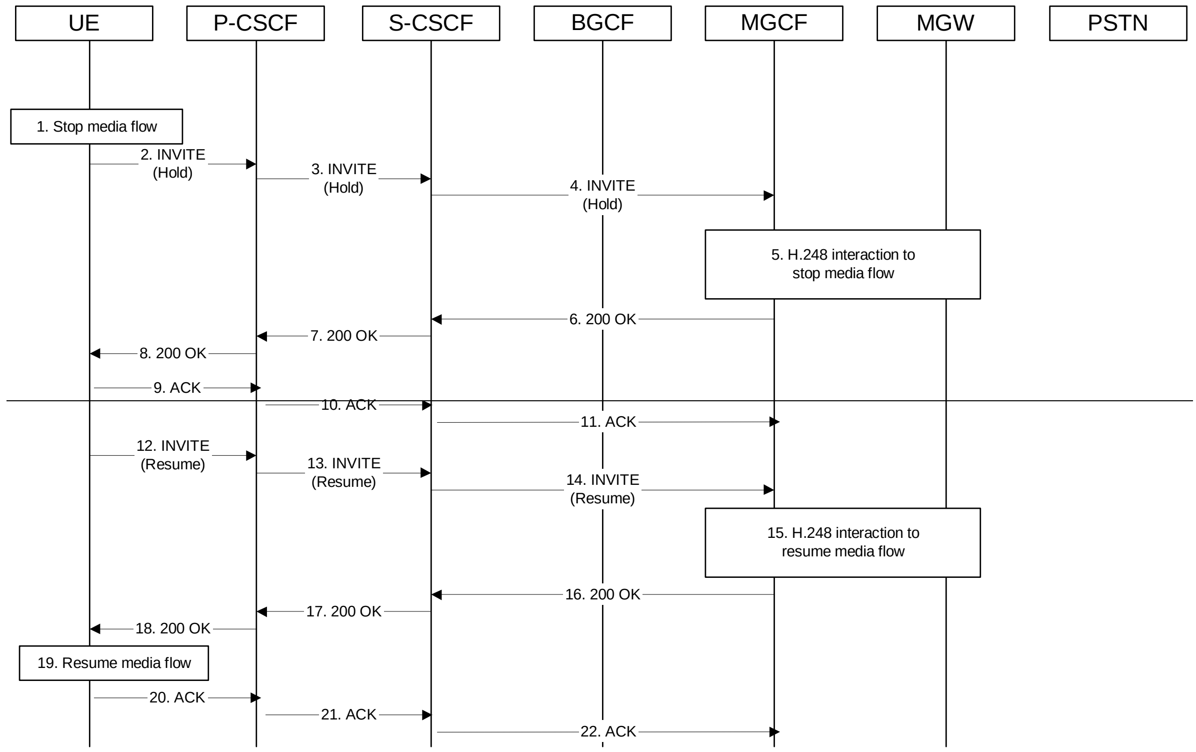
An IM session was previously established between an initiating UE and a MGCF acting as a gateway for a session terminating on the PSTN, or between an initiating MGCF acting as a gateway for a session originating on the PSTN to a terminating UE. The UE has an associated P-CSCF in the same network where it is currently located (either home or roaming), an S-CSCF assigned in its home network, and a BGCF that chooses the MGCF. These functional elements co-operate to clear the session, and the procedures are independent of whether they are located in the subscriber's home or visited networks. Therefore there is no distinction in this clause of home network vs. visited network.

The session hold and resume procedure is similar whether the UE initiated the session to the PSTN, or if the PSTN initiated the session to the UE. The only difference is the optional presence of the BGCF in the case of a session initiated by the UE. The BGCF might or might not be present in the signalling path after the first INVITE is routed.

These procedures show only one combination of Mobile-Originated, Serving-to-Serving, and Mobile-Terminated procedures, MO#2, S-S#3, and CS-T. These procedures do not show the use of optional I-CSCFs, or the use of the BGCF in achieving network configuration independence. If an I-CSCF/BGCF was included in the signalling path during the session establishment procedure, it would continue to be used in any subsequent signalling flows such as the ones described in this clause. Procedures at the I-CSCFs are identical to those described for the BYE, PRACK, and ~~COMET~~ UPDATE requests and responses described in other clauses.

As this flow does not require a user interaction at the remote end, it is realized with an UPDATE request.

The procedures for placing a media stream on hold, and later resuming the media stream, are as shown in figure 10.1.3-1:



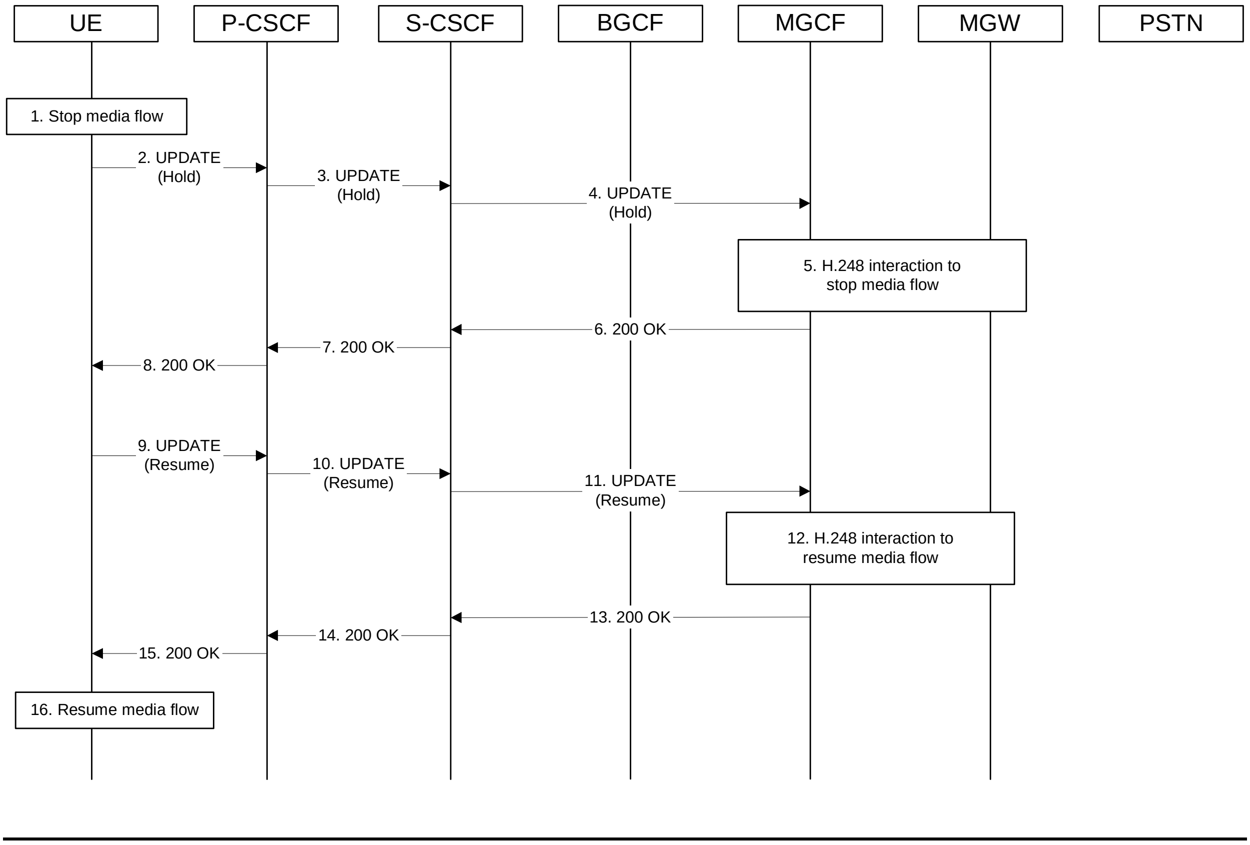


Figure 10.1.3-1: Mobile to PSTN session hold and resume

Signalling flow procedures are as follows:

1. **Stop Media Flow**

   UE#1 detects a request from the subscriber to place a media stream on hold. UE#1 stops sending the media stream to the remote endpoint, but keeps the resources for the session reserved.

2. **~~INVITE~~UPDATE (Hold) (UE to P-CSCF) – see example in 10.1.3-2**

   UE sends a Hold request to its proxy, P-CSCF.

Table 10.1.3-2: ~~INVITE~~UPDATE (Hold) (UE to P-CSCF)

```
INVITEUPDATE sip:mgcf1.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwads:Max-Forwards: 70
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>
RPID-Rpivacy:off;party=calling
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
    seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 130 INVITEUPDATE
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615  2987933616 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=audio 3456 RTP/AVP 97
b=AS:25.4
a=sendonlyinactive
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
```

Request-URI: Contains the value of the Contact header from the ~~200-OK~~ 200 (OK) response to the initial INVITE.

Via: Contains the IP address or FQDN of the originating UE.

From:/To:/Call-ID: Contain the values previously used to establish the session, including the tag value from the response.

Cseq: Next higher sequential value.

Contact: The IP address or FQDN of the originating UE.

SDP The sendrecv media stream is placed on hold by changing it to ~~sendonly~~ inactive media stream, and no media is sent to the far end.

3. **~~INVITE~~UPDATE (Hold) (P-CSCF to S-CSCF) – see example in table 10.1.3-3**

P-CSCF adds a Route header, with the saved value from the previous ~~200-OK~~ 200 (OK) response. ~~P-CSCF identifies the proper saved value by the Request-URI.~~

P-CSCF forwards the Hold request to S-CSCF.

Table 10.1.3-3: ~~INVITE~~UPDATE (Hold) (P-CSCF to S-CSCF)

```
INVITEUPDATE sip:scscf1.home1.netsip:mgcf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwads:Max-Forwards: 69
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>
RPID-Rpivacy:off;party=calling
Record-Route: sip:240f34.1@pcscf1.visited1.net;lr
Route: sip:scscf1.home1.net;lrsip:mgcf1.home1.net
From:
To:
Call-ID:
Cseq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

~~Request-URI:~~ ~~Kept unchanged from the Incoming Invite The first component of the saved Route header.~~

Route: Saved from the ~~200-OK~~ 200 (OK) response to the initial INVITE ~~(with first element moved to Request-URI)~~.

~~Contact:~~ ~~A locally defined value that identifies the UE.~~

4. **~~INVITE~~UPDATE (Hold) (S-CSCF to MGCF) – see example in table 10.1.3-4**

S-CSCF forwards the Hold request to MGCF.

Table 10.1.3-4: ~~INVITE~~UPDATE (Hold) (S-CSCF to MGCF)

```
INVITEUPDATE sip:mgcf1.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
```

```
Max-Forwads:Max-Forwards: 68
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>
RPID-Rpivacy:off;party=calling
Record-Route: sip:332b23.1@scscf1.home1.net;lr, sip:431h23.1@pcscf1.home1.net;lr
From:
To:
Call-ID:
Cseq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

5. **H.248 Interaction to Stop Media flow**

   MGCF initiates a H.248 interaction with MGW instructing it to stop sending the media stream, but to keep the resources for the session reserved.

6. **200-OK (MGCF to S-CSCF) – see example in table 10.1.3-6**

   MGCF acknowledges receipt of the Hold request (4) with a ~~200-OK~~ 200 (OK) final response, sent to S-CSCF.

Table 10.1.3-6: 200 OK (MGCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:scscf1.home1.net;lr, sip:pcscf1.visited1.net;lr
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615  2987933616 IN IP6 5555::eee:fff:aaa:bbb
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=audio 3456 RTP/AVP 97
b=AS:25.4
a=recvonlyinactive
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
```

SDP: Since the media stream was offered as ~~sendonly~~inactive, it is marked as ~~recvonly~~ inactive in the response.

7. **200-OK (S-CSCF to P-CSCF) – see example in table 10.1.3-7**

   S-CSCF forwards the 200 OK final response to P-CSCF.

Table 10.1.3-7: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
From:
To:
```

```
To:
Call-ID:
CSeq:
~~Contact:~~
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

8. **200-OK (P-CSCF to UE) – see example in table 10.1.3-8**

   P-CSCF forwards the 200 OK final response to UE.

Table 10.1.3-8: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

~~P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.~~

~~**Contact:** A locally unique token to identify the saved routing information~~

~~9. **ACK (UE to P-CSCF) – see example in table 10.1.3-9**~~

~~**Table 10.1.3-9: ACK (UE to P-CSCF)**~~

```
~~ACK sip:mgcf1.home1.net SIP/2.0~~
~~Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]~~
~~Max-Forwads: 70~~
~~From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828~~
~~To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159~~
~~Call-ID: cb03a0s09a2sdfglkj490333~~
~~Cseq: 130 ACK~~
~~Content-Length: 0~~
```

~~**Cseq:** Is required to be the same value as Cseq contained in original INVITE request.~~

~~10. **ACK (P-CSCF to S-CSCF) – see example in table 10.1.3-10**~~

~~**Table 10.1.3-10: ACK (P-CSCF to S-CSCF)**~~

```
~~ACK sip:mgcf1.home1.net sip:scscf1.home1.net SIP/2.0~~
```

```
~~Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]~~
~~Max-Forwads: 69~~
~~Route: sip:scscf1.home1.net;lrsip:mgcf1.home1.net~~
~~From:~~
~~To:~~
~~Call-ID:~~
~~Cseq:~~

~~Content-Length:~~
```

~~11. **ACK (S-CSCF to MGCF) – see example in table 10.1.3-11**~~

~~Table 10.1.3-11: ACK (S-CSCF to MGFC)~~

```
~~ACK sip:mgcf1.home1.net SIP/2.0~~
~~Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,~~
    ~~SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]~~
~~Max-Forwads: 68~~
~~From:~~
~~To:~~
~~Call-ID:~~
~~Cseq:~~
~~Content-Length:~~
```

9~~12~~. **~~INVITE~~UPDATE (Resume) (UE to P-CSCF) – see example in table 10.1.3-~~12~~9**

UE detects a request from the subscriber to resume the media stream previously placed on hold. UE sends a Resume request to its proxy, P-CSCF.

Table 10.1.3-~~12~~9: ~~INVITE~~UPDATE (Resume) (UE to P-CSCF)

```
~~INVITE~~UPDATE sip:mgcf1.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
~~Max-Forwads:~~Max-Forwards: 70
~~Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>~~
~~RPID-Rpivacy:off;party=calling~~
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
    seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 131 ~~INVITE~~UPDATE
~~Contact: sip:[5555::aaa:bbb:ccc:ddd]~~
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615  2987933617 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=audio 3456 RTP/AVP 97
b=AS:25.4
a=sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
```

Request-URI:	Contains the value of the Contact header from the~~ 200 OK~~ 200 (OK) response to the initial INVITE.
Via:	Contains the IP address or FQDN of the originating UE.
From:/To:/Call-ID:	Contain the values previously used to establish the session, including the tag value from the response.
Cseq:	Next higher sequential value.
~~**Contact:**~~	~~The IP address or FQDN of the originating UE.~~
SDP	Same SDP as negotiated during the session setup, restores the sendrecv media stream.

~~13~~10. **~~INVITE~~UPDATE (Resume) (P-CSCF to S-CSCF) – see example in table 10.1.3-10**

P-CSCF adds a Route header, with the saved value from the previous ~~200 OK~~ 200 (OK) response~~. P-CSCF identifies the proper saved value by the Request-URI~~.

P-CSCF forwards the Resume request to S-CSCF.

Table 10.1.3-~~13~~10: ~~INVITE~~UPDATE(Resume) (P-CSCF to S-CSCF)

```
INVITEUPDATE sip:mgcf1.home1.net sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwads:Max-Forwards: 69
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>
RPID-Rpivacy:off;party=calling
Record-Route: sip:240f34.1@pcscf1.visited1.net;lr
Route: sip:scscf1.home1.net;lrsip:mgcf1.home1.net
From:
To:
Call-ID:
Cseq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

~~Request-URI:~~ ~~Kept unchanged from the Incoming Invite The first component of the saved Route header.~~

Route: Saved from the ~~200 OK~~ 200 (OK) response to the initial INVITE ~~(with first element moved to Request-URI).~~

~~Contact:~~ ~~A locally defined value that identifies the UE.~~

~~14~~11. **~~INVITE~~UPDATE(Resume) (S-CSCF to MGCF) – see example in table 10.1.3-~~14~~11**

S-CSCF forwards the Resume request to MGCF.

Table 10.1.3-~~14~~11: ~~INVITE~~UPDATE(Resume) (S-CSCF to MGCF)

```
INVITEUPDATE sip:mggcf1.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwads:Max-Forwards: 68
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>
RPID-Rpivacy:off;party=calling
Record-Route: sip:332b23.1@scscf1.home1.net;lr, sip:431h23.1@pcscf1.home1.net;lr
From:
To:
Call-ID:
Cseq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

~~15~~12. **H.248 Interaction to Resume media flow**

MGCF initiates a H.248 interaction with MGW instructing it to resume sending the media stream.

~~16~~13. **~~200-OK~~ 200 OK (MGCF to S-CSCF) – see example in table 10.1.3-~~16~~13**

MGCF acknowledges receipt of the Resume request (11) with a ~~200-OK~~ 200 (OK) final response, sent to S-CSCF.

Table 10.1.3-~~16~~13: 200 OK (MGCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:scscf1.home1.net;lr, sip:pcscf1.visited1.net;lr
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=0
o=- 2987933615  2987933617 IN IP6 5555::eee:fff:aaa:bbb
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=audio 6402 RTP/AVP 97
b=AS:25.4
a=sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
```

~~17~~14. **200-OK (S-CSCF to P-CSCF) – see example in table 10.1.3-~~17~~14**

Table 10.1.3-~~17~~14: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

~~18~~15. **200 -OK (P-CSCF to UE) – see example in table 10.1.3-~~18~~15**

P-CSCF forwards the 200 OK final response to UE.

Table 10.1.3-~~18~~15: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

~~P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.~~

~~**Contact:** A locally unique token to identify the saved routing information.~~

~~19~~16. **Resume Media Flow**

UE resumes sending the media stream to the remote endpoint.

~~20. **ACK (UE to P-CSCF) – see example in table 10.1.3-20**~~

~~Table 10.1.3-20: ACK (UE to P-CSCF)~~

```
ACK sip:mgcf1.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwads: 70
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 131 ACK
Content-Length: 0
```

~~**Cseq:** Is required to be the same value as Cseq contained in original INVITE request.~~

~~21. **ACK (P-CSCF to S-CSCF) – see example in table 10.1.3-21**~~

~~Table 10.1.3-21: ACK (P-CSCF to S-CSCF)~~

```
ACK sip:mgcf1.home1.net sip:scscf1.home1.netc SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwads: 69
Route: sip:scscf1.home1.netsip:mgcf1.home1.net
From:
To:
Call-ID:
Cseq:
Content-Length:
```

~~22. **ACK (S-CSCF to MGCF) – see example in table 10.1.3-22**~~

~~**Table 10.1.3-22: ACK (S-CSCF to MGFC)**~~

```
ACK sip:mggcf1.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]]
Max-Forwads: 68
From:
To:
Call-ID:
Cseq:
Content-Length:
```

10.2 Initiating and destination party identification

10.2.1 Introduction

When the UE (or MGCF) initiates a session in the IM CN subsystem, it ~~shall~~ determines, based on preferences of the initiating user, whether its identity is to be made available to the destination, or to remain anonymous. Three cases ~~shall~~ are~~be~~ distinguished:

1. The initiating user desires his/her identity to be anonymous.
2. The initiating user desires to be identified as the initiator of the session.
3. The initiating user did not state a preference for this session.

The values of the headers "From", "To", "Call-ID", "Remote-Party-ID"~~, and "Contact"~~ and "RPID-Privacy" ~~shall be~~are based on the decision above.

When the UE (or MGCF) receives an incoming session request in the IM CN subsystem, it ~~shall~~ determines, based on preferences of the destination user, whether its identity is to be made available to the initiator or to remain anonymous. Three cases ~~shall~~ are ~~be~~ distinguished:

1. The destination user desires his/her identity to be anonymous.
2. The destination user desires to be identified as the destination of the session.
3. The destination user did not state a preference for this session.

The values of the headers "Remote-Party-ID" and "RPID-Privacy" ~~shall be~~ are based on the decision above.

The rules for processing the header values at a proxy are given in draft-ietf-sip-privacy-04.~~1.~~

10.2.2 IM sessions with session initiator desiring anonymity

If the initiating user desires the session to be anonymous, the following rules ~~shall be~~are followed in generating header values:

From:	UE ~~shall~~ provides an anonymous username ~~cryptographically random identifier for the userinfo, and a non-identifying hostname, e.g. "localhost" in the host name. Username shall be empty~~ .
To:	If a telephone number is used in the addr-spec, the UE ~~shall~~ provides a tel URL containing a full E.164 number including the country code. ~~Otherwise, the UE shall provide a cryptographically random identifier for the userinfo, different from the value of the From header, and a non-identifying hostname, e.g. "localhost" in the host name.~~
Contact:	The userinfo ~~shall~~ is either ~~be~~ empty, or ~~be the same cryptographically random identifier that appears in the From header~~set to anonymous. The hostname ~~shall be~~is an IP address rather than an FQDN.
Remote-Party-ID:	UE ~~shall~~ includes the subscriber identity and URL in the Remote-Party-ID header value~~, with a tag "privacy=full"~~
RPID-Privacy:	UE includes the tag "privacy=full" in the RPID-Privacy header value

An example of an initial INVITE request following the rules for an anonymous session is given in table 10.2.2-1. This revised information would appear as step #1 of MO#1a (subclause 7.2.2), MO#1b (subclause 17.2.2), MO#2 (subclause 7.2.3), and step #4 of CS-O (subclause 7.2.4).

Table 10.2.2-1: INVITE (Anonymous session)

```
INVITE siptel:+1-212-555-2222@home2.net;user=phone SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Supported: 100rel
Max-Forwards: 70
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>;privacy=full
RPID-PrivacyAnonymity: Off privacy=full;party=calling
From: sip:B36(SHA-1(+1-212-555-1111user1_public1@home1.net; time=36123E5B; seq=72))@localhost;
tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333B36(SHA-1(+1-212-555-1111;time=36123E5B;seq=72))@localhost
Cseq: 127 INVITE
Require: precondition
Supported: 100rel
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=audio 3456 RTP/AVP 97 3 96
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecva=qos:mandatory sendrecv
```

From: Contains a cryptographically random identifier for the userinfo, and a non-identifying hostname ("localhost") for the hostname. Username is empty.

To: Contains a cryptographically random identifier for the userinfo, distinct from the value of the From header, and a non-identifying hostname ("localhost") for the hostname. Username is empty.

~~**Call-ID:** Contains a cryptographically random identifier for the useringo, and a non-identifying hostname ("localhost") for the hostname. This value is, in this example, identical to the From header value.~~

The values of From, To, Call-ID, and Remote-Party-ID, as given above, are carried through the INVITE sequence, through the S-CSCF serving the destination subscriber. When S-CSCF#2 forwards the INVITE request to the termination procedure (step #11 of S-S#1a, step #13 of S-S#1b, step#11 of S-S#2, step#4 of MT#1a, step#4 of MT#1b, step#4 of MT#2), the Remote-Party-ID header is updated with a private URL. An example of this INVITE request is given in table 10.2.2-2.

Table 10.2.2-2: INVITE (S-S to MT)

INVITE tel:+1-212-555-22222 ~~sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net~~ SIP/2.0
Max-Forwards: 69
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home2.net, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd])
Route: sip:@pcscf2.~~visited2~~home2.net~~-~~;lr~~, sip:+1-212-555-2222@home2.net;lr;user=phone~~
Record-Route: sip:~~764z87.1~~@scscf2.home2.net;lr, sip:~~332b23.1~~@scscf1.home1.net;lr
~~Supported:~~
Remote-Party-ID: ~~<sip:token(tel:+1-212-555-1111)@scscf2.home2.net;user=private>~~
~~Proxy-Require:~~
RPID-Privacy~~Anonymity~~:
From:
To:
Call-ID:
Cseq:
Supported:
Require:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
a=

Remote-Party-ID: Contains a cryptographically random identifier for the userinfo, generated from the originating subscriber information, and the hostname identifying the S-CSCF that generated the userinfo string. Username is empty.

When an I-CSCF is used to maintain configuration independence, it may (based on operator preferences) update the Remote-Party-ID header in order to hide the S-CSCF address. This occurs in MT#1b step #5. If so, it generates a new private URL with its own hostname. An example of this INVITE request is given in table 10.2.2-3.

Table 10.2.2-3: INVITE (I-CSCF to P-CSCF)

INVITE sip:[5555::eee:fff:aaa:bbb]~~sip:+1-212-555-2222@home2.net;user=phone~~
~~sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net~~ SIP/2.0
Max-Forwards: 68
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home2.net, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd])
Route: sip:@pcscf2.~~visited2~~home2.net;lr~~, sip:+1-212-555-2222@home2.net;lr; user=phone~~
Record-Route: sip:~~764z87.1~~@scscf2.home2.net;lr, sip:~~332b23.1~~@scscf1.home1.net;lr,
sip:pcscf1.home1.net;lr
Supported:
Require:
Remote-Party-ID: <sip:Token(token(tel:+1-212-555-1111)@scscf2.home2.net;
user=private)@icscf.home2.net;~~user=private~~tokenized-by=home2.net>
~~Proxy-Require:~~
RPID-Privacy~~Anonymity~~:
From:
To:
Call-ID:
Cseq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=

```
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

Remote-Party-ID: Contains a cryptographically random identifier for the userinfo, generated from the originating subscriber information, and the hostname identifying the I-CSCF that generated the userinfo string. Username is empty.

10.2.3 IM sessions with session initiator being identified

If the initiating user desires to be identified as the session originator, the following rules ~~shall be~~are followed in generating header values:

From:	UE may provide any of the registered public user identities allocated to the user.~~a cryptographically random identifier for the userinfo, and a non-identifying hostname, e.g. "localhost" in the host name. The username may be provided as an identification string.~~
To:	If a telephone number is used in the addr-spec, the UE may provide a tel URL containing an ~~full~~ E.164 number~~ including the country code~~. Otherwise, the UE may provide the URI of the destination user.~~a cryptographically random identifier for the userinfo, which shall be different from the value of the From header, and a non-identifying hostname, e.g. "localhost" in the host name. The username may be provided as an identification string.~~
Remote-Party-ID:	UE ~~shall~~ includes the subscriber identity and URL in the Remote-Party-ID header value.~~, with a tag "privacy=off"~~
RPID-Privacy:	UE includes the tag "privacy=off" in the RPID-Privacy header value

An example of an initial INVITE request following the rules for an identified session is given in table 10.2.3-1.

Table 10.2.3-1: INVITE (Identified session)

```
INVITE ~~sip~~tel:+1-212-555-2222~~@home2.net;user=phone~~ SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
~~Supported: 100rel~~
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>;~~ privacy=off~~
~~Proxy-Require: privacy~~
RPID-Privacy~~Anonymity~~: privacy=o~~O~~ff;party=calling
From: "Alien Blaster" <~~tel:+1-212-555-1111~~sip:user1_public1@home1.net>;tag=171828
To: ~~sip~~tel:+1-212-555-2222~~@home.net;user=phone~~
Call-ID: cb03a0s09a2sdfglkj490333~~B36(SHA-1(+1-212-555-
1111;time=36123E5B;seq=72))@[5555::aaa:bbb:ccc:ddd]~~
Cseq: 127 INVITE
Require: precondition
Supported: 100rel
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=audio 3456 RTP/AVP 97 3 96
b=AS:25.4
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
```

```
a=des:qos none remote sendrecva=qos:mandatory sendrecv
```

An additional example of signalling flows for this situation, are those contained in clause 8.

10.2.4 IM sessions without initiator preference for anonymity

If the initiating user did not state a preference for whether the session be anonymous, local policies and regulations may force the network operator to make it anonymous. Therefore, the following rules ~~shall be~~are followed in generating header values:

From:	UE ~~shall~~ provides any of the registered public user identities allocated to the user. ~~a cryptographically random identifier for the userinfo, and a non-identifying hostname, e.g. "localhost" in the host name. Username may be empty, or may provide an identifying string. Any identifying string should not identify the subscriber.~~
To:	If a telephone number is used in the addr-spec, the UE ~~shall~~ provides a tel URL containing an~~full~~ E.164 number ~~including the country code~~. Otherwise, the UE ~~shall~~ provides ~~a cryptographically random identifier for the userinfo, different from the value of the From header, and a non-identifying hostname, e.g. "localhost" in the host name.~~the URI of the destination user.
Remote-Party-ID:	UE ~~shall~~ includes the subscriber identity and URL in the Remote-Party-ID header value.~~, without a "privacy" tag.~~
RPID-Privacy:	The UE may specify the tag "privacy=off" in the RPID-Privacy header value

An example of an initial INVITE request following the rules for an unspecified session is given in table 10.2.4-1.

Table 10.2.4-1: INVITE (Unspecified session)

```
INVITE siptel:+1-212-555-2222@home2.net;user=phone SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Supported: 100rel
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>
Proxy-Require: privacy
RPID-PrivacyAnonymity: privacy=oOff;party=calling
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B; seq=72))@localhost>;
    tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333 B36(SHA-1(+1-212-555-1111;time=36123E5B;seq=72))@localhost
Cseq: 127 INVITE
Require: precondition
Supported: 100rel
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=audio 3456 RTP/AVP 97 3 96
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecva=qos:mandatory sendrecv
```

From: Contains a cryptographically random identifier for the userinfo, and a non-identifying hostname ("localhost") for the hostname. Username contains a string that does not identify the subscriber.

To: Contains a cryptographically random identifier for the userinfo, distinct from the value of the From header, and a non-identifying hostname ("localhost") for the hostname. Username is empty.

~~**Call-ID:** Contains a cryptographically random identifier for the useringo, and a non-identifying hostname ("localhost") for the hostname. This value is, in this example, identical to the From header value.~~

The values of From, To, ~~Call-ID, and~~ Remote-Party-ID and RPID-Privacy, as given above, are carried through the INVITE sequence, through the S-CSCF serving the destination subscriber.

Based on local policy or regulatory requirements, the S-CSCF serving the destination subscriber may either allow the identification information to be given to the destination (by following the example in subclause 10.2.2), or may restrict it (by following the example in subclause 10.2.1).

10.2.5 IM sessions with destination requesting privacy~~anonymity~~

If the destination user desires the session to be ~~anonymous~~private, the UE ~~shall~~ indicates this in the value of the ~~Remote-Party-ID~~RPID-Privacy header in the first non-100 response to the initial INVITE. An example of this response from UE to P-CSCF (step#8 of MT#1a, step#10 of MT#1b, step#8 of MT#2), is given in table 10.2.5-1.

Table 10.2.5-1: 183 Session Progress (UE to P-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP pcscf1.visitedhome1.net;branch=token1
Record-Route:
Remote-Party-ID: "John Smith" <tel:+1-212-555-2222>;privacy=full
RPID-PrivacyAnonymity: privacy=Offfull;party=called
Require: 100rel
From:
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost; tag=314159
Call-ID:
CSeq:
Require: 100rel
Contact: sip:[5555::eee:fff:aaa:bbb]
RSeq: 9021
Content-Disposition: precondition
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=audio 6544 RTP/AVP 97
b=AS:25.4 3
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=conf:qos remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=qos:mandatory sendrecv confirm
```

Remote-Party-ID: Identifies the answering subscriber. It contains the public user identity, and the name of the answering party.

RPID-Privacy: The tag "privacy=full" is appended to indicate ~~Anonymity~~ full privacy is requested.

The value of the Remote-Party-ID and RPID-Privacy header is carried through the 183-Session-Progress sequence, to the S-CSCF serving the initiating subscriber. When S-CSCF#1 forwards the 183-Session-Progress response to the originating procedure (step#16 of S-S#1a, step#19 of S-S#1b, step#16 of S-S#2, also step#9 of MO#1a, step#11 of MO#1b, step#9 of MO#2), the Remote-Party-ID header is updated with a private URL. An example of this 183-Session-Progress response is given in table 10.2.5-2.

Table 10.2.5-2: 183 Session Progress (S-SCSF to P-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP pcscf1.visited1home1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
```

```
Record-Route:
Remote-Party-ID: <sip:token(tel:+1-212-555-2222)@scscf1.home1.net;user=private>
RPID-Privacy~~Anonymity~~:
Require:
From:
To:
Call-ID:
CSeq:
Require: 100rel
Contact:
RSeq:
~~Content-Disposition:~~
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

Remote-Party-ID: Contains a cryptographically random identifier for the userinfo, generated from the originating subscriber information, and the hostname identifying the S-CSCF that generated the userinfo string. Username is empty.

When an I-CSCF is used to maintain configuration independence, it may (based on operator preferences) update the Remote-Party-ID header in order to hide the S-CSCF address. This occurs in MO#1b step #12. If so, it generates a new private URL with its own hostname. An example of this INVITE request is given in table 10.2.5-3.

Table 10.2.5-3: 183 Session Progress (S-SCSF to P-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP pcscf1.~~visited1~~home1.net;branch=240f34.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
Remote-Party-ID: <sip:Token(token(tel:+1-212-555-2222)@scscf1.home1.net;
    user=private)@icscf.home1.net;~~user=private~~tokenized-by=home1.net>
RPID-Privacy:~~Anonymity~~:
Require:
From:
To:
Call-ID:
CSeq:
Contact:
RSeq:
~~Content-Disposition:~~
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

Remote-Party-ID: Contains a cryptographically random identifier for the userinfo, generated from the originating subscriber information, and the hostname identifying the I-CSCF that generated the userinfo string. Username is empty.

10.2.6 IM sessions with destination party being identified

If the destination user desires to be identified, the privacy tag of the Remote-Party-ID header indicate "privacy=off". An example of this response from UE to P-CSCF (step#8 of MT#1a, step#10 of MT#1b, step#8 of MT#2), is given in table 10.2.6-1.

Table 10.2.6-1: 183 Session Progress (UE to P-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP ~~pcscf.visited~~pcscf2.visited2.net;branch=token1
Remote-Party-ID: "John Smith" <tel:+1-212-555-2222>~~;privacy=off~~
RPID-Privacy: privacy=off;party=called
~~Anonymity: Off~~
~~Require: 100rel~~
From:
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost; tag=314159
Call-ID:
CSeq:
Require: 100rel
Contact: sip:[5555::eee:fff:aaa:bbb]
RSeq: 9021
~~Content-Disposition: precondition~~
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=audio 6544 RTP/AVP 97
b=AS:25.4~~ 3~~
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=conf:qos remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
~~a=qos:mandatory sendrecv confirm~~
```

Remote-Party-ID: Identifies the answering subscriber. It contains the public user identity, and the name of the answering party.

RPID-Privacy: The tag "privacy=off" is appended to indicate ~~Anonymity~~ privacy is not requested.

An additional example of signalling flows for this situation, are those contained in clause 8.

10.2.7 IM sessions without destination preference for anonymity

If the destination user did not state a preference for whether the session be anonymous, local policies and regulations may force the network operator to make it anonymous. The destination UE indicates its lack of preference by not providing a "privacy" tag on the Remote-Party-ID header. An example of this response from UE to P-CSCF (step#8 of MT#1a, step#10 of MT#1b, step#8 of MT#2), is given in table 10.2.7-1.

Table 10.2.7-1: 183 Session Progress (UE to P-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP ~~pcscf.visited~~pcscf2.visited2.net;branch=token1
Remote-Party-ID: "John Smith" <tel:+1-212-555-2222>
RPID-Privacy: privacy=off;party=called
~~Anonymity: Off~~
~~Require: 100rel~~
From:
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost; tag=314159
```

```
Call-ID:
CSeq:
Require: 100rel
Contact: sip:[5555::eee:fff:aaa:bbb]
RSeq: 9021
Content-Disposition: precondition
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=audio 6544 RTP/AVP 97
b=AS:25.4 3
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=conf:qos remote sendrecv'
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=qos:mandatory sendrecv confirm
```

Remote-Party-ID: Identifies the answering subscriber. It contains the public user identity, and the name of the answering party. The lack of a tag "privacy=" indicates lack of a preference for an anonymous or identified session.

Based on local policy or regulatory requirements, the S-CSCF serving the originating subscriber may either allow the identification information to be given to the initiator (by following the example in subclause 10.2.6), or may restrict it (by following the example in subclause 10.2.5).

10.3 Procedures for codec and media flow negotiations

10.3.1 Introduction

This subclause gives signalling flows for the procedures for determining the set of mutually-supported codecs between the endpoints of a multimedia session, determining the initial codecs to be used for the multimedia session, and the procedures for changing between codecs when multiple ones are supported.

Editor's note: If transcoding is to be supported, these procedures need to be adjusted.

10.3.2 Codec or media flow change within the existing reservation

After the multimedia session is established, it is possible for either endpoint to change the set of media flows or codec for a media flow. If the change is within the resources already reserved, then it is only necessary to synchronise the change with the other endpoint. An admission control decision will not fail if the new resource request is within the existing reservation.

As this flow may require user interaction at the remote end to accept the proposed changes, it is realized with a re-INVITE request.

The signalling flow for changing a codec within an existing reservation is given in figure 10.3.2-1.

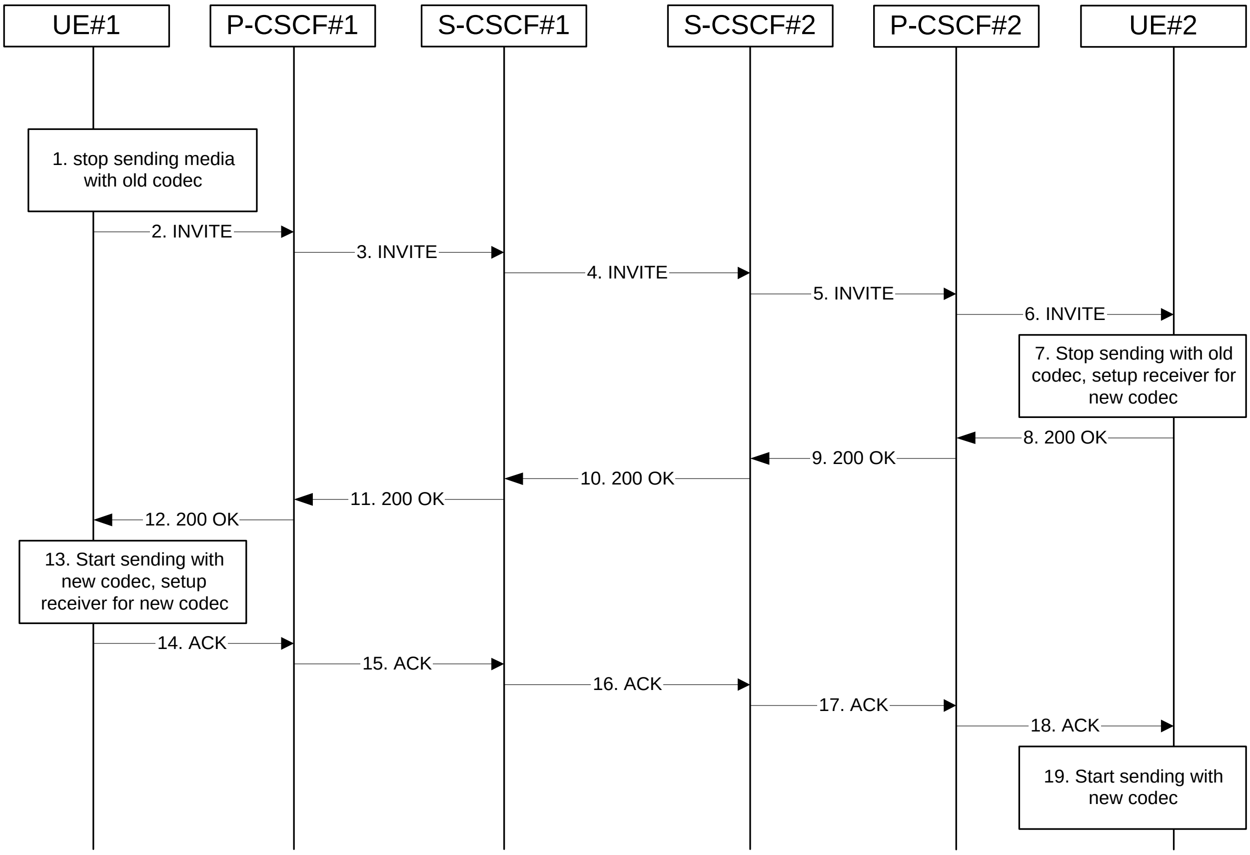


Figure 10.3.2-1: Codec or media flow change - same reservation

For this example, we assume the session was established with authorization for two codecs, AMR and G726-32, but that AMR was initially chosen for the media. UE#1 now desires to change the media to use G726-32.

The detailed procedure is as follows:

1. **UE#1 stops sending media with old codec.**

   UE#1 determines that a new media stream is desired, or that a change is needed in the codec in use for an existing media stream. UE#1 evaluates the impact of this change, and determines the existing resources reserved for the session are adequate. UE#1 builds a revised SDP that includes all the common media flows determined by the initial negotiation, but assigns a codec and port number only to those to be used onward. UE#1 stops transmitting media streams on those to be dropped from the session.

2. **INVITE (UE to P-CSCF) – see example in table 10.3.2-2**

   UE#1 sends the INVITE request to P-CSCF#1 containing this SDP.

Table 10.3.2-2: INVITE (UE to P-CSCF)

```
INVITE sip:[5555::eee:fff:aaa:bbb]sip:user2_public1@home2.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]

Max-Forwards : 70
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>
RPID-Privacy: privacy=off;party=calling
Route: sip:[5555::eee:fff:aaa:bbb]
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
    seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(user2_public1@home2.net; time=36123E5B; seq=73))@localhost;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 131 INVITE
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Content-Type: application/sdp
Content-Length: (…)
```

```
v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP
m=video 0 RTP/AVP
m=audio 3456 RTP/AVP 96
b=AS:25.4
a=rtpmap:96 G726-32/8000
m=audio 0 RTP/AVP
```

Request-URI: Contains the value of the Contact header from the ~~200-OK~~ 200 (OK) response to the initial INVITE.

Via: Contains the IP address or FQDN of the originating UE.

~~**Route:** sip:[5555::eee:fff:aaa:bbb]~~.

From:/To:/Call-ID: Contain the values previously used to establish the session, including the tag value from the response.

Cseq: Next higher sequential value.

Contact: The SIP URI that conatins ~~T~~the IP address or FQDN of the originating UE.

SDP The SDP contains the revised set of codecs desired by UE#1.

3. **INVITE (P-CSCF to S-CSCF) – see example in table 10.3.2-3**

P-CSCF#1 forwards the INVITE request to S-CSCF#1.

Table 10.3.2-3: INVITE (P-CSCF to S-CSCF)

```
INVITE sip:[5555::eee:fff:aaa:bbb]sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards-: 69
Remote-Party-ID:
RPID-Privacy:
Route: sip:scscf1.home1.net-;lr, sip:764z87.1@scscf2.home2.net;lr,
     sip:361k21.1@pcscf2.visited2home2.net;lr
Record-Route: sip:240f34.1@pcscf1.visited1home1.net;lr
From:
To:
Call-ID:
Cseq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
m=
```

~~**Request-URI:** Kept from Incoming Invite The first component of the saved Route header.~~

Route: Saved from the ~~200-OK~~ 200 (OK) response to the initial INVITE ~~(with first element moved to Request-URI).~~

4. **INVITE (S-CSCF to S-CSCF) – see example in table 10.3.2-4**

S-CSCF#1 forwards the INVITE request, through the S-CSCF to S-CSCF signalling flow procedures, to S-CSCF#2.

Table 10.3.2-4: INVITE (S-CSCF to S-CSCF)

```
INVITE sip:[5555::eee:fff:aaa:bbb]sip:scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards-: 68
Remote-Party-ID:
RPID-Privacy:
Route: sip:scscf2.home2.net ;lr, sip:361k21.1@pcscf2.visited2home2.net;lr
Record-Route: sip:332b23.1@scscf1.home1.net;lr, sip:240f34.1@pcscf1.visited1home1.net;lr,
From:
To:
Call-ID:
Cseq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
m=
```

5. **INVITE (S-CSCF to P-CSCF) – see example in table 10.3.2-5**

S-CSCF#3 forwards the INVITE request to P-CSCF#2.

Table 10.3.2-5: INVITE (S-CSCF to P-CSCF)

```
INVITE sip:[5555::eee:fff:aaa:bbb]sip:361k21.1@pcscf2.visited2.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards-: 67
Remote-Party-ID:
RPID-Privacy:
Route: sip:@pcscf2.visited2home2.net;lr  sip:[5555::eee:fff:aaa:bbb]
Record-Route: sip:764z87.1@scscf2.home2.net;lr, sip:332b23.1@scscf1.home1.net;lr,
sip:240f34.1@pcscf1.visited1home1.net;lr,
From:
To:
Call-ID:
Cseq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
m=
```

6. **INVITE (P-CSCF to UE) – see example in table 10.3.2-6**

P-CSCF#2 forwards the INVITE request to UE#2.

Table 10.3.2-6: INVITE (P-CSCF to UE)

```
INVITE sip:[5555::eee:fff:aaa:bbb] SIP/2.0
```

```
Via: SIP/2.0/UDP pcscf2.home2.net;branch=token3
Max-Forwards: 66
Remote-Party-ID:
RPID-Privacy:
P-Media-Authorization: 0020000100100101706366322e78797a2e6e6574000c02013331533134363231
From:
To:
Call-ID:
Cseq:
Contact: token3@pcscf2.home2.net
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
m=
```

~~P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.~~

~~**Contact:**~~ ~~A locally unique token to identify the saved routing information.~~

Via: P-CSCF removes the Via headers~~, and generates a locally unique token to identify the saved values~~. It inserts this as a branch value on its Via header.

P-Media-Authorization: A P-CSCF generated authorization token. This particular example shows a Policy-Element generated by "pcf2.xyz.net" with credentials "31S14621".

7. **UE#2 stops sending with old codec, and initializes receiver for new codec**

   UE#2 receives the INVITE request, and agrees that it is a change within the previous resource reservation. UE#2 stops sending the media streams to be deleted, and initialises its media receivers for the new codec.

   UE#2 may optionally perform an alerting function at this point, and respond to UE#1 with a 180 Ringing provisional response (not shown in figure). When it is ready for the new media stream, UE#2 responds with a 200 OK.

8. **200 OK (UE to P-CSCF) – see example in table 10.3.2-8**

   UE#2 responds to the INVITE request (6) with a 200 OK response, sent to P-CSCF#2.

Table 10.3.2-8: 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf2.home2.net;branch=token3

Remote-Party-ID: "John Smith" <tel:+1-212-555-2222>
RPID-Privacy: privacy=off;party=called
From:
To:
Call-ID:
CSeq: 131 INVITE
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::eee:fff:aaa:bbb
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP
m=video 0 RTP/AVP
m=audio 6544 RTP/AVP 96
b=AS:25.4
```

```
a=rtpmap:96 G726-32/8000
m=audio 0 RTP/AVP
```

9. **200 OK (P-CSCF to S-CSCF) – see example in table 10.3.2-9**

P-CSCF#2 sends the 200 OK response to S-CSCF#2.

Table 10.3.2-9: 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]

Remote-Party-ID:
RPID-Privacy:
Record-Route: sip:764z87.1@scscf2.home2.net;lr, sip:332b23.1@scscf1.home1.net;lr,
sip:240f34.1@pcscf1.visited1home1.net;lr,
From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
m=
```

10. **200 OK (S-CSCF to S-CSCF) – see example in table 10.3.2-10**

S-CSCF#2 sends the 200 OK response to S-CSCF#1.

Table 10.3.2-10: 200 OK (S-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Remote-Party-ID: "John Smith" <tel:+1-212-555-2222>
RPID-Privacy:
Record-Route: sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net,
sip:240f34.1@pcscf1.visited1.net,
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
m=
```

11. **200 OK (S-CSCF to P-CSCF) – see example in table 10.3.2-11**

S-CSCF#1 sends the 200 OK response to P-CSCF#1.

Table 10.3.2-11: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Remote-Party-ID:
RPID-Privacy:
Record-Route:
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
m=
```

12. **200 OK (P-CSCF to UE) – see example in table 10.3.2-12**

P-CSCF#1 sends the 200 OK response to UE#1.

Table 10.3.2-12: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Remote-Party-ID:
RPID-Privacy:
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
m=
```

P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.

~~**Contact:** A locally unique token to identify the saved routing information.~~

13. **UE#1 starts sending with new codec, and initializes receiver for new codec**

UE#1 starts sending media using the new codecs. UE#1 also releases any excess resources no longer needed.

14. **ACK (UE to P-CSCF) – see example in table 10.3.2-14**

UE#1 sends the ACK request to UE#2, along the signalling path established by the INVITE request.

Table 10.3.2-14: ACK (UE to P-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]sip:token6@pcscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards–: 70
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(user2_public1@home2.net; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 131 ACK
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Content-Length: 0
```

15. **ACK (P-CSCF to S-CSCF) – see example in table 10.3.2-15**

    P-CSCF#1 sends the ACK request to S-CSCF#1, along the signalling path established by the INVITE request.

Table 10.3.2-15: ACK (P-CSCF to S-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb] sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:scscf1.home1.net;lr, sip:764z87.1@scscf2.home2.net;lr,
sip:361k21.1@pcscf2.visited2.net;lr
From:
To:
Call-ID:
Cseq:
Content-Length:
```

~~**Request-URI:** The first component of the saved Route header.~~

Route: Saved from the 200 OK response (with first element moved to Request-URI).

16. **ACK (S-CSCF to S-CSCF) – see example in table 10.3.2-16**

    S-CSCF#1 sends the ACK request to S-CSCF#2, along the signalling path established by the INVITE request.

Table 10.3.2-16: ACK (S-CSCF to S-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]sip:scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scscf2.home2.net;lr,sip:361k21.1@pcscf2.visited2.net;lr
From:
To:
Call-ID:
Cseq:
Contact:
Content-Length:
```

17. **ACK (S-CSCF to P-CSCF) – see example in table 10.3.2-17**

    S-CSCF#2 sends the ACK request to P-CSCf#2, along the signalling path established by the INVITE request.

Table 10.3.2-17: ACK (S-CSCF to P-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb] sip:361k21.1@pcscf2.visited2.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:@pcscf2..net;lr
From:
To:
Call-ID:
Cseq:
```

```
Contact:
Content-Length:
```

18. **ACK (P-CSCF to UE) – see example in table 10.3.2-18**

P-CSCF#2 sends the ACK request to UE#2, along the signalling path established by the INVITE request.

Table 10.3.2-18: ACK (P-CSCF to UE)

```
ACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1;branch=token5
Max-Forwards: 66
From:
To:
Call-ID:
Cseq:
Content-Length:
```

~~P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.~~

Via: P-CSCF removes the Via headers~~, and generates a locally unique token to identify the saved values~~. It inserts this as a branch value on its Via header.

19. **UE#2 starts sending with new codec**

UE#2 starts sending media using the new codecs. UE#2 also releases any excess resources no longer needed.

10.3.3 Codec or media flow change requiring new resources and/or authorisation

After the multimedia session is established, it is possible for either endpoint to change the set of media flows or codec for a media flow. If the change requires additional resources beyond those previously reserved, then it is necessary to perform the resource reservation and bearer establishment procedures. If the reservation request fails for whatever reason, the original multimedia session remains in progress.

An example signalling flow for a codec or media flow change requiring new resources and/or authorization is given in figure 10.3.3-1. This example shows mobile originated while in home network, establishing a session with another mobile served by the same network operator, also in its home network (MO#2, S-S#2, MT#2). Other configurations may include I-CSCFs in the signalling path; procedures at the I-CSCFs are identical to those described for the BYE, PRACK, and ~~COMET~~ UPDATE requests and responses described in other clauses.

As this flow may require user interaction at the remote end to accept the proposed changes, it is realized with a re-INVITE request.

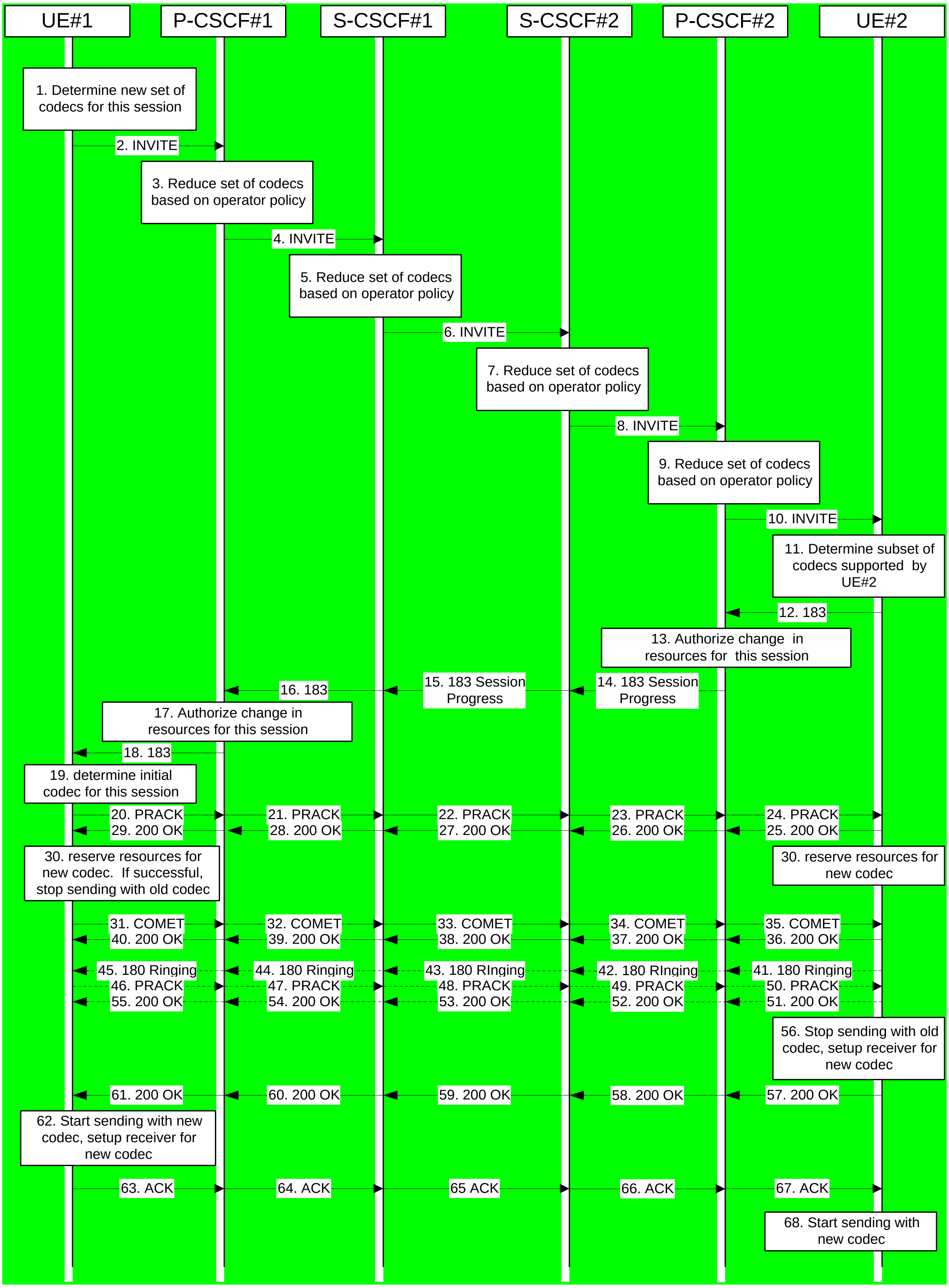


Figure 10.3.3-1: Codec or media flow change - new reservation

The detailed procedure is as follows:

1. **Determine new set of codecs for this session**

   UE#1 determines the revised set of codecs or media streams that it is wishes to support for this session. It builds a SDP containing bandwidth requirements and characteristics of each, and assigns local port numbers for each possible media flow. Multiple media flows may be offered, and for each media flow (m= line in SDP), there may be multiple codec choices offered.

   For this example, assume UE#1 originally established the session using audio (AMR) only, and now wishes to change to stereo (using the L16 2-channel codec, RTP/AVP code 10) and add an additional video media stream (MPV).

2. **INVITE (UE to P-CSCF) – see example in table 10.3.3-2**

   UE#1 sends the INVITE request to P-CSCF#1 containing this SDP.

Table 10.3.3-2: INVITE (UE to P-CSCF)

```
INVITE sip:[5555::eee:fff:aaa:bbb]sip:token6@pcscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>
RPID-Privacy: privacy=off;party=calling
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
    seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 131 INVITE
Require: precondition
Supported: 100rel
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 3400 RTP/AVP 99
b=AS:54.6
a=qos:mandatory sendrecv a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=audio 3456 RTP/AVP 10
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecva=qos:mandatory sendrecv
```

Request-URI:	Contains the value of the Contact header from the ~~200 OK~~ 200 (OK) response to the initial INVITE.
Via:	Contains the IP address or FQDN of the originating UE.
From:/To:/Call-ID:	Contain the values previously used to establish the session, including the tag value from the response.
Cseq:	Next higher sequential value.
Contact:	The SIP URL that contains the IP address or FQDN of the originating UE.
SDP	The SDP contains the revised set of codecs desired by UE#1.

3. **P-CSCF reduces set of supported codecs based on operator policy**

P-CSCF#1 examines the media parameters, and removes any choices that the network operator decides based on local policy, not to allow on the network.

4. **INVITE (P-CSCF to S-CSCF) – see example in table 10.3.3-4**

   P-CSCF#1 forwards the INVITE request to S-CSCF#1.

Table 10.3.3-4: INVITE (P-CSCF to S-CSCF)

```
INVITE sip:[5555::eee:fff:aaa:bbb]sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Remote-Party-ID:
RPID-Privacy:
Route: sip:scscf1.home1.net ;lr, sip:764z87.1@scscf2.home2.net;lr,
sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.homepcscf2.visited2home2.net;lr
Record-Route: sip:@pcscf1.home1.net;lr
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact: sip:%5b5555%3a%3aaaa%3abbb%3accc%3addd%5d@pcscf1.home1.net
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
```

~~**Request-URI:**~~ Kept from Incoming Invite~~The first component of the saved Route header.~~

Route: Saved from the ~~200-OK~~ 200 (OK) response to the initial INVITE ~~(with first element moved to Request-URI).~~

~~**Contact:** A locally defined value that identifies the UE.~~

5. **S-CSCF reduces set of supported codecs based on operator policy**

   S-CSCF#1 examines the media parameters, and removes any choices that the subscriber does not have authority to request.

6. **INVITE (S-CSCF to S-CSCF) – see example in table 10.3.3-6**

   S-CSCF#1 forwards the INVITE request, through the S-CSCF to S-CSCF signalling flow procedures, to S-CSCF#2.

Table 10.3.3-6: INVITE (S-CSCF to S-CSCF)

```
INVITE sip:[5555::eee:fff:aaa:bbb]sip:scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Remote-Party-ID:
RPID-Privacy:
```

```
Route: sip:scscf2.home2.net ;lr,
sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.homepcscf2.home2.net;lr
Record-Route: sip:332b23.1@scscf1.home1.net;lr , sip:@pcscf1.home1.net;lr
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
```

7. **S-CSCF reduces set of supported codecs based on operator policy**

   S-CSCF#2 examines the media parameters, and removes any choices that the destination subscriber does not have authority to request.

8. **INVITE (S-CSCF to P-CSCF) – see example in table 10.3.3-8**

   S-CSCF#3 forwards the INVITE request to P-CSCF#2.

Table 10.3.3-8: INVITE (S-CSCF to P-CSCF)

```
INVITE sip:[5555::eee:fff:aaa:bbb]sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Remote-Party-ID:
RPID-Privacy:
Record-Route: sip:764z87.1@scscf2.home2.net;lr, sip:332b23.1@scscf1.home1.net;lr,
sip:@pcscf1.home1visited1.net;lr
Route : sip:@pcscf2.visited2home2.net;lr
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
m=
```

```
b=
a=
a=
a=
a=
```

9. **P-CSCF reduces set of supported codecs based on operator policy**

   P-CSCF#2 examines the media parameters, and removes any that the network operator decides, based on local policy, not to allow on the network.

10. **INVITE (P-CSCF to UE) – see example in table 10.3.3-10**

    P-CSCF#2 forwards the INVITE request to UE#2.

Table 10.3.3-10: INVITE (P-CSCF to UE)

```
INVITE sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=token3
Max-Forwards: 66
Remote-Party-ID:
RPID-Privacy:
P-Media-Authorization: 0020000100100101706366322e78797a2e6e6574000c02013331533134363231
From:
To:
Call-ID:
Cseq:
Require:
Supported:

Contact: token3@pcscf2.home2.net
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
```

P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.

~~**Contact:**~~ ~~A locally unique token to identify the saved routing information.~~

Via: P-CSCF removes the Via headers~~, and generates a locally unique token to identify the saved values~~. It inserts this as a branch value on its Via header.

P-Media-Authorization: A P-CSCF generated authorization token. This particular example shows a Policy-Element generated by "pcf2.xyz.net" with credentials "31S14621".

11. **Determine ~~sub~~set of codecs supported by UE#2**

    UE#2 determines the ~~sub~~set of codecs that it is capable of supporting for this session.~~ It determines the intersection of those it supports with those appearing in the SDP in the INVITE request. For each media flow that is not supported, UE#2 inserts a SDP entry for media (m= line) with port=0. For each media flow that is~~

~~supported, UE#2 inserts a SDP entry with an assigned port and with the codecs in common with those in the SDP from UE#1.~~

For this example, assume UE#2 supports all those requested by UE#1.

12. **183 Session Progress (UE to P-CSCF) – see example in table 10.3.3-12**

UE#2 returns a 183 Session Progress response, containing ~~SDP listing common media flows and codec~~the SDP answer~~s~~, to P-CSCF#2.

Table 10.3.3-12: 183 Session Progress (UE to P-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP pcscf2.visitedhome2.net;branch=token3
Require: 100rel
Remote-Party-ID: "John Smith" <tel:+1-212-555-2222>
RPID-Privacy: privacy=off;party=called
From:
To:
Call-ID:
CSeq:
Contact: sip:[5555::eee:fff:aaa:bbb]
RSeq: 18
Content-Disposition: precondition
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::eee:fff:aaa:bbb
s=-
c=IN IP6 5555::-eee:fff:aaa:bbb
t=907165275 0
m=video 6540 RTP/AVP 99
b=AS:54.6
a=qos:mandatory sendrecv confirm
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=conf:qos remote sendrecv
a=rtpmap:99:MPV
m=audio 6544 RTP/AVP 10
b=AS:25.4
a=qos:mandatory sendrecv confirm
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=conf:qos remote sendrecv
```

SDP The SDP contains ~~the subset of codecs~~an answer to the received offer~~ supported by UE#2~~.

13. **Authorize resources for common codecs for this session**

P-CSCF#2 authorises the QoS resources for the common media flows and codec choices.

14. **183 Session Progress (P-CSCF to S-CSCF) - see example in table 10.3.3-14**

P-CSCF#2 forwards the 183 Session Progress response to S-CSCF#2.

Table 10.3.3-14: 183 Session Progress (P-CSCF to S-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd])
Record-Route: @sip:pcscf2.visited2.net;lr, sip:764z87.1@scscf2.home2.net;lr,
sip:332b23.1@scscf1.home1.net;lr, sip:@pcscf1.visited1.net;lr
Require:
Remote-Party-ID:
RPID-Privacy:
From:
To:
```

```
Call-ID:
CSeq:
Contact: sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net
RSeq:
Content-Disposition:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
a=
```

15. **183 Session Progress (S-CSCF to S-CSCF) – see example in table 10.3.3-15**

S-CSCF#2 forwards the 183 Session Progress response to S-CSCF#1.

Table 10.3.3-15: 183 Session Progress (S-CSCF to S-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
Require:
From:
To:
Call-ID:
CSeq:
Contact:
RSeq:
Content-Disposition:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
a=
```

16. **183 Session Progress (S-CSCF to P-CSCF) – see example in table 10.3.3-16**

S-CSCF#1 forwards the 183 Session Progress response to P-CSCF#1.

Table 10.3.3-16: 183 Session Progress (S-CSCF to P-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
Require:
From:
To:
Call-ID:
CSeq:
Contact:
RSeq:
Content-Disposition:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
a=
```

17. **Authorize resources for common codecs for this session**

P-CSCF#1 authorises the QoS resources for the remaining media flows and codec choices.

18. **183 Session Progress (P-CSCF to UE) – see example in table 10.3.3-18**

P-CSCF#1 forwards the 183 Session Progress response to UE#1.

Table 10.3.3-18: 183 Session Progress (P-CSCF to UE)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
P-Media-Authorization: 0020000100100101706366312e78797a2e6e6574000c02013942563330373200
Require:
From:
To:
Call-ID:
CSeq:
Contact: sip:token1@pcscf1.home1.net
RSeq:
Content-Disposition:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

```
b=
a=
a=
a=
a=
a=
```

P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE~~. The saved value of the Route header is:~~

```
Route: sip:332b23.1@scscf1.home1.net, sip:764z87.1@scscf2.home2.net,
  sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net
```

~~**Contact:** A locally unique token to identify the saved routing information.~~

P-Media-Authorization: A P-CSCF generated authorization token. This particular example shows a Policy-Element generated by "pcf1.xyz.net" with credentials "9BV3072".

19. **Determine revised codec(s) for this session**

UE#1 determines which media flows should be used for this session, and which codecs should be used for each of those media flows. If there was any change in media flows, or if there was more than one choice of codec for a media flow, then UE#1 must include an SDP in the PRACK request sent to UE#2.

For this example, assume UE#1 chooses L10 for stereo audio and MPV for video, so no changes are made to the SDP.

20. **PRACK (UE to P-CSCF) – see example in table 10.3.3-20**

UE#1 sends the PRACK request to UE#2, along the signalling path established by the INVITE request.

Table 10.3.3-20: PRACK (UE to P-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb]sip:token1@pcscf1.visited1.net SIP/2.0

Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: "Alien Blaster" <sip:B36(SHA-1(555-1111user1_public1@home1.net; time=36123E5B;
seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 132 PRACK
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Rack: 18 131 INVITE
Content-Length: 0
```

Request-URI: Takes the value of the Contact header of the received 183 Session Progress response.

~~**Via:, Contact:** Take the value of either the IP address of FQDN of the originating UE.~~

From:/To:/Call-ID: Copied from the 183 Session Progress response so that they include any tag parameter.

Cseq: Takes a higher value than that in the previous request.

21. **PRACK (P-CSCF to S-CSCF) – see example in table 10.3.3-21**

P-CSCF#1 sends the PRACK request to S-CSCF#1, along the signalling path established by the INVITE request.

Table 10.3.3-21: PRACK (P-CSCF to S-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb]sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:scscf1.home1.net;lr, sip:764z87.1@scscf2.home2.net;lr, sip:pcscf2.home2.net;lr
sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.homepcscf2.visited2.net
From:
```

```
To:
Call-ID:
Cseq:
Contact: sip:%5b5555%3a%3aaaa%3abbb%3accc%3addd%5d@pcscf1.home1.net
Rack:
Content-Length:
```

~~**Request-URI:** The first component of the saved Route header.~~

Route: Saved from the previous response ~~(with first element moved to Request-URI)~~.

~~**Contact:** A locally defined value that identifies the UE.~~

22. **PRACK (S-CSCF to S-CSCF) – see example in table 10.3.3-22**

S-CSCF#1 sends the PRACK request to S-CSCF#2, along the signalling path established by the INVITE request.

Table 10.3.3-22: PRACK (S-CSCF to S-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb]sip:scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scscf2.home2.net;lr,sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net;lr
From:
To:
Call-ID:
Cseq:
Contact:
Rack:
Content-Length:
```

Request-URI: Kept Unchanged~~the first component of the Route header. This will vary according to which S-CSCF to S-CSCF signalling flow is used.~~

23. **PRACK (S-CSCF to P-CSCF) – see example in table 10.3.3-23**

S-CSCF#2 sends the PRACK request to P-CSCf#2, along the signalling path established by the INVITE request.

Table 10.3.3-23: PRACK (S-CSCF to P-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb]sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Record-Route: sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net
From:
To:
Call-ID:
Cseq:
Contact:
Rack:
Content-Length:
```

24. **PRACK (P-CSCF to UE) – see example in table 10.3.3-24**

P-CSCF#2 sends the PRACK request to UE#2, along the signalling path established by the INVITE request.

Table 10.3.3-24: PRACK (P-CSCF to UE)

```
PRACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1;branch=token2
Max-Forwards: 66
From:
To:
Call-ID:
```

```
Cseq:
~~Contact: token2@pcscf2.home2.net~~
Rack:
Content-Length:
```

P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.

~~**Contact:** A locally unique token to identify the saved routing information.~~

Via: P-CSCF removes the Via headers~~, and generates a locally unique token to identify the saved values~~. It inserts this as a branch value on its Via header.

25. **200 OK (UE to P-CSCF) – see example in table 10.3.3-25**

UE#2 responds to the PRACK request (24) with a 200 OK response to P-CSCF#2.

Table 10.3.3-25: 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1~~;branch=token2~~
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

26. **200 OK (P-CSCF to S-CSCF) – see example in table 10.3.3-26**

P-CSCF#2 sends the 200 OK response to S-CSCF#2.

Table 10.3.3-26: 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
~~Record-Route: sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net~~
From:
To:
Call-ID:
CSeq:
Content-Length:
```

27. **200 OK (S-CSCF to S-CSCF) – see example in table 10.3.3-27**

S-CSCF#2 sends the 200 OK response to S-CSCF#1.

Table 10.3.3-27: 200 OK (S-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
~~Remote-Party-ID:~~
~~RPID-Privacy:~~
~~Record-Route: sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net~~
From:
To:
Call-ID:
CSeq:
~~Contact:~~
Content-Length:
```

28. **200 OK (S-CSCF to P-CSCF) – see example in table 10.3.3-28**

S-CSCF#1 sends the 200 OK response to P-CSCF#1.

Table 10.3.3-28: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
~~Record-Route:~~
From:
To:
Call-ID:
CSeq:
~~Contact:~~
Content-Length:
```

29. **200 OK (P-CSCF to UE) – see example in table 10.3.3-29**

P-CSCF#1 sends the 200 OK response to UE#1.

Table 10.3.3-29: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
~~Contact: sip:token2@pcscf1.home1.net~~
Content-Length:
```

~~P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.~~

~~**Contact:** A locally unique token to identify the saved routing information.~~

30. **Reserve resources for new media streams**

UE#1 and UE#2 reserve the resources needed for the added or changed media flows. If the reservation is successfully completed by UE#1, it stops transmitting any deleted media streams.

31. **UPDATE ~~COMET~~ (UE to P-CSCF) – see example in table 10.3.3-31**

UE#1 sends the UPDATE~~COMET~~ request to P-CSCF#1.

Table 10.3.3-31: UPDATE~~COMET~~ (UE to P-CSCF)

```
UPDATE~~COMET~~ sip:[5555:eee:aaa:bbb]~~sip:token1@pcscf1.homep1.net~~ SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70

From: "Alien Blaster" <sip:B36(SHA-1(~~555-1111~~user1_public1@home1.net; time=36123E5B;
seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 133 UPDATE~~COMET~~
~~Contact: sip:[5555::aaa:bbb:ccc:ddd]~~
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 3400 RTP/AVP 99
b=AS:54.6
~~a=qos:success send~~a=curr:qos local sendrecv
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=audio 3456 RTP/AVP 10
b=AS:25.4
~~a=qos:success send~~a=curr:qos local senedrecv
```

```
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
```

~~**Request-URI:** Takes the value of the Contact header of the received 183 Session Progress response.~~

~~**Via:, Contact:** Take the value of either the IP address or FQDN of the originating UE.~~

~~**From:/To:/Call-ID:** Copied from the 183 Session Progress response so that they include any tag parameters.~~

CSeq: Takes a higher value than that in the previous request.

The SDP indicates that the resource reservation was successful in the local segment.

32. **UPDATE~~COMET~~ (P-CSCF to S-CSCF) – see example in table 10.3.3-32**

P-CSCF#1 sends the UPDATE~~COMET~~ request to S-CSCF#1.

Table 10.3.3-32: UPDATE~~COMET~~ (P-CSCF to S-CSCF)

```
UPDATECOMET sip:[5555::eee:fff:aaa:bbb]sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.homepcscf1.visited1home1.net;branch=431h23.1, SIP/2.0/UDP
    [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:scscf1.home1.net;lr,
sip:764z87.1@scscf2.home2.net;lr, sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net;lr
From:
To:
Call-ID:
Cseq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
```

~~**Request-URI:**~~ Kept Unchanged~~The first component of the saved Route header.~~

Route: Saved from the 183 Session Progress response ~~(with first element moved to Request-URI~~).

~~**Contact:** A locally defined value that identifies the UE.~~

33. **UPDATE~~COMET~~ (S-CSCF to S-CSCF) – see example in table 10.3.3-33**

S-CSCF#1 sends the UPDATE~~COMET~~ request to S-CSCF#2.

Table 30.3.3-33: UPDATE~~COMET~~ (MO#2 to S-S)

```
UPDATECOMET sip:[5555::eee:fff:aaa:bbb] sip:scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scscf2.home2.net ;lr, sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net;lr
From:
```

```
To:
Call-ID:
Cseq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
```

Request-URI: Kept Unchanged~~The first component of the Route header. This will vary according to which S-CSCF to S-CSCF signalling flow is used.~~

34. **UPDATE~~COMET~~ (S-CSCF to P-CSCF) – see example in table 10.3.3-34**

S-CSCF#2 sends the UPDATE ~~COMET~~ request to P-CSCF#2.

Table 10.3.3-34: UPDATE~~COMET~~ (S-CSCF to P-CSCF)

```
UPDATECOMET sip:[5555::eee:fff:aaa:bbb]sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net
SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:pcscf2.home2.net;lr
Record-Route: sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net
From:
To:
Call-ID:
Cseq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
```

35. UPDATE**~~COMET~~ (P-CSCF to UE) – see example in table 10.3.3-35**

P-CSCF#2 sends the UPDATE~~COMET~~ request to UE#2.

Table 10.3.3-35: UPDATE~~COMET~~ (P-CSCF to UE)

```
UPDATECOMET sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1;branch=token6
Max-Forwards: 66
From:
To:
Call-ID:
Cseq:
Contact: token6@pcscf2.home2.net
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
```

~~P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.~~

~~**Contact:** A locally unique token to identify the saved routing information.~~

Via: P-CSCF removes the Via headers~~, and generates a locally unique token to identify the saved values~~. It inserts this as a branch value on its Via header.

36. **200 OK (UE to P-CSCF) – see example in table 10.3.3-36**

UE#2 responds to the ~~COMET~~ UPDATE request (35) with a 200 OK response, sent to P-CSCF#2.

Table 10.3.3-36: 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1;branch=token6
From:
To:
Call-ID:
CSeq:
Conten-Type: application/sdp
Content-Length: (…)0

v=0
o=- 2987933615 2987933615 IN IP6 5555::eee:fff:aaa:bbb
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 6540 RTP/AVP 99
b=AS:54.6
a=curr:qos local sendrecv
a=curr:qos remote sendrecv
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=rtpmap:99:MPV
m=audio 6544 RTP/AVP 10
b=AS:25.4
a=curr:qos local sendrecv
a=curr:qos remote sendrecv
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
```

37. **200 OK (P-CSCF to S-CSCF) – see example in table 10.3.3-37**

P-CSCF#2 sends the 200 OK response to S-CSCF#2.

Table 10.3.3-37: 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net
From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length: (…)0

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
```

38. **200 OK (S-CSCF to S-CSCF) – see example in table 10.3.3-38**

S-CSCF#2 sends the 200 OK response to S-CSCF#1.

Table 10.3.3-38: 200 OK (S-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
```

39. **200 OK (S-CSCF to P-CSCF) – see example in table 10.3.3-39**

S-CSCF#1 sends the 200 OK response to P-CSCF#1.

Table 10.3.3-39: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
```

40. **200 OK (P-CSCF to UE) – see example in table 10.3.3-40**

P-CSCF#1 sends the 200 OK response to UE#1.

Table 10.3.3-40: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact: sip:token3@pcscf1.home1.net
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
```

- ~~P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.~~

~~**Contact:** A locally unique token to identify the saved routing information.~~

41. **180 Ringing (UE to P-CSCF) – see example in table 10.3.3-41**

Depending on the type of codec change being performed, alerting may be required at the destination UE. If so, UE#2 sends a 180 Ringing provisional response to the originator, through P-CSCF#2.

Table 10.3.3-41: 180 Ringing (UE to P-CSCF)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP pcscf2.home2.net;branch=token3
Require: 100rel
From:
To:
Call-ID:
CSeq:
Require: 100rel
Contact: sip:[5555::eee:fff:aaa:bbb]
RSeq: 19
Content-Length: 0
```

42. **180 Ringing (P-CSCF to S-CSCF) – see example in table 10.3.3-42**

P-CSCF#2 sends the 180 Ringing response to S-CSCF#2.

Table 10.3.3-42: 180 Ringing (P-CSCF to S-CSCF)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:pcscf2,@home2.net;lr,sip:764z87.1@scscf2.home2.net;lr,
       sip:332b23.1@scscf1.home1.net;lr, sip:pcscf1@.home1.net;lr
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Length:
```

43. **180 Ringing (S-CSCF to S-CSCF) – see example in table 10.3.3-43**

S-CSCF#2 sends the 180 Ringing response to S-CSCF#1.

Table 10.3.3-43: 180 Ringing (S-CSCF to S-CSCF)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Length:
```

44. **180 Ringing (S-CSCF to P-CSCF) – see example in table 10.3.3-44**

S-CSCF#1 sends the 180 Ringing response to P-CSCF#1.

Table 10.3.3-44: 180 Ringing (S-CSCF to P-CSCF)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Length:
```

45. **180 Ringing (P-CSCF to UE) – see example in table 10.3.3-45**

P-CSCF#1 sends the 180 Ringing response to UE#1.

Table 10.3.3-45: 180 Ringing (P-CSCF to UE)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Require:
From:
To:
Call-ID:
CSeq:
Contact: sip:token4@pcscf1.home1.net
RSeq:
Content-Length:
```

Editor's Note: Additional QoS interactions to handle one-way media at this point (e.g. for PSTN ringback and announcements) is for further study.

46. **PRACK (UE to P-CSCF) – see example in table 10.3.3-46**

UE#1 sends the PRACK request to UE#2, along the signalling path established by the INVITE request.

Table 10.3.3-46: PRACK (UE to P-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb]sip:token4@pcscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 130 PRACK
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Rack: 19 131 INVITE
Content-Length: 0
```

~~**Request-URI:** Takes the value of the Contact header of the 180 Ringing response.~~

~~**Via:, Contact:** Take the value of either the IP address or FQDN of the UE.~~

~~**From:/To:/Call-ID:** Copied from the 180 Ringing response so that they include any revised tag parameters.~~

~~**Cseq:** Takes a higher value than in the previous request.~~

47. **PRACK (P-CSCF to S-CSCF) – see example in table 10.3.3-47**

P-CSCF#1 sends the PRACK request to S-CSCF#1, along the signalling path established by the INVITE request.

Table 10.3.3-47: PRACK (P-CSCF to S-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb]sip:scscf1.home1.net SIP/2.0
```

```
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:scsf1.@home1.net;lr, sip:764z87.1@scscf2.home2.net;lr,
sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net;lr
From:
To:
Call-ID:
Cseq:
Contact: sip:%5b5555%3a%3aaaa%3abbb%3accc%3addd%5d@pcscf1.home1.net
Rack:
Content-Length:
```

Route: P-CSCF adds a Route header, with the saved value from the previous response. ~~P-CSCF identifies the proper saved value by the Request-URI.~~

48. **PRACK (S-CSCF to S-CSCF) – see example in table 10.3.3-48**

S-CSCF#1 sends the PRACK request to S-CSCF#2, along the signalling path established by the INVITE request.

Table 10.3.3-48: PRACK (S-CSCF to S-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb]sip:scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68

Route: sip:scscf2.home2.net;lr,  sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net;lr
Record-Route: sip:332b23.1@scscf1.home1.net
From:
To:
Call-ID:
Cseq:
Contact:
Rack:
Content-Length:
```

49. **PRACK (S-CSCF to P-CSCF) – see example in table 10.3.3-49**

S-CSCF#2 sends the PRACK request to P-CSCf#2, along the signalling path established by the INVITE request.

Table 10.3.3-49: PRACK (S-CSCF to P-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb]sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net
Max-Forwards: 67
Route: sip:pcscf2.@home2.net;lr
From:
To:
Call-ID:
Cseq:
Contact:
Rack:
Content-Length:
```

50. **PRACK (P-CSCF to UE) – see example in table 10.3.3-50**

P-CSCF#2 sends the PRACK request to UE#2, along the signalling path established by the INVITE request.

Table 10.3.3-50: PRACK (P-CSCF to UE)

```
PRACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Max-Forwards: 66
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1;branch=token4
From:
To:
```

```
Call-ID:
Cseq:
~~Contact: token4@pcscf2.home2.net~~
Rack:
Content-Length:
```

- ~~P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.~~

~~**Contact:** A locally unique token to identify the saved routing information.~~

Via: P-CSCF removes the Via headers~~, and generates a locally unique token to identify the saved values~~. It inserts this as a branch value on its Via header.

51. **200 OK (UE to P-CSCF) – see example in table 10.3.3-51**

    UE#2 responds to the PRACK request (50) with a 200 OK response to P-CSCF#2.

Table 10.3.3-51: 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1~~;branch=token4~~
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

52. **200 OK (P-CSCF to S-CSCF) – see example in table 10.3.3-52**

    P-CSCF#2 sends the 200 OK response to S-CSCF#2.

Table 10.3.3-52: 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
~~Record-Route: sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net~~
From:
To:
Call-ID:
CSeq:
Content-Length:
```

53. **200 OK (S-CSCF to S-CSCF) – see example in table 10.3.3-53**

    S-CSCF#2 sends the 200 OK response to S-CSCF#1.

Table 10.3.3-53: 200 OK (S-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
~~Record-Route: sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net~~
From:
To:
Call-ID:
CSeq:
~~Contact:~~
Content-Length:
```

54. **200 OK (S-CSCF to P-CSCF) – see example in table 10.3.3-54**

    S-CSCF#1 sends the 200 OK response to P-CSCF#1.

Table 10.3.3-54: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net
From:
To:
Call-ID:
CSeq:
Contact:
Content-Length:
```

55. **200 OK (P-CSCF to UE) – see example in table 10.3.3-55**

P-CSCF#1 sends the 200 OK response to UE#1.

Table 10.3.3-55: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact: sip:token5@pcscf1.home1.net
Content-Length:
```

~~P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.~~

~~**Contact:** A locally unique token to identify the saved routing information.~~

56. **Perform Codec change**

UE#2 stops sending the media streams to be deleted, and initialises its media receivers for the new codec.

57. **200 OK (UE to P-CSCF) – see example in table 10.3.3-57**

UE#2 responds to the INVITE request (10) with a 200 OK response, sent to P-CSCF#2.

Table 10.3.3-57: 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1token3

From:
To:
Call-ID:
CSeq: 131 INVITE
Content-Length: 0
```

58. **200 OK (P-CSCF to S-CSCF) – see example in table 10.3.3-58**

P-CSCF#2 sends the 200 OK response to S-CSCF#2.

Table 10.3.3-58: 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:pcscf2.@home2.net;lr, sip:764z87.1@scscf2.home2.net;lr,
    sip:332b23.1@scscf1.home1.net;lr, sip:pcscf1.@home1.net;lr
From:
To:
Call-ID:
CSeq:
Content-Length:
```

59. **200 OK (S-CSCF to S-CSCF) – see example in table 10.3.3-59**

S-CSCF#2 sends the 200 OK response to S-CSCF#1.

Table 10.3.3-59: 200 OK (S-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net
From:
To:
Call-ID:
CSeq:
Contact:
Content-Length:
```

60. **200 OK (S-CSCF to P-CSCF) – see example in table 10.3.3-60**

S-CSCF#1 sends the 200 OK response to P-CSCF#1.

Table 10.3.3-60: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
From:
To:
Call-ID:
CSeq:
Contact:
Content-Length:
```

61. **200 OK (P-CSCF to UE) – see example in table 10.3.3-61**

P-CSCF#1 sends the 200 OK response to UE#1.

Table 10.3.3-61: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact: sip:token6@pcscf1.home1.net
Content-Length:
```

P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.

~~**Contact:** A locally unique token to identify the saved routing information.~~

62. **Start using new codec**

UE#1 starts sending media using the new codecs. UE#1 also releases any excess resources no longer needed.

63. **ACK (UE to P-CSCF) – see example in table 10.3.3-63**

UE#1 sends the ACK request to UE#2, along the signalling path established by the INVITE request.

Table 10.3.3-63: ACK (UE to P-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]sip:token6@pcscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70

From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
```

```
Cseq: 131 ACK
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Content-Length: 0
```

64. **ACK (P-CSCF to S-CSCF) – see example in table 10.3.3-64**

P-CSCF#1 sends the ACK request to S-CSCF#1, along the signalling path established by the INVITE request.

Table 10.3.3-64: ACK (P-CSCF to S-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:scscf1.@home1.net;lr,sip:764z87.1@scscf2.home2.net;lr,
sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net;lr
From:
To:
Call-ID:
Cseq:
Contact: sip:%5b5555%3a%3aaaa%3abbb%3accc%3addd%5d@pcscf1.home1.net
Content-Length:
```

~~**Request-URI:**~~ Kept Unchanged ~~The first component of the saved Route header.~~

~~**Route:** Saved from the 200 OK response (with first element moved to Request-URI).~~

~~**Contact:** A locally defined value that identifies the UE.~~

65. **ACK (S-CSCF to S-CSCF) – see example in table 10.3.3-65**

S-CSCF#1 sends the ACK request to S-CSCF#2, along the signalling path established by the INVITE request.

Table 10.3.3-65: ACK (S-CSCF to S-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]sip:scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip–:scscf2@home2.net;lr, sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net
Record-Route: sip:332b23.1@scscf1.home1.net
From:
To:
Call-ID:
Cseq:
Contact:
Content-Length:
```

66. **ACK (S-CSCF to P-CSCF) – see example in table 10.3.3-66**

S-CSCF#2 sends the ACK request to P-CSCf#2, along the signalling path established by the INVITE request.

Table 10.3.3-66: ACK (S-CSCF to P-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:pcscf2.@home2.net;lr
Record-Route: sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net
From:
To:
Call-ID:
Cseq:
Contact:
Content-Length:
```

67. **ACK (P-CSCF to UE) – see example in table 10.3.3-67**

P-CSCF#2 sends the ACK request to UE#2, along the signalling path established by the INVITE request.

Table 10.3.3-67: ACK (P-CSCF to UE)

```
ACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1;branch=token5
Max-Forwards: 66
From:
To:
Call-ID:
Cseq:
Contact: token5@pcscf2.home2.net
Content-Length:
```

~~P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.~~

~~**Contact:** A locally unique token to identify the saved routing information.~~

Via: P-CSCF removes the Via headers~~, and generates a locally unique token to identify the saved values~~. It inserts this as a branch value on its Via header.

68. **Start using new codec**

UE#2 starts sending media using the new codecs. UE#2 also releases any excess resources no longer needed.

10.3.4 Error in changing codec or media flow within an existing reservation

After the multimedia session is established, it is possible for either endpoint to change the set of media flows or codec for a media flow. If the change is within the resources already reserved, then it is only necessary to synchronise the change with the other endpoint. An admission control decision will not fail if the new resource request is within the existing reservation.

However, it is possible the destination UE can no longer support the requested codec, due to, for example, other simultaneous sessions involving the destination UE. The destination UE therefore has the ability to refuse the codec change.

The signalling flow for refusing a codec change within an existing reservation is given in figure 10.3.4-1.

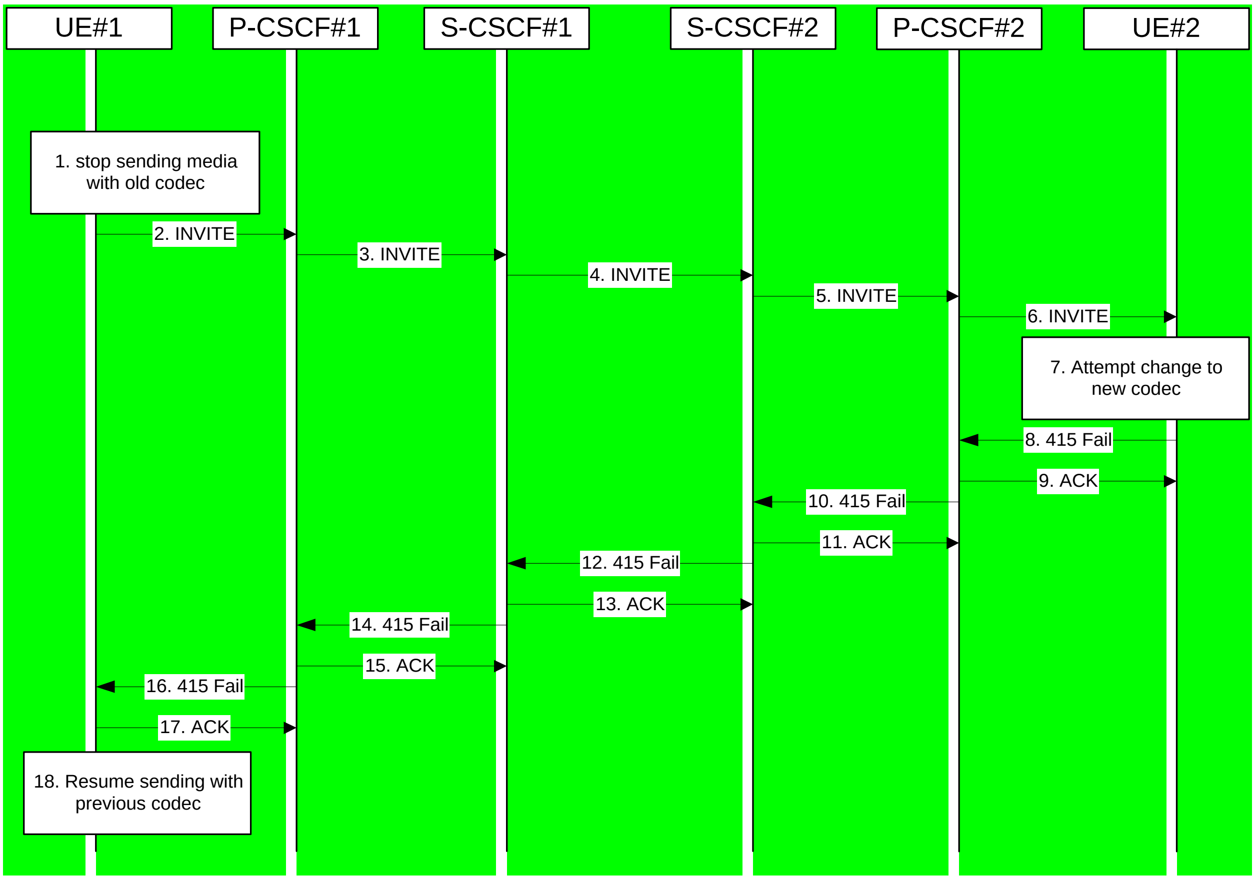


Figure 10.3.4-1: Error changing codec or media flow – within previous reservation

For this example, we assume the session was established with authorization for two codecs, AMR and G726-32, but that AMR was initially chosen for the media. UE#1 now desires to change the media to use G726-32.

The detailed procedure is as follows:

1. **UE#1 stops sending media with old codec.**

   UE#1 determines that a new media stream is desired, or that a change is needed in the codec in use for an existing media stream. UE#1 evaluates the impact of this change, and determines the existing resources reserved for the session are adequate. UE#1 builds a revised SDP that includes all the common media flows determined by the initial negotiation, but assigns a codec and port number only to those to be used onward. UE#1 stops transmitting media streams on those to be dropped from the session.

2. **INVITE (UE to P-CSCF) – see example in table 10.3.4-2**

   UE#1 sends the INVITE request to P-CSCF#1 containing this SDP.

Table 10.3.4-2: INVITE (UE to P-CSCF)

```
INVITE sip:[5555::eee:fff:aaa:bbb]sip:token6@pcscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>
RPID-Privacy: privacy=off;party=calling
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
    seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 131 INVITE
```

```
Supported: 100rel
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP
m=video 0 RTP/AVP
m=audio 3456 RTP/AVP 96
b=AS:25.4
a=rtpmap:96 G726-32/8000
m=audio 0 RTP/AVP
```

Request-URI: Contains the value of the Contact header from the ~~200 OK~~ 200 (OK) response to the initial INVITE.

Via: Contains the IP address or FQDN of the originating UE.

From:/To:/Call-ID: Contain the values previously used to establish the session, including the tag value from the response.

Cseq: Next higher sequential value.

Contact: It contains a SIP URL with ~~T~~the IP address or FQDN of the originating UE.

SDP The SDP contains the revised set of codecs desired by UE#1.

3. **INVITE (P-CSCF to S-CSCF) – see example in table 10.3.4-3**

P-CSCF#1 forwards the INVITE request to S-CSCF#1.

Table 10.3.4-3: INVITE (P-CSCF to S-CSCF)

```
INVITE sip:[5555::eee:fff:aaa:bbb]sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Remote-Party-ID:
RPID-Privacy:
Route: sip–:pcscf1.@home1.net;lr, sip:764z87.1@scscf2.home2.net;lr,
     sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net;lr

Record-Route: sip:pcscf1.home1.net;lr
From:
To:
Call-ID:
Cseq:
Supported:
Contact: sip:%5b5555%3a%3aaaa%3abbb%3accc%3addd%5d@pcscf1.home1.net
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
m=
```

~~**Request-URI:**~~ Kept Unchanged~~The first component of the saved Route header.~~

Route: Saved from the ~~200 OK~~ 200 (OK) response to the initial INVITE ~~(with first element moved to Request-URI).~~

~~**Contact:** A locally defined value that identifies the UE.~~

4. **INVITE (S-CSCF to S-CSCF) – see example in table 10.3.4-4**

S-CSCF#1 forwards the INVITE request, through the S-CSCF to S-CSCF signalling flow procedures, to S-CSCF#2.

Table 10.3.4-4: INVITE (S-CSCF to S-CSCF)

```
INVITE sip:[5555::eee:fff:aaa:bbb]~~sip:scscf2.home2.net~~ SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    ~~pcscf1.home~~pcscf1.~~visited1~~home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Remote-Party-ID:
RPID-Privacy:
Route: sip:scscf2.home2.net;lr, ~~–~~sip:~~%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d~~@pcscf2.home2.net;lr
Record-Route: sip:~~332b23.1~~@scscf1.home1.net;lr, sip:pcscf1.@home1.net;lr
From:
To:
Call-ID:
Cseq:
Supported:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
m=
```

5. **INVITE (S-CSCF to P-CSCF) – see example in table 10.3.4-5**

S-CSCF#3 forwards the INVITE request to P-CSCF#2.

Table 10.3.4-5: INVITE (S-CSCF to P-CSCF)

```
INVITE sip:[5555::eee:fff:aaa:bbb]~~sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net~~ SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Remote-Party-ID:
RPID-Privacy:
Record-Route: sip:~~764z87.1~~@scscf2.home2.net;lr, sip:~~332b23.1~~@scscf1.home1.net;lr,
sip:pcscf1.@home1.net;lr
Route: sip:pcscf2.home2.net;lr
From:
To:
Call-ID:
Cseq:
Supported:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
m=
```

6. **INVITE (P-CSCF to UE) – see example in table 10.3.4-6**

   P-CSCF#2 forwards the INVITE request to UE#2.

Table 10.3.4-6: INVITE (P-CSCF to UE)

```
INVITE sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=token3
Max-Forwards: 66
Remote-Party-ID:
RPID-Privacy:
P-Media-Authorization: 0020000100100101706366322e78797a2e6e6574000c020133315331343363231
From:
To:
Call-ID:
Cseq:
Supported:
Contact: token3@pcscf2.home2.net
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
m=
```

P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.

~~**Contact:** A locally unique token to identify the saved routing information.~~

Via: P-CSCF removes the Via headers~~, and generates a locally unique token to identify the saved values~~. It inserts this as a branch value on its Via header.

P-Media-Authorization: A P-CSCF generated authorization token. This particular example shows a Policy-Element generated by "pcf2.xyz.net" with credentials "31S14621".

7. **UE#2 attempts to change to new codec**

   UE#2 receives the INVITE request, and agrees that it is a change within the previous resource reservation. UE#2 encounters a failure attempting to change to the new codec, due to, e.g., internal resources that were available when the session was initiated but which are no longer available.

8. **415 Unsupported Media Type (UE to P-CSCF) – see example in table 10.3.4-8**

   UE#2 responds to the INVITE request (6) with a 415 Unsupported Media Type response, sent to P-CSCF#2.

Table 10.3.4-8: 415 Unsupported Media Type (UE to P-CSCF)

```
SIP/2.0 415 Unsupported Media Type
Via: SIP/2.0/UDP pcscf2.home2.net;branch=token3
From:
To:
Call-ID:
CSeq: 131 INVITE
Content-Length: 0
```

9. **ACK (P-CSCF to UE) – see example in table 10.3.4-9**

   P-CSCF#2 acknowledges the error response by sending an ACK request to UE#2.

Table 10.3.4-9: ACK (P-CSCF to UE)

```
ACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1
Max-Forwards: 70
From:
To:
Call-ID:
Cseq:
Content-Length:
```

10. **415 Unsupported Media Type (P-CSCF to S-CSCF) – see example in table 10.3.4-10**

    P-CSCF#2 sends the 415 Unsupported Media Type response to S-CSCF#2.

Table 10.3.4-10: 415 Unsupported Media Type (P-CSCF to S-CSCF)

```
SIP/2.0 415 Unsupported Media Type
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

11. **ACK (S-CSCF to P-CSCF) – see example in table 10.3.4-11**

    S-CSCF#2 acknowledges the error response by sending an ACK request to P-CSCf#2, along the signalling path established by the INVITE request.

Table 10.3.4-11: ACK (S-CSCF to P-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1
Max-Forwards: 7069
From:
To:
Call-ID:
Cseq:
Content-Length:
```

12. **415 Unsupported Media Type (S-CSCF to S-CSCF) – see example in table 10.3.4-10**

    S-CSCF#2 sends the 415 Unsupported Media Type response to S-CSCF#1.

Table 10.3.4-10: 415 Unsupported Media Type (S-CSCF to S-CSCF)

```
SIP/2.0 415 Unsupported Media Type
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

13. **ACK (S-CSCF to S-CSCF) – see example in table 10.3.4-13**

    S-CSCF#1 acknowledges the error response by sending an ACK request to S-CSCF#2.

Table 10.3.4-13: ACK (S-CSCF to S-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]sip:scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
Max-Forwards: 7068
From:
```

```
To:
Call-ID:
Cseq:
Content-Length:
```

14. **415 Unsupported Media Type (S-CSCF to P-CSCF) – see example in table 10.3.4-11**

S-CSCF#1 sends the 415 Unsupported Media Type response to P-CSCF#1.

Table 10.3.4-11: 415 Unsupported Media Type (S-CSCF to P-CSCF)

```
SIP/2.0 415 Unsupported Media Type
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

15. **ACK (P-CSCF to S-CSCF) – see example in table 10.3.4-15**

P-CSCF#1 acknowledges the error response by sending an ACK request to S-CSCF#1.

Table 10.3.4-15: ACK (P-CSCF to S-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1
Max-Forwards: 7067
From:
To:
Call-ID:
Cseq:
Content-Length:
```

16. **415 Unsupported Media Type (P-CSCF to UE) – see example in table 10.3.4-16**

P-CSCF#1 sends the 415 Unsupported Media Type response to UE#1.

Table 10.3.4-16: 415 Unsupported Media Type (P-CSCF to UE)

```
SIP/2.0 415 Unsupported Media Type
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

17. **ACK (UE to P-CSCF) – see example in table 10.3.4-17**

UE#1 acknowledges the error response by sending an ACK request to P-CSCF#1.

Table 10.3.4-17: ACK (UE to P-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb] sip:token6@pcscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 7066
From:
To:
Call-ID:
Cseq:
Content-Length:
```

18. **UE#1 resumes sending with previous codec**

UE#1 resumes sending media using the previous codecs.

10.3.5 Error changing codec or media flows requiring new resources and/or authorisation

After the multimedia session is established, it is possible for either endpoint to change the set of media flows or codec for a media flow. If the change requires additional resources beyond those previously reserved, then it is necessary to perform the resource reservation and bearer establishment procedures. If the reservation request fails for whatever reason, the original multimedia session remains in progress.

If the destination UE is unable, or unwilling, to change to the new set of codecs, it may return a 415 Unsupported Media Type error response.

If the P-CSCF and/or S-CSCF disallow a particular media flow or codec appearing in the SDP from the initiating UE, and it is the last codec in the last media flow, the CSCF ~~shall~~ returns a 415 Unsupported Media Type error response.

An example signalling flow for an error changing codec or media flow requiring new resources and/or authorization is given in figure 10.3.5-1. This is the case where the UE rejects the codec change; rejection by a CSCF is a subset of this signalling flow.

This example shows mobile originated while in home network, establishing a session with another mobile served by the same network operator, also in its home network (MO#2, S-S#2, MT#2). Other configurations may include I-CSCFs in the signalling path; procedures at the I-CSCFs are identical to those described for the BYE, PRACK, and ~~COMET~~ UPDATE requests and responses described in other clauses.

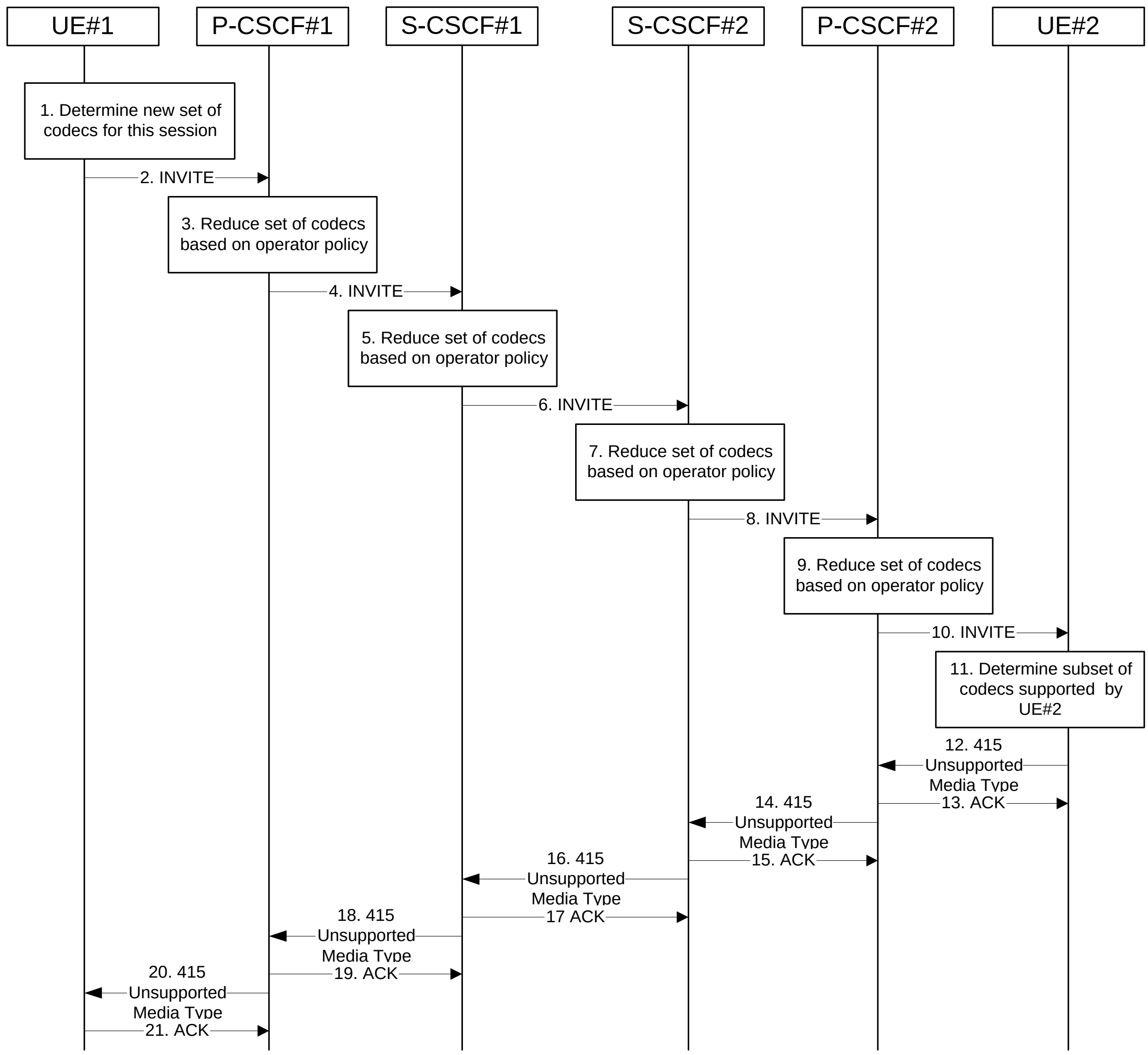


Figure 10.3.5-1: Error changing Codec or media flows needing a new reservation

The detailed procedure is as follows:

1. **Determine new set of codecs for this session**

   UE#1 determines the revised set of codecs that it is wishes to support for this session. It builds a SDP containing bandwidth requirements and characteristics of each, and assigns local port numbers for each possible media flow. Multiple media flows may be offered, and for each media flow (m= line in SDP), there may be multiple codec choices offered.

   For this example, assume UE#1 originally established the session using audio (AMR) only, and now wishes to change to stereo (using the L16 2-channel codec, RTP/AVP code 10) and add an additional video media stream (MPV).

2. **INVITE (UE to P-CSCF) – see example in table 10.3.5-2**

   UE#1 sends the INVITE request to P-CSCF#1 containing this SDP.

Table 10.3.5-2: INVITE (UE to P-CSCF)

```
INVITE sip:[5555:eee:fff:aaa:bbb]~~token6@pcscf1.home1.net~~ SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
```

```
Max-Forwards: 70
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>
RPID-Privacy: privacy=off;party=calling

From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 131 INVITE
Require: precondition
Supported: 100rel
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 3400 RTP/AVP 99
b=AS:54.6
a=qos:mandatory sendrecv
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=audio 3456 RTP/AVP 10
b=AS:25.4
a=qos:mandatory sendrecv
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
```

Request-URI: Contains the value of the Contact header from the ~~200 OK~~ 200 (OK) response to the initial INVITE.

Via: Contains the IP address or FQDN of the originating UE.

From:/To:/Call-ID: Contain the values previously used to establish the session, including the tag value from the response.

Cseq: Next higher sequential value.

Contact: A SIP URI that contains t~~T~~he IP address or FQDN of the originating UE.

SDP The SDP contains the revised set of codecs desired by UE#1.

3. **P-CSCF reduces set of supported codecs based on operator policy**

   P-CSCF#1 examines the media parameters, and removes any choices that the network operator decides based on local policy, not to allow on the network.

4. **INVITE (P-CSCF to S-CSCF) – see example in table 10.3.5-4**

   P-CSCF#1 forwards the INVITE request to S-CSCF#1.

Table 10.3.5-4: INVITE (P-CSCF to S-CSCF)

```
INVITE sip:[5555:eee:fff:aaa:bbb]sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Remote-Party-ID:
RPID-Privacy:
Route: sip:scscf1.home1.net;lr, sip:764z87.1@scscf2.home2.net;lr,
sip:.:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net;lr
Record-Route: sip:pcscf1.home1.net;-lr
From:
To:
Call-ID:
Cseq:
```

```
Require:
Supported:
Contact: sip:%5b5555%3a%3aaaa%3abbb%3accc%3addd%5d@pcscf1.home1.net
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
```

~~**Request-URI:**~~ Kept Unchanged~~The first component of the saved Route header.~~

Route: Saved from the ~~200-OK~~ 200 (OK) response to the initial INVITE ~~(with first element moved to Request-URI).~~

~~**Contact:**~~ ~~A locally defined value that identifies the UE.~~

5. **S-CSCF reduces set of supported codecs based on operator policy**

   S-CSCF#1 examines the media parameters, and removes any choices that the subscriber does not have authority to request.

6. **INVITE (S-CSCF to S-CSCF) – see example in table 10.3.5-6**

   S-CSCF#1 forwards the INVITE request, through the S-CSCF to S-CSCF signalling flow procedures, to S-CSCF#2.

Table 10.3.5-6: INVITE (S-CSCF to S-CSCF)

```
INVITE sip:[5555:eee:fff:aaa:bbb]sip:scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Remote-Party-ID:
RPID-Privacy:
Route: sip–:scscf2.&home2.net;lr, sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net;lr
Record-Route: sip:332b23.1@scscf1.home1.net;lr, sip:pcscf1@visited1home1.net;lr
From:
To:
Call-ID:
Cseq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
m=
b=
```

```
a=
a=
a=
a=
```

7. **S-CSCF reduces set of supported codecs based on operator policy**

   S-CSCF#2 examines the media parameters, and removes any choices that the destination subscriber does not have authority to request.

8. **INVITE (S-CSCF to P-CSCF) – see example in table 10.3.5-8**

   S-CSCF#3 forwards the INVITE request to P-CSCF#2.

Table 10.3.5-8: INVITE (S-CSCF to P-CSCF)

```
INVITE sip:[5555:eee:fff:aaa:bbb]sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Remote-Party-ID:
RPID-Privacy:
Route-: sip:pcscf2.home2.net;lr
Record-Route: sip:764z87.1@scscf2.home2.net;lr, sip:332b23.1@scscf1.home1.net;lr,
      sip:pcscf1.@visited1home1.net;-lr
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
```

9. **P-CSCF reduces set of supported codecs based on operator policy**

   P-CSCF#2 examines the media parameters, and removes any that the network operator decides, based on local policy, not to allow on the network.

10. **INVITE (P-CSCF to UE) – see example in table 10.3.5-10**

    P-CSCF#2 forwards the INVITE request to UE#2.

Table 10.3.5-10: INVITE (P-CSCF to UE)

```
INVITE sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=token3
Max-Forwards: 66
Remote-Party-ID:
RPID-Privacy:
P-Media-Authorization: 0020000100100101706366322e78797a2e6e6574000c020133315331343363231
```

```
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact: token3@pcscf2.home2.net
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
```

P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.

~~**Contact:**~~ ~~A locally unique token to identify the saved routing information~~.

Via: P-CSCF removes the Via headers~~, and generates a locally unique token to identify the saved values~~. It inserts this as a branch value on its Via header.

P-Media-Authorization: A P-CSCF generated authorization token. This particular example shows a Policy-Element generated by "pcf2.xyz.net" with credentials "31S14621".

11. **Determine subset of codecs supported by UE#2**

UE#2 determines the subset of codecs that it is capable of supporting for this session. It determines the intersection of those it supports with those appearing in the SDP in the INVITE request. For each media flow that is not supported, UE#2 inserts a SDP entry for media (m= line) with port=0. For each media flow that is supported, UE#2 inserts a SDP entry with an assigned port and with the codecs in common with those in the SDP from UE#1.

For this example, assume UE#2 does not supports any of those requested by UE#1.

12. **415 Unsupported Media Type (UE to P-CSCF) – see example in table 10.3.5-12**

UE#2 responds to the INVITE request (10) with a 415 Unsupported Media Type response, sent to P-CSCF#2.

Table 10.3.5-12: 415 Unsupported Media Type (UE to P-CSCF)

```
SIP/2.0 415 Unsupported Media Type
Via: SIP/2.0/UDP pcscf2.home2.net;branch=token3
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

13. **ACK (P-CSCF to UE) – see example in table 10.3.5-13**

P-CSCF#2 responds to the 415 Unsupported Media Type error (12) by sending an ACK request to UE#2.

Table 10.3.5-13: ACK (P-CSCF to UE)

```
ACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1
Max-Forwards: 70
From:
To:
Call-ID:
Cseq:
Content-Length:
```

14. **415 Unsupported Media Type (P-CSCF to S-CSCF) – see example in table 10.3.5-14**

    P-CSCF#2 sends the 415 Unsupported Media Type response to S-CSCF#2.

Table 10.3.5-14: 415 Unsupported Media Type (P-CSCF to S-CSCF)

```
SIP/2.0 415 Unsupported Media Type
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

15. **ACK (S-CSCF to P-CSCF) – see example in table 10.3.5-15**

    S-CSCF#2 responds to the 415 Unsupported Media Type error by sending an ACK request to P-CSCf#2, along the signalling path established by the INVITE request.

Table 10.3.5-15: ACK (S-CSCF to P-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]~~sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net~~ SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1
Max-Forwards: 70~~69~~
From:
To:
Call-ID:
Cseq:
Content-Length:
```

16. **415 Unsupported Media Type (S-CSCF to S-CSCF) – see example in table 10.3.5-16**

    S-CSCF#2 sends the 415 Unsupported Media Type response to S-CSCF#1.

Table 10.3.5-16: 415 Unsupported Media Type (S-CSCF to S-CSCF)

```
SIP/2.0 415 Unsupported Media Type
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

17. **ACK (S-CSCF to S-CSCF) – see example in table 10.3.5-17**

    S-CSCF#1 acknowledges the error indication (16) by sending an ACK request to S-CSCF#2, along the signalling path established by the INVITE request.

Table 10.3.5-17: ACK (S-CSCF to S-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]~~sip:scscf2.home2.net~~ SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
Max-Forwards: 70~~68~~
```

```
From:
To:
Call-ID:
Cseq:
Content-Length:
```

18. **415 Unsupported Media Type (S-CSCF to P-CSCF) – see example in table 10.3.5-18**

S-CSCF#1 sends the 415 Unsupported Media Type response to P-CSCF#1.

Table 10.3.5-18: 415 Unsupported Media Type (S-CSCF to P-CSCF)

```
SIP/2.0 415 Unsupported Media Type
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

19. **ACK (P-CSCF to S-CSCF) – see example in table 10.3.5-19**

P-CSCF#1 acknowledges the error response (18) by sending an ACK request to S-CSCF#1.

Table 10.3.5-19: ACK (P-CSCF to S-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]~~sip:scscf1.home1.net~~ SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1
Max-Forwards: 70~~67~~
From:
To:
Call-ID:
Cseq:
Content-Length:
```

20. **415 Unsupported Media Type (P-CSCF to UE) – see example in table 10.3.5-16**

P-CSCF#1 sends the 415 Unsupported Media Type response to UE#1.

Table 10.3.5-16: 415 Unsupported Media Type (P-CSCF to UE)

```
SIP/2.0 415 Unsupported Media Type
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

21. **ACK (UE to P-CSCF) – see example in table 10.3.5-21**

UE#1 acknowledges the error response by sending an ACK request to P-CSCF#1.

Table 10.3.5-21: ACK (UE to P-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]~~sip:token6@pcscf1.home1.net~~ SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70~~66~~

From:
To:
Call-ID:
Cseq:
Content-Length:
```

3GPP TSG-CN1#24 Meeting **Tdoc N1-021505~~422~~**
Budapest, Hungary 13. - 17. May 2002

CR-Form-v5

CHANGE REQUEST

⌘	**24.228**	**CR**	**019**	⌘ **rev**	**5** ~~**2**~~	⌘ Current version:	**5.0.0** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [X] Radio Access Network [ ] Core Network [X]

Title:	⌘	MO, S-S, MT #2 reference flows update
Source:	⌘	dynamicsoft
Work item code:	⌘	IMS-CCR ***Date:*** ⌘ 04-05-2002
Category:	⌘	**F** ***Release:*** ⌘ REL-5

Use one of the following categories:
- ***F*** *(correction)*
- ***A*** *(corresponds to a correction in an earlier release)*
- ***B*** *(addition of feature),*
- ***C*** *(functional modification of feature)*
- ***D*** *(editorial modification)*

Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:
- *2 (GSM Phase 2)*
- *R96 (Release 1996)*
- *R97 (Release 1997)*
- *R98 (Release 1998)*
- *R99 (Release 1999)*
- *REL-4 (Release 4)*
- *REL-5 (Release 5)*

Reason for change:	⌘	Changes within RFC 3261 and to the Privacy and Manyfolks drafts require correction of flows in 24.228
Summary of change:	⌘	Update based on latest IETF RFCs and I-Ds, correction of mistakes
Consequences if not approved:	⌘	24.228 call flows will not be IETF compliant

Clauses affected:	⌘	7.2.3.1, 7.2.3.2, 7.2.3.3, 7.3.5.1, 7.3.5.2, 7.4.3.1
Other specs affected:	⌘	[X] Other core specifications ⌘ 24.229 [ ] Test specifications [ ] O&M Specifications

Other comments: ⌘ The updated flow contains the following major changes:
- Loose routing adopted (change of Request-URI, Route header fields)
- UPDATE method + Manyfolks-05 adopted (change of the figures, SDP, Require, Supported header fields, place of the Resource Reservation box, Content-disposition header field removed)
- Max-Forwards header field added to every request
- Branch parameters deleted from Route and Record-Route header fields
- Storage information tables at P-CSCF/S-CSCF in MO/MT flows updated
- Anonymity header fields deleted (privacy-04)
- RPID-Privacy header field added (privacy-04)
- Media-Authorization header field changed to P-Media-Authorization (call-auth-04)
- 'Service Control' changed to 'Evaluation of initial filter criterias' for INVITE, deleted for 180 Ringing, 200 OK of INVITE
- editorial corrections
 mistakes

	update of the description text update of the header descriptions SDP update (missing parameters added) inconsistency between MO/S-S/MT flows corrected (output of MO = input of S-S; output of S-S = input of MT)

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

7.2.3 MO#2

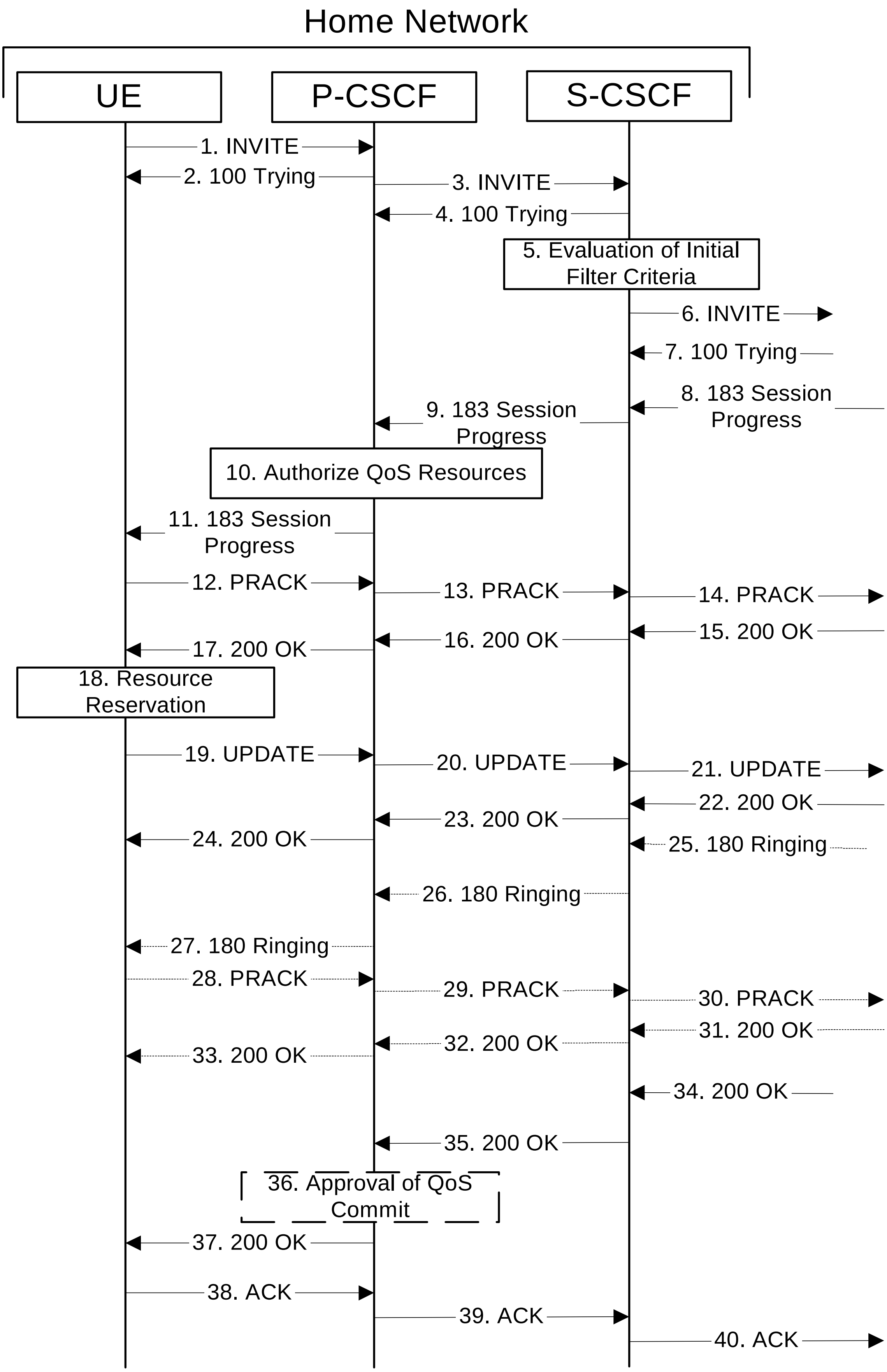
7.2.3.1 (MO#2) Mobile origination, located in home network (S-S#2, MT#2 assumed)

Figure 7.2.3.1-1 shows an origination procedure which applies to subscribers located in their home service area.

The UE is located in the home network, and determines the P-CSCF via the CSCF discovery procedure. During registration, the home network allocates an S-CSCF in the home network.

When registration is complete, the P-CSCF knows the name/address of S-CSCF.

NOTE: Although S-S#2 flow is assumed, home2.net is used in the Record-Route and Route headers in order to be more generic and clearly identify the originating and terminating nodes. In the S-S#2 scenario home2.net = home1.net.


Home Network
UE
P-CSCF
S-CSCF
1. INVITE
2. 100 Trying
3. INVITE
4. 100 Trying
5. Evaluation of Initial Filter Criteria
6. INVITE
7. 100 Trying
8. 183 Session Progress
9. 183 Session Progress
10. Authorize QoS Resources
11. 183 Session Progress
12. PRACK
13. PRACK
14. PRACK
15. 200 OK
16. 200 OK
17. 200 OK
18. Resource Reservation
19. UPDATE
20. UPDATE
21. UPDATE
22. 200 OK
23. 200 OK
24. 200 OK
25. 180 Ringing
26. 180 Ringing
27. 180 Ringing
28. PRACK
29. PRACK
30. PRACK
31. 200 OK
32. 200 OK
33. 200 OK
34. 200 OK
35. 200 OK
36. Approval of QoS Commit
37. 200 OK
38. ACK
39. ACK
40. ACK

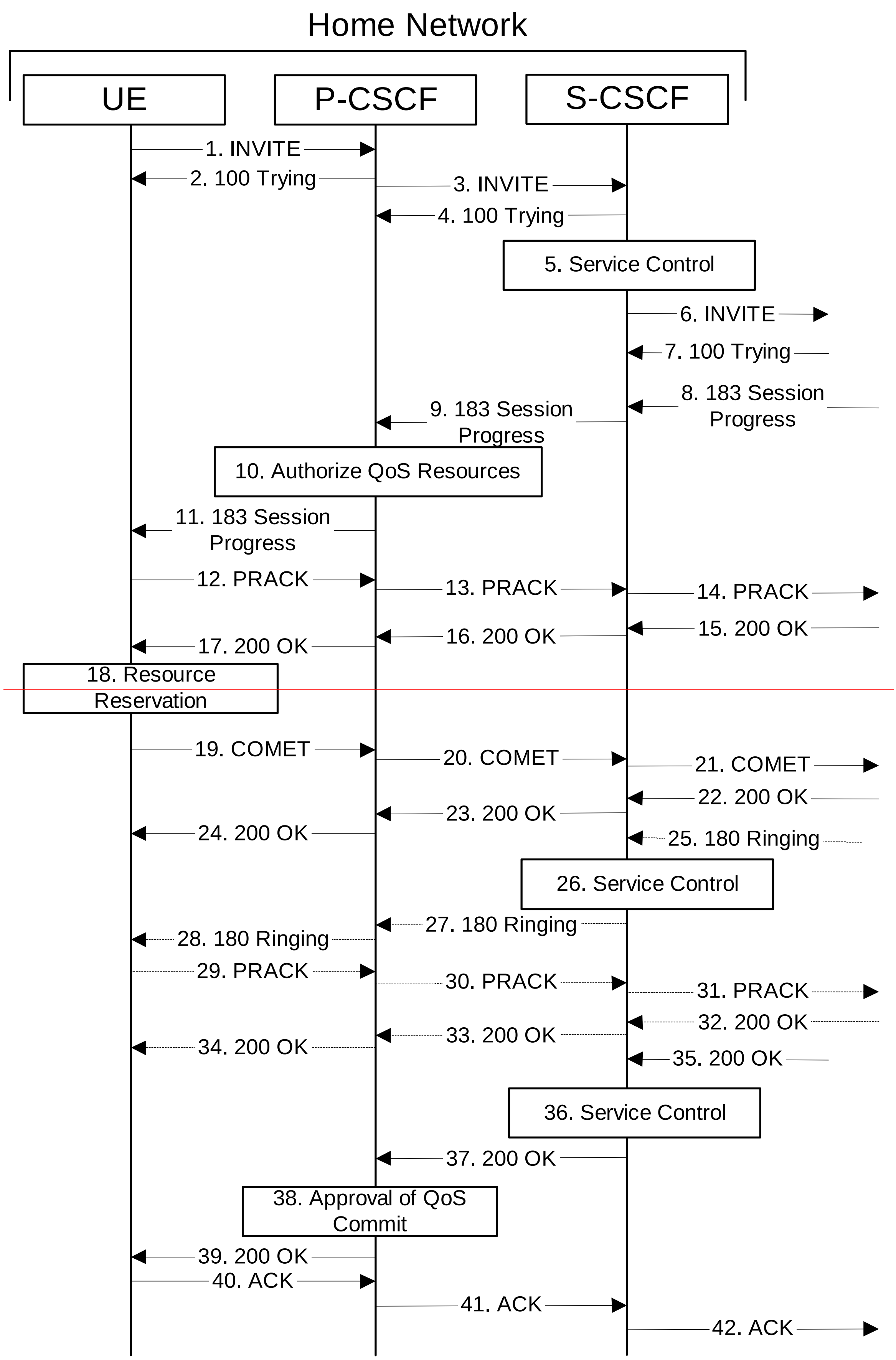


Figure 7.2.3.1-1: MO#2

Procedure MO#2 is as follows:

1. **INVITE (UE to P-CSCF) - see example in table 7.2.3.1-1**

   UE#1 determines the complete set of codecs that it is capable of supporting for this session. It builds a SDP containing bandwidth requirements and characteristics of each, and assigns local port numbers for each possible media flow. Multiple media flows may be offered, and for each media flow (m= line in SDP), there may be multiple codec choices offered.

   For this example, assume UE#1 is capable of sending two simultaneous video streams, either H261 or MPV format, and two simultaneous audio streams, either AMR, G726-32, PCMU, or G728.

   UE sends the INVITE request, containing an initial SDP, to the P-CSCF determined via the CSCF discovery mechanism.

Table 7.2.3.1-1: INVITE (UE to P-CSCF)

```
INVITE ~~sip~~tel:+1-212-555-2222~~@home1.net;user=phone~~ SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
~~Supported: 100rel~~
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>~~;privacy=off~~
RPID-Privacy: privacy=off;party=calling
~~Anonymity: Off~~
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
seq=72))@localhost>; tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 127 INVITE
Require: precondition
Supported: 100rel
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 3400 RTP/AVP 98 99
b=AS:54.6
~~a=qos:mandatory sendrecv~~
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:98 H261
a=rtpmap:99:MPV
m=video 3402 RTP/AVP 98 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
~~a=qos:mandatory sendrecv~~
a=rtpmap:98 H261
a=rtpmap:99:MPV
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
~~a=qos:mandatory sendrecv~~
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
```

```
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
a=qos:mandatory sendrecv
```

Request-URI: contains the keyed number from the user. This is specified by the UE as ~~sip~~tel:<keyed number>~~@home1.net~~. This is in accordance to standard IETF procedures for specifying dialled digits.

Via: contains the IP address or FQDN of the originating UE.

Remote-Party-ID: contains the originator's public user identity. The Display name is optional.

From:/To:/Call-ID: follow the recommendations of draft-ietf-sip-privacy[13]~~-01~~, even though anonymity is not being requested for this session.

Cseq: A random starting number.

Contact: is a SIP URL that contains the IP address or FQDN of the originating UE~~The IP address or FQDN of the originating UE~~.

SDP The SDP contains a set of codecs supported by UE#1 and desired by the user at UE#1 for this session.

Upon receiving the INVITE, the P-CSCF stores the following information about this session, for use in possible error recovery actions – see example in table 7.2.3.1-1b:

Table 7.2.3.1-1b: Storage of information at P-CSCF

```
Request-URI: siptel:+1-212-555-2222@home1.net;user=phone
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
seq=72))@localhost>; tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
Cseq(2dest): 127 INVITE
Cseq(2orig): none
Contact(orig): sip:[5555::aaa:bbb:ccc:ddd]
```

2. **100 Trying (P-CSCF to UE) – see example in table 7.2.3.1-2**

P-CSCF responds to the INVITE request (1) with a 100 Trying provisional response.

Table 7.2.3.1-2: 100 Trying (P-CSCF to UE)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

3. **INVITE (P-CSCF to S-CSCF) – see example in table 7.2.3.1-3**

P-CSCF remembers (from the registration procedure) the request routing for this UE. This becomes a Route ~~the Request-URI~~ header in the request. This next hop is the S-CSCF within the home network of UE#1.

P-CSCF adds itself to the Record-Route header and Via header.

P-CSCF~~#1~~ examines the media parameters, and removes any choices that the network operator decides based on local policy, not to allow on the network.

For this example, assume the network operator disallows H261 video encoding.

The INVITE request is forwarded to the S-CSCF.

Table 7.2.3.1-3: INVITE (P-CSCF to S-CSCF)

INVITE ~~sip~~tel:+1-212-555-2222~~@home1.net;user=phone~~~~scscf1.home1.net~~ SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Record-Route: sip: ~~431h23.1@~~pcscf1.home1.net;lr
Route: sip:~~+~~scscf1.home1.net;lr~~1-212-555-2222@home1.net;user=phone~~
~~Supported:~~
Remote-Party-ID:
RPID-Privacy:
~~Anonymity:~~
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 3400 RTP/AVP 99
b=AS:54.6
~~a=qos:mandatory sendrecv~~
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=video 3402 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
~~a=qos:mandatory sendrecv~~
a=rtpmap:99:MPV
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
~~a=qos:mandatory sendrecv~~
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
~~a=qos:mandatory sendrecv~~
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000

~~**Request-URI:** The first component in the remembered Path header from Registration.~~

Route: Contains the ~~remaining~~ elements from the Path header from rRegistration~~, with the initial Request-URI (received from the UE) appended as the final component~~.

SDP The SDP contains the restricted set of codecs allowed by the network operator. The "m=" lines for the video media streams no longer list code 98 (H261).

Upon receiving the INVITE, the S-CSCF stores the following information about this session, for use in possible error recovery actions – see example in table 7.2.3.1-3b:

Table 7.2.3.1-3b: Storage of information at S-CSCF

```
Request-URI: ~~sip~~tel:+1-212-555-2222~~@home1.net;user=phone~~
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
seq=72))@localhost>; tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
CSeq(2dest): 127 INVITE
Cseq(2orig): none
Route(2orig): sip:pcscf1.home1.net
Contact (~~local~~orig): sip:[5555::aaa:bbb:ccc:ddd]
```

4. **100 Trying (S-CSCF to P-CSCF) - see example in table 7.2.3.1-4**

S-CSCF responds to the INVITE request (3) with a 100 Trying provisional response.

Table 7.2.3.1-4: 100 Trying (S-CSCF to P-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

5. **Evaluation of initial filter criterias~~Service Control~~**

S-CSCF validates the service profile of this subscriber, and evaluates the initial filter criterias~~performs any origination service control required for this subscriber~~.

~~S-CSCF#1 examines the media parameters, and removes any choices that the subscriber does not have authority to request.~~

~~For this example, assume the subscriber is not allowed video.~~

6. **INVITE (MO#2 to S-S) – see example in table 7.2.3.1-6**

S-CSCF examines the media parameters, and removes any choices that the subscriber does not have authority to request. For this example, assume the subscriber is not allowed video.

S-CSCF forwards the INVITE request, as specified by the S-CSCF to S-CSCF procedures.

~~Editor's Note: Need for additional headers to transport e.g. Billing-Correlation-Identifier is FFS.~~

Table 7.2.3.1-6: INVITE (MO#2 to S-S)

```
INVITE sip:~~+1-212-555-2222~~user2_public1@home2.net~~;user=phone~~ SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Record-Route: sip:~~332b23.1@~~scscf1.home1.net;lr, sip:~~431h23.1@~~pcscf1.home1.net;lr
~~Supported:~~
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>; ~~privacy=off;~~screen=yes
RPID-Privacy:
~~Anonymity:~~
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length: (...)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
```

```
t=907165275 0
m=video 0 RTP/AVP 99
b=AS:54.6
a=qos:mandatory sendrecv 
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=qos:mandatory sendrecv 
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=qos:mandatory sendrecv
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
```

SDP The SDP contains the restricted set of codecs allowed by the network operator. The "m=" lines for the video media streams show a port number zero, which removes them from the negotiation.

Request-URI: In the case where the ~~Route header~~Request-URI of the incoming INVITE request to S-CSCF contains a TEL-URL [5], it has to be translated to a globally routable SIP-URL before applying it as Request-URI of the outgoing INVITE request. For this address translation the S-CSCF shall use the services of an ENUM-DNS protocol according to RFC 2916 [6], or any other suitable translation database. Database aspects of ENUM are outside the scope of this specification.

7. **100 Trying (S-S to MO#2) – see example in table 7.2.3.1-7**

S-CSCF receives a 100 Trying provisional response, as specified by the S-CSCF to S-CSCF procedures.

Table 7.2.3.1-7: 100 Trying (S-S to MO#2)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

8. **183 Session Progress (S-S to MO#2) – see example in table 7.2.3.1-8**

The media stream capabilities of the destination are returned along the signalling path, in a 183 Session Progress provisional response (to (6)), per the S-CSCF to S-CSCF procedures.

Table 7.2.3.1-8: 183 Session Progress (S-S to MO#2)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
```

```
Record-Route: sip: 876t12.1@pcscf2.home2.net;lr, sip: 764z87.1@scscf2.home2.net;lr,
sip:332b23.1@scscf1.home1.net, sip:431h23.1@pcscf1.home1.net
Remote-Party-ID: "John Smith" <tel:+1-212-555-2222>; privacy=off;screen=yes
RPID-Privacy: privacy=off;party=called
Anonymity: Off
Require: 100rel
From:
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost; tag=314159
Call-ID:
CSeq:
Require: 100rel
Contact: sip:[5555::eee:fff:aaa:bbb]
RSeq: 9021
Content-Disposition: precondition
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97 96
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=conf:qos remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
a=qos:mandatory sendrecv confirm
m=audio 0 RTP/AVP 97 96 0 15
```

Upon receiving the 183 Session Progress, the S-CSCF stores the following information about this session, for use in providing enhanced services or in possible error recovery actions – see example in table 7.2.3.1-8b.

Table 7.2.3.1-8b: Storage of information at S-CSCF

```
Request-URI: telsip:+1-212-555-2222@home1.net;user=phone
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
seq=72))@localhost>; tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost; tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
CSeq(2dest): 127 INVITE
CSeq(2orig): none
Route(2dest): sip:scscf2.home2.net,sip:pcscf2.home2.net
Route(2orig): sip:pcscf1.home1.net
Contact(dest): sip:[5555::eee:fff:aaa:bbb]
Contact(orig): sip:[5555::aaa:bbb:ccc:ddd]
```

9. **183 Session Progress (S-CSCF to P-CSCF) – see example in table 7.2.3.1-9**

S-CSCF forwards the 183 Session Progress response to P-CSCF.

Table 7.2.3.1-9: 183 Session Progress (S-CSCF to P-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
Remote-Party-ID:
RPID-Privacy:
Anonymity:
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
```

```
RSeq:
Content-Disposition: 
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
a=
m=
```

Upon receiving the 183 Session Progress, the P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE. The saved value of the information for this session is – see example in table 7.2.3.1-9b:

Table 7.2.3.1-9b: Storage of information at P-CSCF

```
Request-URI: siptel:+1-212-555-2222@home1.net;user=phone
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
seq=72))@localhost>; tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
Cseq(2dest): 127 INVITE
CSeq(2orig): none
Route(2dest): sip:scscf1.home1.net, sip:scscf2.home2.net, sip:pcscf2.home2.net
Contact (dest): sip:[5555::eee:fff:aaa:bbb]
Contact (origlocal): sip:[5555::aaa:bbb:ccc:ddd]
Route: sip:332b23.1@scscf1.home1.net, sip:764z87.1@scscf2.home2.net, 
 sip:876t12.1@pcscf2.home2.net
```

10. **Authorize QoS Resources**

P-CSCF authorizes the resources necessary for this session. The approval of QoS commitment either happens at this stage or after 200 OK of INVITE (35) based on operator local policy.

11. **183 Session Progress (P-CSCF to UE) – see example in table 7.2.3.1-11**

P-CSCF forwards the 183 Session Progress response to the originating endpoint.

Table 7.2.3.1-11: 183 Session Progress (P-CSCF to UE)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Media-P-Media-Authorization: 0020000100100101706366312e78797a2e6e6574000c02013942563330373200
Remote-Party-ID:
RPID-Privacy:
Anonymity: 
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Disposition: 
Content-Type:
Content-Length:
```

```
v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
a=
m=
```

~~Media~~ P-Media-**Authorization:** a P-CSCF generated authorization token. This particular example shows a Policy-Element generated by "pcf1.xyz.net" with credentials "9BV3072". "00" at the end of the authorization token is required to pad to a multiple of 4 bytes.

12. **PRACK (UE to P-CSCF) – see example in table 7.2.3.1-12**

UE#1 determines which media flows should be used for this session, and which codecs should be used for each of those media flows. If there was any change in media flows, or if there was more than one choice of codec for a media flow, then UE#1 ~~must~~ include a newn SDP offer in the PRACK request sent to UE#2).

For this example, assume UE#1 chooses AMR as the codec to use for the single audio stream.

UE includes this information in the PRACK request to P-CSCF.

Table 7.2.3.1-12: PRACK (UE to P-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 128 PRACK
Require: precondition
Rack: 9021 127 INVITE
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 3456 RTP/AVP 97
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=qos:mandatory sendrecv
m=audio 0 RTP/AVP 97 96 0 15
```

Request-URI: Takes the value of the Contact header of the received 183 Session Progress response.

Via: Takes the value of either the IP address or~~f~~ FQDN of the originating UE.

From:/To:/Call-ID: Copied from the 183 Session Progress response so that they include any tag parameter.

Cseq: Takes a higher value than that in the previous request.

~~The final selection of the media stream from the set of those supported by the terminating endpoint, given in the received 183 Session Progress response (14), is made by the originating UE and included in the SDP.~~

13. **Resource Reservation**

After determining the final media streams in step #11, UE initiates the reservation procedures for the resources needed for this session.

14~~3~~. **PRACK (P-CSCF to S-CSCF) – see example in table 7.2.3.1-14~~3~~**

P-CSCF adds the Route header corresponding to the session.

P-CSCF forwards the PRACK request to S-CSCF.

Table 7.2.3.1-14~~3~~: PRACK (P-CSCF to S-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb]scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:scscf1.home1.net;lr, sip: 764z87.1@scscf2.home2.net; lr;lr, sip:
876t12.1@pcscf2.home2.net;lr, sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Require:
Rack:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

Request-URI: The first component of the saved Route header.

Route: saved from the 183 Session Progress response (with first element moved to Request-URI) with the initial Request-URI (received from the UE) appended as the final component.

15~~4~~. **PRACK (MO#2 to S-S) – see example in table 7.2.3.1-15~~4~~**

S-CSCF forwards the PRACK request to the terminating endpoint, as per the S-CSCF to S-CSCF procedure.

Table 7.2.3.1-15~~4~~: PRACK (MO#2 to S-S)

```
PRACK sip:[5555::eee:fff:aaa:bbb]~~scscf2.home2.net ~~SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scscf2.home2.net;lr, sip: ~~876t12.1@~~pcscf2.home2.net;lr,sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Require:
Rack:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

~~**Request-URI:** The first component of the Route header. This will vary according to which S-CSCF to S-CSCF signalling flow is used.~~

16~~5~~. **200 OK (S-S to MO#2) – see example in table 7.2.3.1-16~~5~~**

The destination endpoint responds to the PRACK request (14) with a 200 OK response, per the S-CSCF to S-CSCF procedures.

Table 7.2.3.1-16~~5~~: 200 OK (S-S to MO#2)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Type: application/sdp
Content-Length: ~~0~~(…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=conf:qos remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
m=audio 0 RTP/AVP 97 96 0 15
```

17~~6~~. **200 OK (S-CSCF to P-CSCF) – see example in table 7.2.3.1-17~~6~~**

S-CSCF forwards the 200 OK response to P-CSCF.

Table 7.2.3.1-17~~6~~: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

18~~7~~. **200 OK (P-CSCF to UE) – see example in table 7.2.3.1-18~~7~~**

P-CSCF forwards the 200 OK response to UE.

Table 7.2.3.1-18~~7~~: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

~~18. **Resource Reservation**~~

~~After determining the final media streams in step #11, UE initiates the reservation procedures for the resources needed for this session.~~

19. **~~COMET~~UPDATE (UE to P-CSCF) – see example in table 7.2.3.1-19**

When the resource reservation is completed, UE sends the ~~COMET~~UPDATE request to the terminating endpoint, via the signalling path established by the INVITE request. The request is sent first to P-CSCF.

Table 7.2.3.1-19: ~~COMET~~UPDATE (UE to P-CSCF)

```
~~COMET~~UPDATE sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>; tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 129 ~~COMET~~UPDATE
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 3456 RTP/AVP 97
b=AS:25.4
a=curr:qos local sendrecv
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
~~a=qos:success sendonly~~
m=audio 0 RTP/AVP 97 96 0 15
```

Request-URI:	Takes the value of the Contact header of the received 183 Session Progress response.
Via:	Takes the value of either the IP address or FQDN of the originating UE.
From:/To:/Call-ID:	Copied from the 183 Session Progress response so that they include any tag parameters.
CSeq:	Takes a higher value than that in the previous request.

The SDP indicates that the resource reservation was successful in the local segment.

20. **~~COMET~~UPDATE (P-CSCF to S-CSCF) – see example in table 7.2.3.1-20**

P-CSCF adds the Route header corresponding to the session.

P-CSCF forwards the ~~COMET~~UPDATE request to S-CSCF.

Table 7.2.3.1-20: ~~COMET~~UPDATE (P-CSCF to S-CSCF)

```
~~COMET~~UPDATE sip:[5555::eee:fff:aaa:bbb]~~scscf1.home1.net~~ SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:scscf1.home1.net;lr, sip:~~764z87.1@~~scscf2.home2.net~~; lr~~;lr, sip:~~876t12.1@~~pcscf2.home2.net~~; lr~~;lr~~, sip:[5555::eee:fff:aaa:bbb]~~
From:
To:
Call-ID:
Cseq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
```

```
a=
a=
a=
a=
a=
m=
```

~~Request-URI:~~ ~~the first component of the saved Route header.~~

Route: saved from the Record-Route header of the 183 Session Progress response. ~~(with first element moved to Request-URI) with the initial Request-URI (received from the UE) appended as the final component.~~

21. **~~COMET~~UPDATE (MO#2 to S-S) – see example in table 7.2.3.1-21**

S-CSCF forwards the ~~COMET~~UPDATE request to the terminating endpoint, as per the S-CSCF to S-CSCF procedure.

Table 7.2.3.1-21: ~~COMET~~UPDATE (MO#2 to S-S)

```
COMETUPDATE sip:[5555::eee:fff:aaa:bbb]scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scscf2.home2.net;lr, sip: 876t12.1@pcscf2.home2.net; lr;lr, sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

~~Request-URI:~~ ~~the first component of the Route header. This will vary according to which S-CSCF to S-CSCF signalling flow is used.~~

22. **200 OK (S-S to MO#2) – see example in table 7.2.3.1-22**

The destination endpoint responds to the ~~COMET~~UPDATE request (21) with a 200 OK, per the S-CSCF to S-CSCF procedures.

Table 7.2.3.1-22: 200 OK (S-S to MO#2)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Type: application/sdp
Content-Length: 0(…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
```

```
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97
b=AS:25.4
a=curr:qos local sendrecv
a=curr:qos remote sendrecv
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
m=audio 0 RTP/AVP 97 96 0 15
```

The SDP indicates that the resource reservation was successful both in the local and the remote segment.

23. **200 OK (S-CSCF to P-CSCF) – see example in table 7.2.3.1-23**

S-CSCF forwards the 200 OK response to P-CSCF.

Table 7.2.3.1-23: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

24. **200 OK (P-CSCF to UE) – see example in table 7.2.3.1-24**

P-CSCF forwards the 200 OK response to UE.

Table 7.2.3.1-24: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
```

```
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

25. **180 Ringing (S-S to MO#2) - see example in table 7.2.3.1-25**

The called UE may optionally perform alerting. If so, it signals this to the calling party by a 180 Ringing provisional response to (6). This response is sent to S-CSCF per the S-CSCF to S-CSCF procedure.

Table 7.2.3.1-25: 180 Ringing (S-S to MO#2)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:876t12.1@pcscf2.home2.net;lr, sip:764z87.1@scscf2.home2.net; lr;lr,
    sip:332b23.1@scscf1.home1.net;lr, sip:431h23.1@pcscf1.home1.net;lr
Require: 100rel
From:
To:
Call-ID:
CSeq:
Require: 100rel
Contact: sip:[5555::eee:fff:aaa:bbb]
RSeq: 9022
Content-Length: 0
```

~~26. **Service Control**~~

~~The S-CSCF validates the service profile and performs any service control required for this subscriber.~~

267. **180 Ringing (S-CSCF to P-CSCF) – see example in table 7.2.3.1-267**

S-CSCF forwards the 180 Ringing response to P-CSCF.

Table 7.2.3.1-267: 180 Ringing (S-CSCF to P-CSCF)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Length:
```

278. **180 Ringing (P-CSCF to UE) – see example in table 7.2.3.1-278**

P-CSCF removes the Record-Route headers.

P-CSCF forwards the 180 Ringing response to UE.

Table 7.2.3.1-278: 180 Ringing (P-CSCF to UE)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Require:
From:
To:
Call-ID:
```

```
CSeq:
Require:
Contact:
RSeq:
Content-Length:
```

~~Editor's Note: Additional QoS interactions to handle one-way media at this point (e.g. for PSTN ringback and announcements) is for further study.~~

28~~9~~. **PRACK (UE to P-CSCF) – see example in table 7.2.3.1-28~~9~~**

UE indicates to the originating subscriber that the destination is ringing. It acknowledges the 180 Ringing provisional response (27) with a PRACK request.

Table 7.2.3.1-28~~9~~: PRACK (UE to P-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 130 PRACK
Rack: 9022 127 INVITE
Content-Length: 0
```

Request-URI: Takes the value of the Contact header of the received 180 Ringing response.

Via: Takes the value of either the IP address or FQDN of the originating UE.

From:/To:/Call-ID: Copied from the 180 Ringing response so that they include any revised tag parameters.

Cseq: Takes a higher value than in the previous request.

~~30~~29. **PRACK (P-CSCF to S-CSCF) – see example in table 7.2.3.1-29~~30~~**

P-CSCF adds the Route header corresponding to the session.

P-CSCF forwards the PRACK request to S-CSCF.

Table 7.2.3.1-29~~30~~: PRACK (P-CSCF to S-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb]scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Route: sip:764z87.1@scscf2.home2.net;lr, sip:876t12.1@pcscf2.home2.net;lr,
sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Rack:
Content-Length:
```

30~~1~~. **PRACK (MO#2 to S-S) – see example in table 7.2.3.1-30~~1~~**

S-CSCF forwards the PRACK request to the terminating endpoint, as per the S-CSCF to S-CSCF procedure.

Table 7.2.3.1-30~~1~~: PRACK (MO#2 to S-S)

```
PRACK sip:[5555::eee:fff:aaa:bbb]scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Route: sip:scscf2.home2.net;lr,sip:876t12.1@pcscf2.home2.net;lr,sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Rack:
```

```
Content-Length:
```

~~32~~31. **200 OK (S-S to MO#2) – see example in table 7.2.3.1-31~~2~~**

The destination endpoint responds to the PRACK request (30~~1~~) with a 200 OK response.

Table 7.2.3.1-31~~2~~: 200 OK (S-S to MO#2)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

32~~3~~. **200 OK (S-CSCF to P-CSCF) – see example in table 7.2.3.1-32~~3~~**

S-CSCF forwards the 200 OK response to P-CSCF.

Table 7.2.3.1-32~~3~~: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

33~~4~~. **200 OK (P-CSCF to UE) – see example in table 7.2.3.1-33~~4~~**

P-CSCF forwards the 200 OK response to UE.

Table 7.2.3.1-33~~4~~: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

34~~5~~. **200 OK (S-S to MO#2) – see example in table 7.2.3.1-34~~5~~**

When the called party answers, the terminating endpoint sends a 200 OK final response to the INVITE request (6), as specified by the termination procedures and the S-CSCF to S-CSCF procedures, to S-CSCF.

Table 7.2.3.1-34~~5~~: 200 OK (S-S to MO#2)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:876t12.1@pcscf2.home2.net;lr, sip: 764z87.1@scscf2.home2.net;lr,
    sip:332b23.1@scscf1.home1.net;lr, sip:431h23.1@pcscf1.home1.net;lr
From:
To:
Call-ID:
CSeq: 127 INVITE
Contact: sip:[5555::eee:fff:aaa:bbb]
Content-Type: application/sdp
Content-Length: (...)0

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
```

```
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97
b=AS:25.4
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=qos:success sendrecv
m=audio 0 RTP/AVP 97 96 0 15
```

~~Upon receiving the 200 OK, the S-CSCF stores the following information about this session, for use in providing enhanced services or in possible error recovery actions – see example in table 7.2.3.1-35b.~~

~~Table 7.2.3.1-35b: Storage of information at S-CSCF~~

```
Request-URI: sip:+1-212-555-2222@home1.net;user=phone
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B; seq=72))@localhost>; tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
CSeq(2dest): 127 INVITE
CSeq(2orig): none
Route(2dest): sip:scscf2.home2.net,sip:pcscf2.home2.net
Route(2orig): sip:pcscf1.home1.net
```

~~36. **Service Control**~~

~~S-CSCF performs whatever service control is appropriate for the completed session~~

35~~7~~. **200 OK (S-CSCF to P-CSCF) – see example in table 7.2.3.1-35~~7~~**

S-CSCF sends a 200 OK final response along the signalling path back to P-CSCF.

Table 7.2.3.1-35~~7~~: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
From:
To:
Call-ID:
CSeq:
Contact:
Content-Types:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
m=
```

36~~8~~. **Approval of QoS Commit**

The P-CSCF approves the commitment of the QoS resources if it was not approved already in step (10).

37~~9~~. **200 OK (P-CSCF to UE) – see example in table 7.2.3.1-37~~9~~**

P-CSCF indicates the resources reserved for this session should now be committed, and forwards the 200 OK final response to the session originator. UE can start media flow(s) for this session.

Table 7.2.3.1-3~~7~~9: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
m=
```

~~P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.~~

38~~40~~. **ACK (UE to P-CSCF) – see example in table 7.2.3.1-38~~40~~**

UE starts the media flow for this session, and responds to the 200 OK (39) with an ACK request sent to P-CSCF.

Table 7.2.3.1-38~~40~~: ACK (UE to P-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 127 ACK
Content-Length: 0
```

Cseq: Is required to be the same value as Cseq is original INVITE request [3].

39~~41~~. **ACK (P-CSCF to S-CSCF) – see example in table 7.2.3.1-39~~41~~**

P-CSCF adds the Route header corresponding to the session.

P-CSCF forwards the ACK request to S-CSCF.

Table 7.2.3.1-39~~41~~: ACK (P-CSCF to S-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:scscf1.home1.net;lr,sip: 764z87.1@scscf2.home2.net;lr, sip: 876t12.1@pcscf2.home2.net;lr,
sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Content-Length:
```

~~**Request-URI:** The first component of the saved Route header.~~

Route: Saved from the Record-Route header of the 183 Session Progress ~~200 OK~~ response. ~~(with first element moved to Request-URI) with the initial Request-URI (received from the UE) appended as the final component.~~

40~~2~~. **ACK (MO#2 to S-S) – see example in table 7.2.3.1-40~~2~~**

S-CSCF forwards the ACK request to the terminating endpoint, per the S-CSCF to S-CSCF procedure.

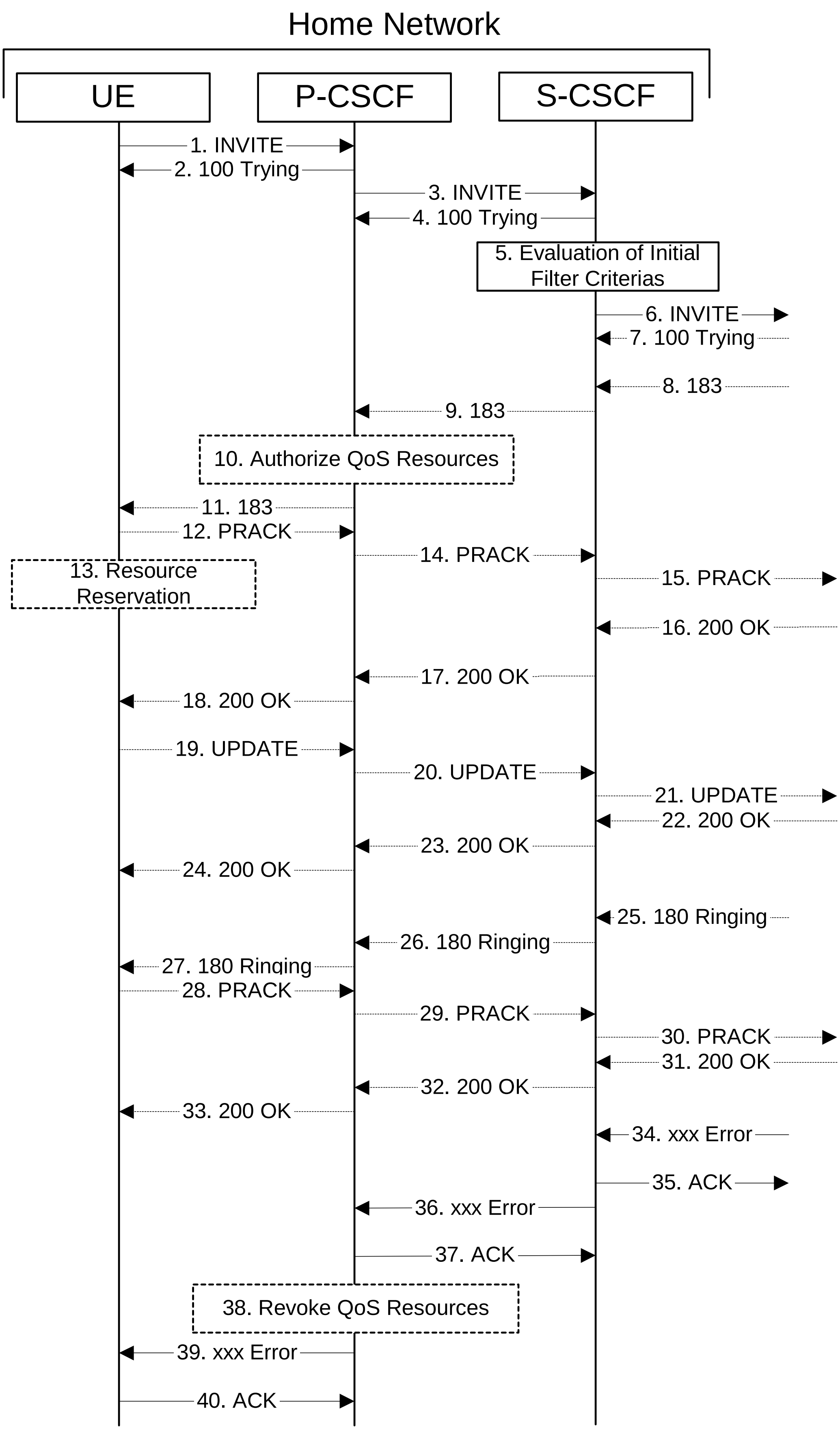
Table 7.2.3.1-40~~2~~: ACK (MO#2 to S-S)

```
ACK sip:[5555::eee:fff:aaa:bbb]scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Route: sip:scscf2.home2.net;lr,sip:876t12.1@pcscf2.home2.net;lr, sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Content-Length:
```

7.2.3.2 Failure in termination procedure

The roaming subscriber that initiated a session with procedure MO#2 had the attempt fail due to an error detected in the Termination procedure or in the S-CSCF-to-S-CSCF procedure. This could be due to, for example, destination busy (error code 486), destination service denied (error code 403), destination currently out of coverage (error code 480), or some other error.

Depending on the exact error that causes the session initiation failure, and when the error situation was detected, UE#1 could be at many different stages in the session establishment procedure. This is shown in figure 7.2.3.2-1, as optional messages 7-33 that may appear in this error procedure.


Home Network
UE
P-CSCF
S-CSCF
1. INVITE
2. 100 Trying
3. INVITE
4. 100 Trying
5. Evaluation of Initial Filter Criterias
6. INVITE
7. 100 Trying
8. 183
9. 183
10. Authorize QoS Resources
11. 183
12. PRACK
13. Resource Reservation
14. PRACK
15. PRACK
16. 200 OK
17. 200 OK
18. 200 OK
19. UPDATE
20. UPDATE
21. UPDATE
22. 200 OK
23. 200 OK
24. 200 OK
25. 180 Ringing
26. 180 Ringing
27. 180 Ringing
28. PRACK
29. PRACK
30. PRACK
31. 200 OK
32. 200 OK
33. 200 OK
34. xxx Error
35. ACK
36. xxx Error
37. ACK
38. Revoke QoS Resources
39. xxx Error
40. ACK

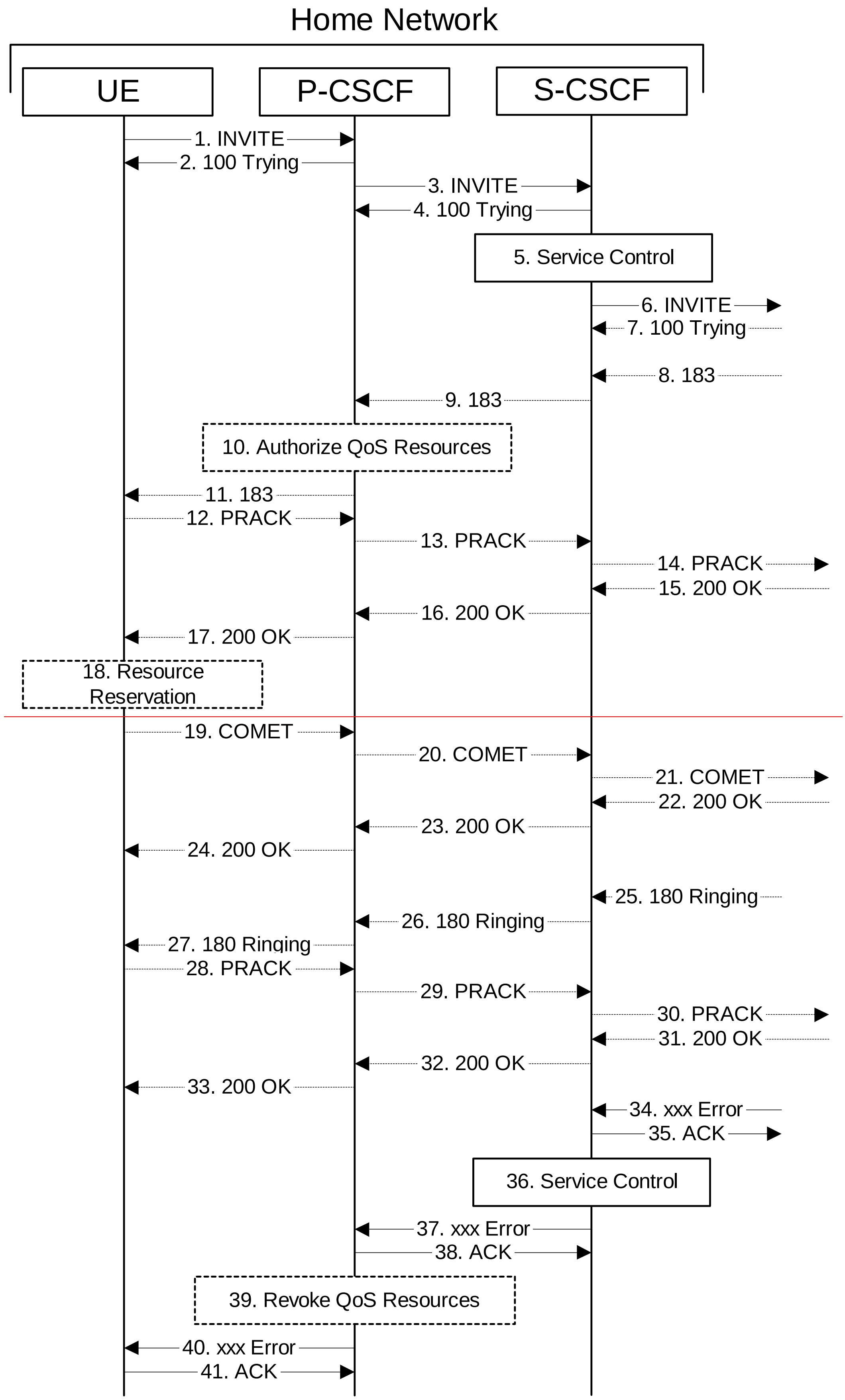


Figure 7.2.3.2-1: Failure in termination procedure

1-6. **INVITE (UE to P-CSCF) et seq**

UE#1 initiated a session, as described in subclause 7.2.3.1.

7-33. **100 Trying (S-S to MO#2) et seq**

Session initiation possibly continued, prior to detection of a failure condition, as described in subclause 7.2.3.1.

34. **xxx Error (S-S to MO#2) – see example in table 7.2.3.2-34**

The termination procedure detected some error situation, and returned a SIP error response.

NOTE 1: The error response may be, for example, "486 Busy", "403 Service Denied", "480 Temporarily Unavailable", or others. For this example, "486 Busy" is shown.

Table 7.2.3.2-34: 486 Busy Here (S-S to MO#2)

```
SIP/2.0 486 Busy Here
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B; seq=72))@localhost>;
    tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost; tag=1234
Contact: sip:[5555::eee:fff:aaa:bbb]
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 127 INVITE
Retry-After:3600
Content-Length: 0
```

35. **ACK (MO#2 to S-S) – see example in table 7.2.3.2-35**

Upon receive the 486 response from the S-S procedure, S-CSCF sends ACK.

Table 7.2.3.2-35: ACK (MO#2 to S-S)

```
ACK sip:[5555::eee:fff:aaa:bbb]~~:+1-212-555-2222@home2.net;user=phone~~ SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
Max-Forwards: 70
Route: sip:scscf2.home2.net;lr
From:
To:
Call-ID:
CSeq: 127 ACK
Content-Length: 0
```

~~36. **Service Control**~~

~~S-CSCF performs whatever service control is appropriate for this failed session attempt.~~

36~~7~~. **xxx Error (S-CSCF to P-CSCF) – see example in table 7.2.3.2-36~~7~~ (related to table 7.2.3.2-34)**

The S-CSCF returned a SIP error response to P-CSCF.

NOTE 2: The error response may be, for example, "486 Busy", "403 Service Denied", "480 Temporarily Unavailable", or others. For this example, "486 Busy" is shown.

Table 7.2.3.2-36~~7~~: 486 Busy Here (S-CSCF to P-CSCF)

```
SIP/2.0 486 Busy Here
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Contact:
Call-ID:
CSeq:
Retry-After:3600
Content-Length: 0
```

37~~8~~. **ACK (P-CSCF to S-CSCF) – see example in table 7.2.3.2-37~~8~~**

Upon receive the 486 response from the S-CSCF procedure, P-CSCF sends ACK.

Table 7.2.3.2-37~~8~~: ACK (P-CSCF to S-CSCF)

```
ACK sip:[~~+~~5555::eee:fff:aaa:bbb]~~1-212-555-2222@home1.net;user=phone~~ SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1
Max-Forwards: 70
Route: sip:scscf1.home1.net;lr
From:
To:
Call-ID:
CSeq: 127 ACK
Content-Length: 0
```

38~~9~~. **Revoke QoS authorization**

P-CSCF removes the QoS authorization, if any, for this session.

39~~40~~. **xxx Error (P-CSCF to UE) – see example in table 7.2.3.2-39~~40~~ (related to table 7.2.3.2-36~~7~~)**

The P-CSCF returned a SIP error response to UE.

NOTE 3: The error response may be, for example, "486 Busy", "403 Service Denied", "480 Temporarily Unavailable", or others. For this example, "486 Busy" is shown.

Table 7.2.3.2-39~~40~~: 486 Busy Here (P-CSCF to UE)

```
SIP/2.0 486 Busy Here
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Contact:
Call-ID:
CSeq:
Retry-After:3600
Content-Length: 0
```

40~~1~~. **ACK (P-CSCF to S-CSCF) – see example in table 7.2.3.2-40~~1~~**

Upon receive the 486 response from the P-CSCF, UE sends ACK.

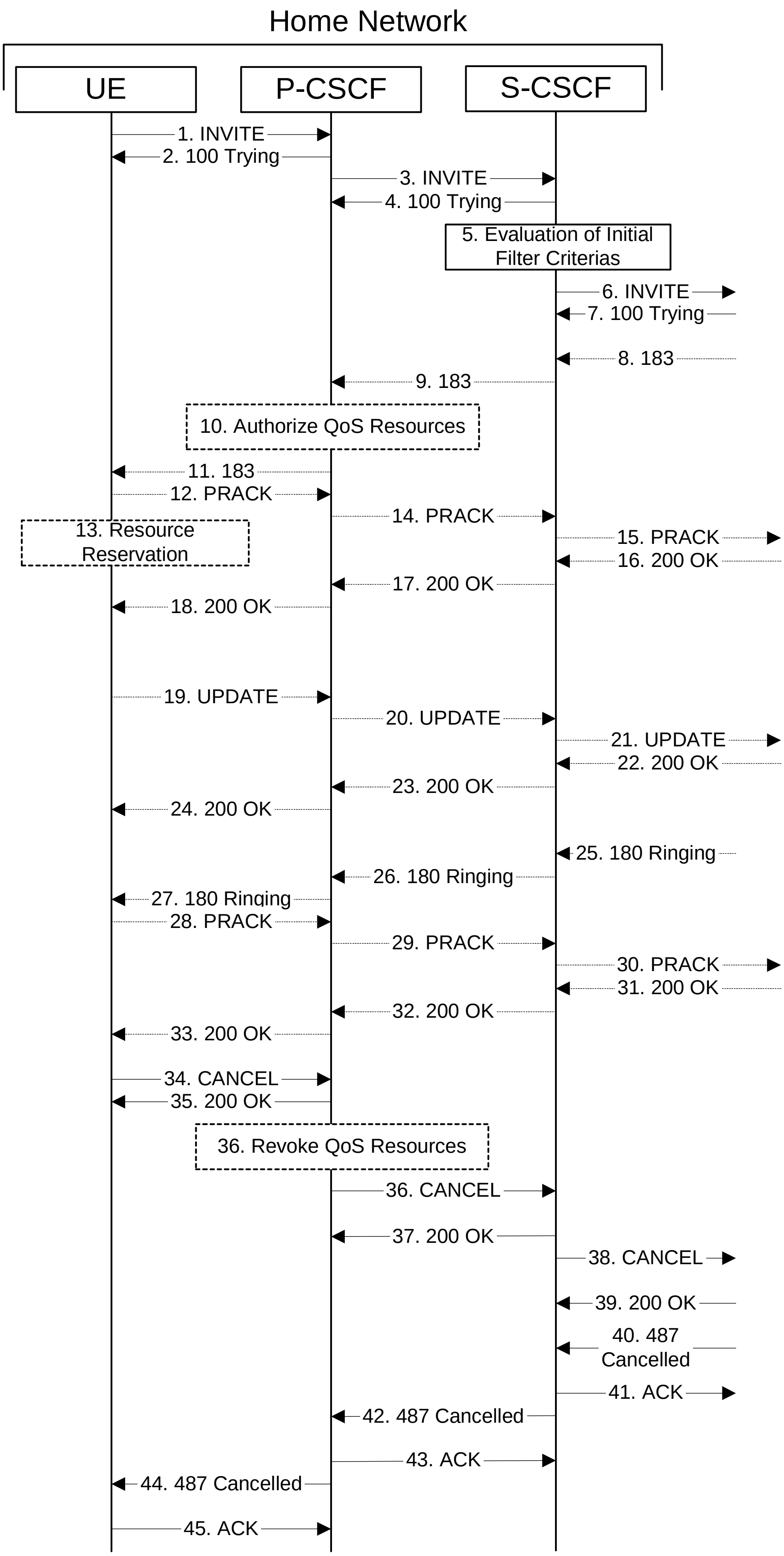
Table 7.2.3.2-40~~1~~: ACK (UE to P-CSCF)

```
ACK sip:[~~+~~5555::eee:fff:aaa:bbb]~~1-212-555-2222@home1.net;user=phone~~ SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From:
To:
Call-ID:
CSeq: 127 ACK
Content-Length: 0
```

7.2.3.3 Session abandoned, or resource failure

The roaming subscriber that initiated a session with procedure MO#2 either abandoned the attempt, or was unable to obtain the resources necessary for the session. The signalling flow for this error handling is shown in figure 7.2.3.3-1.

If the session is aborted due to failure to obtain resources, it will occur at step #18 in the signalling flow; steps 19-33 (marked as optional) will not be present. If the session is abandoned due to user command, it can happen at any point between steps 8-33.


Home Network
UE
P-CSCF
S-CSCF
1. INVITE
2. 100 Trying
3. INVITE
4. 100 Trying
5. Evaluation of Initial Filter Criterias
6. INVITE
7. 100 Trying
8. 183
9. 183
10. Authorize QoS Resources
11. 183
12. PRACK
13. Resource Reservation
14. PRACK
15. PRACK
16. 200 OK
17. 200 OK
18. 200 OK
19. UPDATE
20. UPDATE
21. UPDATE
22. 200 OK
23. 200 OK
24. 200 OK
25. 180 Ringing
26. 180 Ringing
27. 180 Ringing
28. PRACK
29. PRACK
30. PRACK
31. 200 OK
32. 200 OK
33. 200 OK
34. CANCEL
35. 200 OK
36. Revoke QoS Resources
36. CANCEL
37. 200 OK
38. CANCEL
39. 200 OK
40. 487 Cancelled
41. ACK
42. 487 Cancelled
43. ACK
44. 487 Cancelled
45. ACK

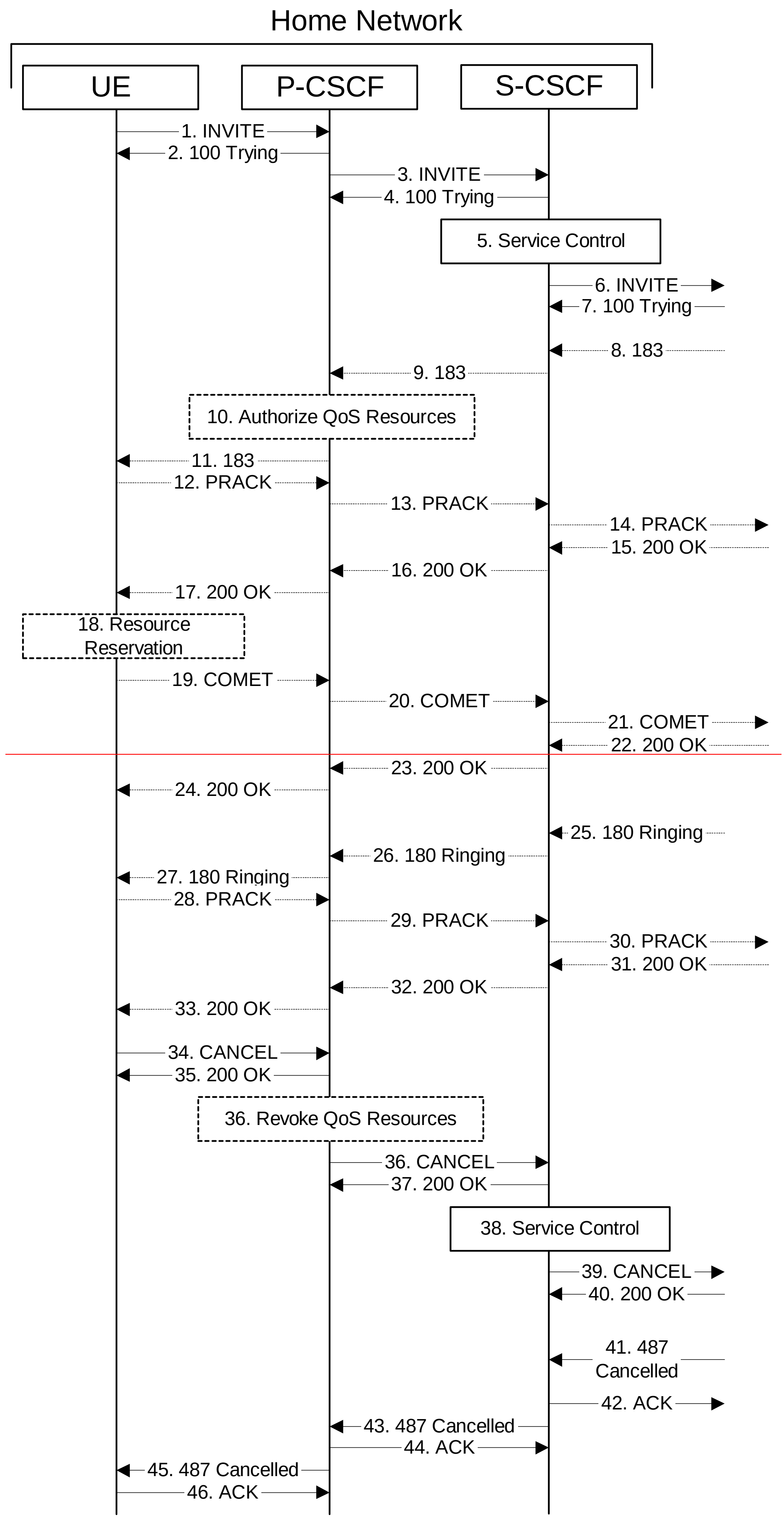


Figure 7.2.3.3-1: Session abandoned or resource failure

1-7. **INVITE (UE to P-CSCF) et seq**

UE#1 initiated a session, as described in subclause 7.2.3.1.

8-33. **183 Session Progress (S-S to MO#2) et seq**

Session initiation possibly continued, prior to detection of a failure condition, as described in subclause 7.2.3.1.

34. **CANCEL (UE to P-CSCF) – see example in table 7.2.3.3-34**

The UE cancelled the original INVITE request.

Table 7.2.3.3-34: CANCEL (UE to P-CSCF)

```
CANCEL sip:[5555::eee:fff:aaa:bbb]~~;user=phone~~ SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
    seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 127 CANCEL
Content-Length: 0
```

35. **200 OK (P-CSCF to UE) – see example in table 7.2.3.3-35**

Upon receive the CANCEL request from the UE, P-CSCF sends 200 OK.

Table 7.2.3.3-35: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

36. **Revoke QoS authorization**

P-CSCF removes the QoS authorization, if any, for this session.

37. **CANCEL (P-CSCF to S-CSCF) – see example in table 7.2.3.3-37 (related to table 7.2.3.3-34)**

The P-CSCF forwards the CANCEL request to S-CSCF.

Table 7.2.3.3-37: CANCEL (P-CSCF to S-CSCF)

```
CANCEL sip:[5555::eee:fff:aaa:bbb]~~scscf1.home1.net~~ SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:scfcf1.home1.net;lr,sip: ~~764z87.1@~~scscf2.home2.net;lr,~~ ~~sip: ~~876t12.1@~~pcscf2.home2.net;lr~~,~~
~~sip:[5555::eee:fff:aaa:bbb]~~
From:
To:
Call-ID:
Cseq:
Content-Length:
```

38. **200 OK (S-CSCF to P-CSCF) – see example in table 7.2.3.3-38**

Upon receiving the CANCEL request from the P-CSCF, S-CSCF sends 200 OK.

Table 7.2.3.3-38: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

~~39. **Service Control**~~

~~S-CSCF performs whatever service control is appropriate for this failed session attempt.~~

39~~40~~. **CANCEL (S-CSCF to S-S) – see example in table 7.2.3.3-39~~40~~ (related to table 7.2.3.3-37)**

The S-CSCF forwards the CANCEL request to the appropriate S-CSCF-to-S-CSCF procedure.

Table 7.2.3.3-39~~40~~: CANCEL (S-CSCF to S-S)

```
CANCEL sip:~~scscf2.home2.net;user=phone~~[555:eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scscf2.home2.net;lr,sip:~~876t12.1@~~pcscf2.home2.net~~, sip:[5555::eee:fff:aaa:bbb]~~
From:
To:
Call-ID:
Cseq:
Contact:
Content-Length:
```

40~~1~~. **200 OK (S-S to S-CSCF) – see example in table 7.2.3.3-40~~1~~**

Upon receive the CANCEL request from the S-CSCF, the next hop (whatever it is) sends 200 OK.

Table 7.2.3.3-40~~1~~: 200 OK (S-S to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

41~~2~~. **487 Cancelled (S-S to MO#2) – see example in table 7.2.3.3-41~~2~~**

The termination procedure cancelled the request, and returned a SIP error response to the original INVITE request.

Table 7.2.3.3-41~~2~~: 487 Cancelled (S-S to MO#2)

```
SIP/2.0 487 Cancelled
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Contact: sip:[5555::eee:fff:aaa:bbb]
Call-ID:
CSeq: 127 INVITE
Content-Length: 0
```

42~~3~~. **ACK (MO#2 to S-S) – see example in table 7.2.3.3-42~~3~~**

Upon receive the 487 response from the S-S procedure, S-CSCF sends ACK.

Table 7.2.3.3-4~~2~~3: ACK (MO#2 to S-S)

```
ACK sip:[5555::eee:fff:aaa:bbb]+1-212-555-2222@home2.net;user=phone SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
Max-Forwards 70
Route: sip:scscf2.home2.net;lr
From:
To:
Call-ID:
CSeq: 127 ACK
Content-Length: 0
```

4~~3~~4. **487 Cancelled (S-CSCF to P-CSCF) – see example in table 7.2.3.3-4~~3~~4 (related to table 7.2.3.3-4~~1~~2)**

The S-CSCF returned the SIP error response to P-CSCF.

Table 7.2.3.3-4~~3~~4: 487 Cancelled (S-CSCF to P-CSCF)

```
SIP/2.0 487 Cancelled
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Contact:
Call-ID:
CSeq:
Content-Length: 0
```

4~~4~~5. **ACK (P-CSCF to S-CSCF) – see example in table 7.2.3.3-4~~4~~5**

Upon receive the 487 response from the S-CSCF, P-CSCF sends ACK.

Table 7.2.3.3-4~~4~~5: ACK (P-CSCF to S-CSCF)

```
ACK sip:+[5555::eee:fff:aaa:bbb]1-212-555-2222@home1.net;user=phone SIP/2.0
Via: SIP/2.0/UDP pcscf.home.net
Max-Forwards: 70
Route: sip:scscf1.home1.net;lr
From:
To:
Call-ID:
CSeq: 127 ACK
Content-Length: 0
```

4~~5~~6. **487 Cancelled (P-CSCF to UE) – see example in table 7.2.3.3-4~~5~~6 (related to table 7.2.3.3-4~~3~~4)**

The P-CSCF returned a SIP error response to UE.

Table 7.2.3.3-4~~5~~6: 487 Cancelled (P-CSCF to UE)

```
SIP/2.0 487 Cancelled
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Contact:
Call-ID:
CSeq:
Retry-After:3600
Content-Length: 0
```

4~~6~~7. **ACK (UE to P-CSCF) – see example in table 7.2.3.3-4~~6~~7**

Upon receive the 487 response from the P-CSCF, UE sends ACK.

Table 7.2.3.3-4~~6~~7: ACK (UE to P-CSCF)

```
ACK sip:+1-212-555-2222@home1.net;user=phone SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From:
To:
Call-ID:
CSeq: 127 ACK
Content-Length: 0
```

7.3.5 S-S#2

7.3.5.1 (S-S#2) Single network operator performing origination and termination (MO#2, MT#2 assumed)

Figure 7.3.5.1-1 shows a S-CSCF handling session origination, which performs an analysis of the destination address, and determines that it belongs to a subscriber of the same operator. The request is therefore forwarded to a local I-CSCF. The I-CSCF queries the HSS for current location information, and finds the S-CSCF assigned to the subscriber (S-CSCF#2), and forwards the request to S-CSCF#2.

Origination sequences that share this common S-CSCF to S-CSCF procedure are:

MO#1a Mobile origination, roaming, without a THIG. The "Originating Network" of S-S#2 is therefore a visited network.

MO#1b Mobile origination, roaming, with a THIG in home network. The "Originating Network" of S-S#2 is therefore a visited network.

MO#2 Mobile origination, located in home service area. The "Originating Network" of S-S#2 is therefore the home network.

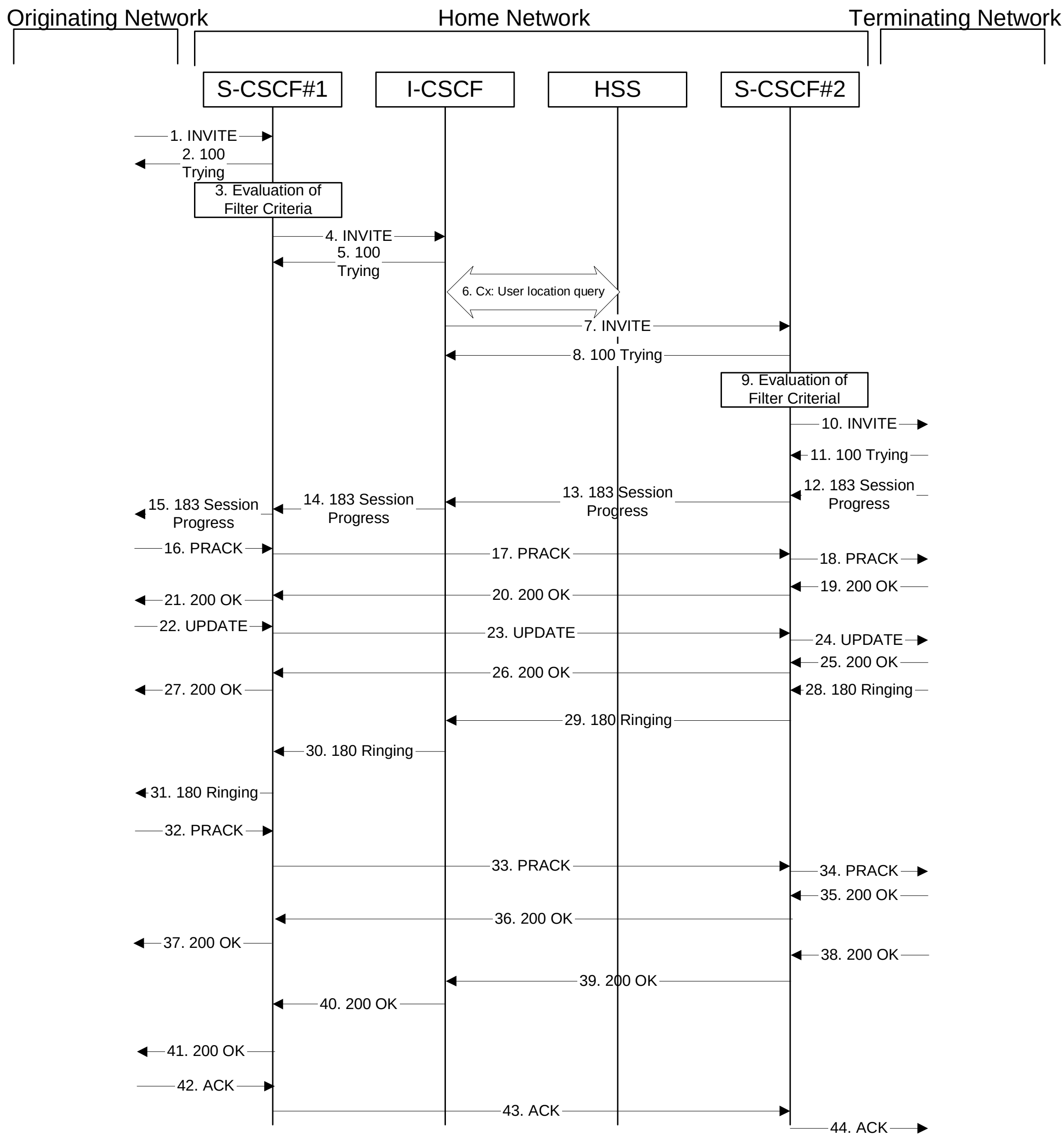
CS-O CS Networks origination. The "Originating Network" of S-S#2 is the home network. The element labeled S-CSCF#1 is the MGCF of the CS-O procedure.

Termination sequences that share this common S-CSCF to S-CSCF procedure are:

MT#1a Mobile termination, roaming, without a THIG. The "Terminating Network" of S-S#2 is a visited network.

MT#1b Mobile termination, roaming, with a THIG in home network. The "Terminating Network" of S-S#2 is a visited network.

MT#2 Mobile termination, located in home service area. The "Terminating Network" of S-S#2 is the home network.



Originating Network
Home Network
Terminating Network
S-CSCF#1
I-CSCF
HSS
S-CSCF#2
1. INVITE
2. 100 Trying
3. Evaluation of Filter Criteria
4. INVITE
5. 100 Trying
6. Cx: User location query
7. INVITE
8. 100 Trying
9. Evaluation of Filter Criterial
10. INVITE
11. 100 Trying
12. 183 Session Progress
13. 183 Session Progress
14. 183 Session Progress
15. 183 Session Progress
16. PRACK
17. PRACK
18. PRACK
19. 200 OK
20. 200 OK
21. 200 OK
22. UPDATE
23. UPDATE
24. UPDATE
25. 200 OK
26. 200 OK
27. 200 OK
28. 180 Ringing
29. 180 Ringing
30. 180 Ringing
31. 180 Ringing
32. PRACK
33. PRACK
34. PRACK
35. 200 OK
36. 200 OK
37. 200 OK
38. 200 OK
39. 200 OK
40. 200 OK
41. 200 OK
42. ACK
43. ACK
44. ACK

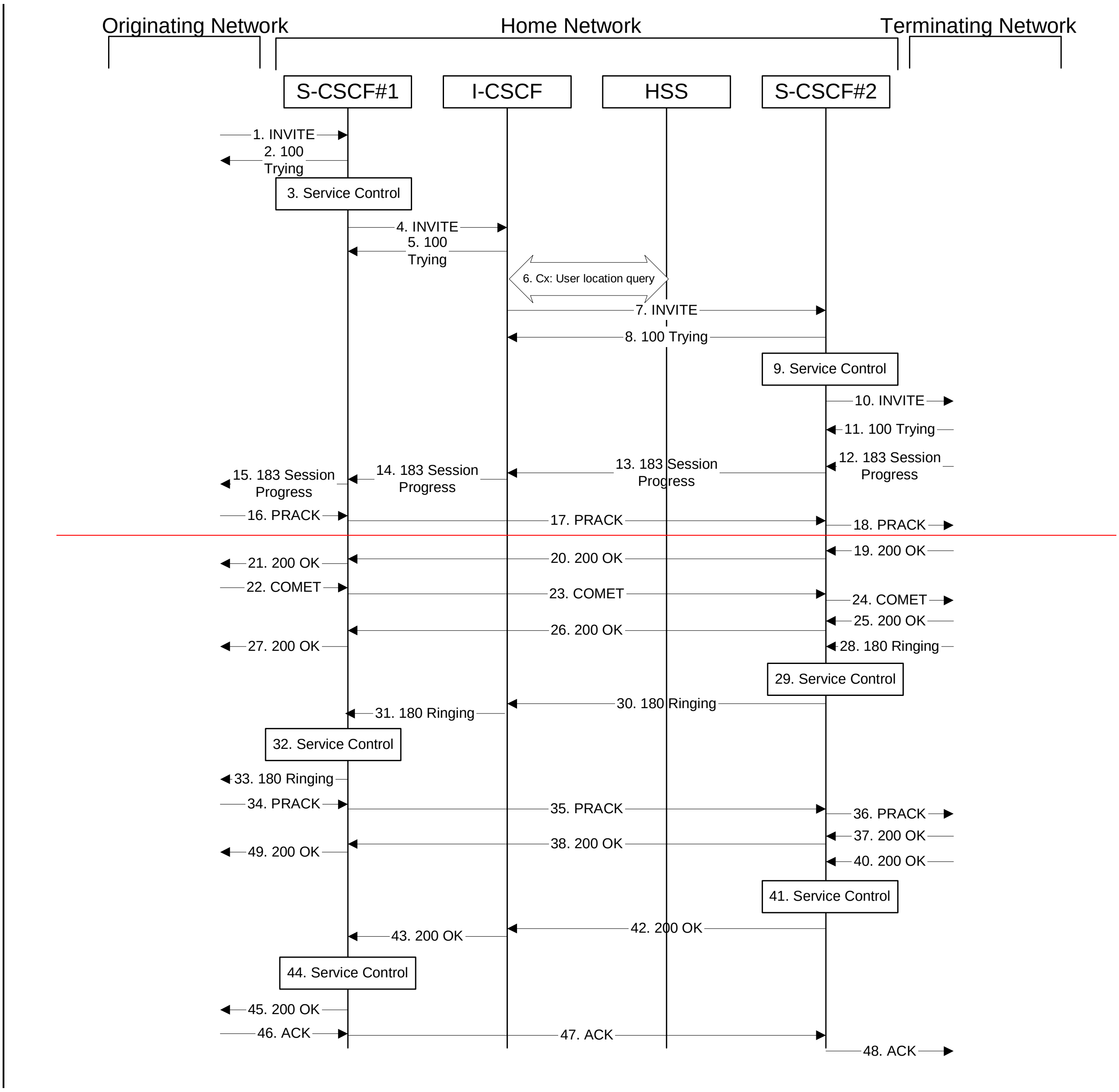


Figure 7.3.5.1-1: S-S#2

Procedure S-S#2 is as follows:

1. **INVITE (MO to S-S#2) – see example in table 7.3.5.1-1**

   The INVITE request is sent from the UE to S-CSCF#1 by the procedures of the originating signalling flow.

Table 7.3.5.1-1: INVITE (MO to S-S#2)

```
INVITE ~~sip~~tel:+1-212-555-2222~~@home1.net;user=phone~~~~scscf1.home1.net~~ SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Record-Route: sip: ~~431h23.1@~~pcscf1.home1.net
Route: sip:~~+~~scscf1.home1.net;lr~~1-212-555-2222@home1.net;user=phone~~
~~Supported: 100rel~~
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>~~;privacy=off~~
RPID-Privacy: privacy=off;party=calling ~~Anonymity: Off~~
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 127 INVITE
Require: precondition
Supported: 100rel
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 3400 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv ~~a=qos:mandatory sendrecv~~
a=rtpmap:99:MPV
m=video 3402 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv ~~a=qos:mandatory sendrecv~~
a=rtpmap:99:MPV
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
~~a=qos:mandatory sendrecv~~
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
~~a=qos:mandatory sendrecv~~
```

2. **100 Trying (S-S#2 to MO) – see example in table 7.3.5.1-2**

   S-CSCF#1 responds to the INVITE request (1) with a 100 Trying provisional response.

Table 7.3.5.1-2: 100 Trying (S-S#2 to MO)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

3. **Evaluation of initial filter criterias**

    S-CSCF#1 validates the service profile of this subscriber and evaluates the initial filter criterias. For this example, assume no Application Server involvement.

~~**Service Control**~~

~~S-CSCF#1 performs whatever service control logic is appropriate for this session attempt.~~

~~S-CSCF#1 examines the media parameters, and removes any choices that the subscriber does not have authority to request.~~

~~For this example, assume the subscriber is not allowed video.~~

4. **INVITE (S-CSCF to I-CSCF) – see example in table 7.3.5.1-4**

    S-CSCF#1 performs an analysis of the destination address, and determines the network operator to whom the destination subscriber belongs. Since the originating operator does not desire to keep their internal configuration hidden, S-CSCF#1 forwards the INVITE request directly to to I-CSCF in the destination network.

    S-CSCF examines the media parameters, and removes any choices that the subscriber does not have authority to request. For this example, assume the subscriber is not allowed video.

Table 7.3.5.1-4: INVITE (S-CSCF to I-CSCF)

```
INVITE sip:+1-212-555-2222user2_public1@home2.net@home1.net;user=phone SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Record-Route: sip: 332b23.1@scscf1.home1.net;lr, sip: 431h23.1@pcscf1.home1.net;lr
Supported: 
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>;privacy=off;screen=yes;screen=yes
RPID-Privacy:Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=qos:mandatory sendrecv 
a=rtpmap:97 AMR
```

```
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
a=qos:mandatory sendrecv
```

Request-URI: In the case where the ~~Route header~~Request-URI of the incoming INVITE request to S-CSCF contains a TEL-URL [5], it has to be translated to a globally routable SIP-URL before applying it as Request-URI of the outgoing INVITE request. For this address translation the S-CSCF shall use the services of an ENUM-DNS protocol according to RFC 2916 [6], or any other suitable translation database. Database aspects of ENUM are outside the scope of this specification.

5. **100 Trying (I-CSCF to S-CSCF) – see example in table 7.3.5.1-5**

I-CSCF responds to the INVITE request (4) by sending a 100 Trying provisional response to S-CSCF#1.

Table 7.3.5.1-5: 100 Trying (I-CSCF to S-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

6. **Cx: User Location Query procedure**

The I-CSCF sends a query to the HSS to find out the S-CSCF of the called user. The HSS responds with the address of the current S-CSCF for the terminating subscriber.

For detailed message flows see 3GPP TS 29.228[11].

Table 7.3.2.1-6a provides the parameters in the SIP INVITE request (flow 4), which are sent to the HSS.

Table 7.3.2.1-6b provides the parameters sent from the HSS that need to be mapped to SIP INVITE request (flow 7) and sent to S-CSCF.

7. **INVITE (I-CSCF to S-CSCF) – see example in table 7.3.5.1-7**

I-CSCF forwards the INVITE request to the S-CSCF (S-CSCF#2) that will handle the session termination.

Table 7.3.5.1-7: INVITE (I-CSCF to S-CSCF)

```
INVITE sip:user2_public1@home2.net +1-212-555-2222@home2.net;user=phonescscf2.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf2_s.home1.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:+1-212-555-2222@home1.net;user=phone
Record-Route: sip:332b23.1@scscf1.home1.net;lr,-sip:431h23.1@pcscf1.home1.net;lr
Route: sip:scscf2.home1.net;lr
Supported:
Remote-Party-ID:
RPID-Privacy:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
```

```
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
a=
a=
```

NOTE: The I-CSCF does not add itself to the Record-Route header, as it has no need to remain in the signalling path once the session is established.

8. **100 Trying (S-CSCF to I-CSCF) – see example in table 7.3.5.1-8**

S-CSCF#2 responds to the INVITE request (8) with a 100 Trying provisional response.

Table 7.3.5.1-8: 100 Trying (S-CSCF to I-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP icscf2_s.home1.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

9. **Evaluation of initial filter criterias**

S-CSCF#2 validates the service profile of this subscriber and evaluates the initial filter criterias.~~**Service Control**~~

~~- S-CSCF#2 performs whatever service control logic is appropriate for this session attempt.~~

~~- S-CSCF#2 examines the media parameters, and removes any choices that the destination subscriber does not have authority to request.~~

~~- For this example, assume the destination subscriber is not allowed stereo, so only a single audio stream is permitted.~~

10. **INVITE (S-S#2 to MT) – see example in table 7.3.5.1-10**

S-CSCF#2 forwards the INVITE request, as determined by the termination procedure. S-CSCF#2 remembers (from the registration procedure) the UE Contact address and the next hop CSCF for this UE.

S-CSCF#2 examines the media parameters, and removes any choices that the destination subscriber does not have authority to request. For this example, assume the destination subscriber is not allowed stereo, so only a single audio stream is permitted.

Table 7.3.5.1-10: INVITE (S-S#2 to MT)

```
INVITE sip:[5555::eee:fff:aaa:bbb]pcscf2.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home1.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home1.net;branch=871y12.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 66
Route: sip:+1-212-555-2222@home1.net;user=phone
Record-Route: sip:764z87.1@scscf2.home1.net;lr,-sip:332b23.1@scscf1.home1.net;lr,
    sip:240f34.1@pcscf1.home1.net;lr
Route: sip:pcscf2.home1.net;lr
Supported: 
Remote-Party-ID:
AnonymityRPID-Privacy:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
P-Called-Party-ID: <telsip:+1-212-555-2222@home2.net;user=phone>
Content-Type:
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd 
t=907165275 0
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR 
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 0 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR 
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
```

~~c=IN IP6 5555::aaa:bbb:ccc:ddd~~
~~t=907165275 0~~
~~m=video 0 RTP/AVP 99~~
~~m=video 0 RTP/AVP 99~~
~~m=audio 3456 RTP/AVP 97 96 0 15~~
~~b=AS:25.4~~
~~a=qos:mandatory sendrecv~~
~~a=rtpmap:97 AMR~~
~~a=fmtp:97 mode-set=0,2,5,7; maxframes=2~~
~~a=rtpmap:96 G726-32/8000~~
~~m=audio 0 RTP/AVP 97 96 0 15~~

11. **100 Trying (MT to S-S#2) – see example in table 7.3.5.1-11 (related to table 7.3.5.1-10)**

S-CSCF#2 receives a 100 Trying provisional response to the INVITE request (11), as specified by the termination procedures.

Table 7.3.5.1-11: 100 Trying (MT to S-S#2)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP scscf2.home1.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home1.net;branch=871y12.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

12. **183 Session Progress (MT to S-S#2) – see example in table 7.3.5.1-12 (related to table 7.3.5.1-10)**

The media stream capabilities of the destination are returned along the signalling path, in a 183 Session Progress provisional response, as per the termination procedure.

Table 7.3.5.1-12: 183 Session Progress (MT to S-S#2)

SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP scscf2.home1.net;branch=764z87.1, SIP/2.0/UDP icscf2.home1.net, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:~~876t12.1@~~pcscf2.home1.net;lr, sip:~~764z87.1@~~scscf2.home1.net;lr, sip:~~332b23.1@~~scscf1.home1.net;lr, sip:~~431h23.1@~~pcscf1.home1.net;lr
Remote-Party-ID: "John Smith" <tel:+1-212-555-2222>~~;privacy=off~~;
~~Anonymity~~RPID-Privacy: privacy=Off;party=called
~~Require: 100rel~~
From:
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost; tag=314159
Call-ID:
CSeq:
Require: 100rel
Contact: sip:[5555::eee:fff:aaa:bbb]
RSeq: 9021
~~Content-Disposition: precondition~~
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97 96
b=AS:25.4~~3~~
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=conf:qos remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2

```
a=rtpmap:96 G726-32/8000
a=qos:mandatory sendrecv confirm
m=audio 0 RTP/AVP 97 96 0 15
```

13. **183 Session Progress (S-CSCF to I-CSCF) – see example in table 7.3.5.1-13**

S-CSCF#2 forwards the 183 Session Progress provisional response to I-CSCF.

Table 7.3.5.1-13: 183 Session Progress (S-CSCF to I-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP icscf2_s.home1.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
Remote-Party-ID: "John Smith" <tel:+1-212-555-2222>;privacy=off;screen=yes
AnonymityRPID-Privacy:
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Disposition: 
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
a=
m=
```

14. **183 Session Progress (I-CSCF to S-CSCF) – see example in table 7.3.5.1-14**

I-CSCF forwards the 183 Session Progress provisional response to S-CSCF#1.

Table 7.3.5.1-14: 183 Session Progress (I-CSCF to S-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
Remote-Party-ID:
AnonymityRPID-Privacy:
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Disposition: 
Content-Type:
Content-Length:

v=
o=
```

```
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
a=
m=
```

15. **183 Session Progress (S-S#2 to MO) – see example in table 7.3.5.1-15**

S-CSCF#1 forwards the 183 Session Progress to the originator, as per the originating procedure.

Table 7.3.5.1-15: 183 Session Progress (S-S#2 to MO)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
Remote-Party-ID:
AnonymityRPID-Privacy:
Require 
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Disposition: 
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
a=
m=
```

16. **PRACK (MO to S-S#2) – see example in table 7.3.5.1-16**

The originator decides the final set of media streams, and includes this information in the PRACK request sent to S-CSCF#1 by the origination procedures.

Table 7.3.5.1-16: PRACK (MO to S-S#2)

```
PRACK sip:[5555::eee:fff:aaa:bbb]scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:scscf1.home1.net;lr,sip:764z87.1@scscf2.home1.net;lr, sip:876t12.1@pcscf2.home1.net;lr, 
sip:[5555::eee:fff:aaa:bbb]
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
```

```
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 128 PRACK
Require: precondition
Rack: 9021 127 INVITE
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 3456 RTP/AVP 97
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=qos:mandatory sendrecv
m=audio 0 RTP/AVP 97 96 0 15
```

17. **PRACK (S-CSCF to S-CSCF) – see example in table 7.3.5.1-17**

S-CSCF#1 forwards the PRACK request to S-CSCF#2.

Table 7.3.5.1-17: PRACK (S-CSCF to S-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb]scscf2.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scscf2.home1.net;lr,sip:876t12.1@pcscf2.home1.net;lr, sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Require:
Rack:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

18. **PRACK (S-S#2 to MT) – see example in table 7.3.5.1-18**

S-CSCF#2 forwards the PRACK request to the terminating endpoint, as per the termination procedure.

Table 7.3.5.1-18: PRACK (S-S#2 to MT)

```
PRACK sip:[5555::eee:fff:aaa:bbb]pcscf2.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home1.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:pcscf2.home1.net;lr[5555::eee:fff:aaa:bbb]
```

```
From:
To:
Call-ID:
Cseq:
Require:
Rack:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

19. **200 OK (MT to S-S#2) – see example in table 7.3.5.1-19 (related to table 7.3.5.1-18)**

    The terminating endpoint responds to the PRACK request (19) with a 200 OK response.

Table 7.3.5.1-19: 200 OK (MT to S-S#2)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home1.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Type: application/sdp
Content-Length: (…)0

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=conf:qos remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
m=audio 0 RTP/AVP 97 96 0 15
```

20. **200 OK (S-CSCF to S-CSCF) – see example in table 7.3.5.1-20**

    S-CSCF#2 forwards the 200 OK response to S-CSCF#1.

Table 7.3.5.1-20: 200 OK (S-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
```

```
CSeq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

21. **200 OK (S-S#2 to MO) – see example in table 7.3.5.1-21**

S-CSCF#1 forwards the 200 OK response to the originating endpoint.

Table 7.3.5.1-21: 200 OK (S-S#2 to MO)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

22. **~~COMET~~UPDATE (MO to S-S#2) – see example in table 7.3.5.1-22**

When the originating endpoint has completed the resource reservation procedures, it sends the ~~COMET~~UPDATE request to S-CSCF#1 by the origination procedures.

Table 7.3.5.1-22: ~~COMET~~UPDATE (MO to S-S#2)

```
COMETUPDATE sip:[5555::eee:fff:aaa:bbb]scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:scscf1.home1.net;lr,sip:764z87.1@scscf2.home1.net;lr, sip:876t12.1@pcscf2.home1.net;lr,
sip:[5555::eee:fff:aaa:bbb]
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 129 COMETUPDATE
Content-Type: application/sdp
Content-Length: (…)
```

```
v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 3456 RTP/AVP 97
b=AS:25.4
a=curr:qos local sendrecv
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=qos:success sendonly
m=audio 0 RTP/AVP 97 96 0 15
```

23. ~~COMET~~UPDATE (S-CSCF to S-CSCF) – see example in table 7.3.5.1-23

S-CSCF#1 forwards the ~~COMET~~UPDATE request to S-CSCF#2.

Table 7.3.5.1-23: ~~COMET~~UPDATE (S-CSCF to S-CSCF)

```
COMETUPDATE sip:[5555::eee:fff:aaa:bbb]scscf2.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sipsip:scscf2.home1.net;lr,sip:876t12.1@pcscf2.home1.net;lr, sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

24. ~~COMET~~UPDATE (S-S#2 to MT) – see example in table 7.3.5.1-24

S-CSCF#2 forwards the ~~COMET~~UPDATE request to the terminating endpoint, as per the termination procedure.

Table 7.3.5.1-24: ~~COMET~~UPDATE (S-S#2 to MT)

```
COMETUPDATE sip:[5555::eee:fff:aaa:bbb]pcscf2.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home1.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:pcscf2.home1.net;lr[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Content-Type:
Content-Length:
```

```
v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

25. **200 OK (MT to S-S#2) – see example in table 7.3.5.1-25 (related to table 7.3.5.1-24)**

The terminating endpoint responds to the ~~COMET~~UPDATE request (24~~5~~) with a 200 OK response.

Table 7.3.5.1-25: 200 OK (MT to S-S#2)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home1.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Type: application/sdp
Content-Length: (…)0

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
m=audio 0 RTP/AVP 97 96 0 15
```

26. **200 OK (S-CSCF to S-CSCF) – see example in table 7.3.5.1-26**

S-CSCF#2 forwards the 200 OK response to S-CSCF#1.

Table 7.3.5.1-26: 200 OK (S-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
```

```
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

27. **200 OK (S-S#2 to MO) – see example in table 7.3.5.1-27**

S-CSCF#1 forwards the 200 OK response to the originating endpoint.

Table 7.3.5.1-27: 200 OK (S-S#2 to MO)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

28. **180 Ringing (MT to S-S#2) – see example in table 7.3.5.1-28 (related to table 7.3.5.1-10)**

The terminating endpoint may optionally send a 180 Ringing provisional response indicating alerting is in progress. This response is sent by the termination procedure to S-CSCF#2.

Table 7.3.5.1-28: 180 Ringing (MT to S-S#2)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP scscf2.home1.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home1.net;branch=871y12.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:876t12.1@pcscf2.home1.net;lr, sip:764z87.1@scscf2.home1.net;lr,
    sip:332b23.1@scscf1.home1.net;lr, sip:431h23.1@pcscf1.home1.net;lr
Require: 100rel
From:
To:
Call-ID:
CSeq:
Require: 100rel
Contact: sip:[5555::eee:fff:aaa:bbb]
RSeq: 9022
Content-Length: 0
```

~~29. **Service Control**~~

~~The S-CSCF validates the service profile and performs any service control required for this subscriber.~~

2930. **180 Ringing (S-CSCF to I-CSCF) – see example in table 7.3.5.1-2930**

S-CSCF#2 forwards the 180 Ringing response to I-CSCF.

Table 7.3.5.1-29~~30~~: 180 Ringing (S-CSCF to I-CSCF)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP icscf2_s.home1.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
~~Require:~~
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Length:
```

30~~1~~. **180 Ringing (I-CSCF to S-CSCF) – see example in table 7.3.5.1-30~~1~~**

I-CSCF forwards the 180 Ringing response to S-CSCF#1.

Table 7.3.5.1-30~~1~~: 180 Ringing (I-CSCF to S-CSCF)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
~~Require:~~
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Length:
```

~~32. **Service Control**~~

~~The S-CSCF validates the service profile and performs any service control required for this subscriber.~~

31~~3~~. **180 Ringing (S-S#2 to MO) – see example in table 7.3.5.1-31~~3~~**

S-CSCF#1 forwards the 180 Ringing response to the originator, per the origination procedure.

Table 7.3.5.1-31~~3~~: 180 Ringing (S-S#2 to MO)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
~~Require:~~
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Length:
```

32~~4~~. **PRACK (MO to S-S#2) – see example in table 7.3.5.1-32~~4~~**

The originator acknowledges the 180 Ringing provisional response (34) with a PRACK request.

Table 7.3.5.1-32~~4~~: PRACK (MO to S-S#2)

```
PRACK sip:[5555::eee:fff:aaa:bbb]~~scscf1.home1.net ~~SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
```

```
Max-Forwards: 69
Route: sip:scscf1.home1.net;lr,sip:~~764z87.1@~~scscf2.home1.net;lr, sip:~~876t12.1@~~pcscf2.home1.net;lr,~~ sip:[5555::eee:fff:aaa:bbb]~~
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 130 PRACK
Rack: 9022 127 INVITE
Content-Length: 0
```

33~~5~~. **PRACK (S-CSCF to S-CSCF) – see example in table 7.3.5.1-33~~5~~**

S-CSCF#1 forwards the PRACK request to S-CSCF#2.

Table 7.3.5.1-33~~5~~: PRACK (S-CSCF to S-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb]~~scscf2.home1.net~~ SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: ~~sip~~sip:scscf2.home1.net;lr,sip:~~876t12.1@~~pcscf2.home1.net;lr~~, sip:[5555::eee:fff:aaa:bbb]~~
From:
To:
Call-ID:
Cseq:
Rack:
Content-Length:
```

34~~6~~. **PRACK (S-S#2 to MT) – see example in table 7.3.5.1-34~~6~~**

S-CSCF#2 forwards the PRACK request to the terminating endpoint.

Table 7.3.5.1-34~~6~~: PRACK (S-S#2 to MT)

```
PRACK sip:[5555::eee:fff:aaa:bbb]~~pcscf2.home1.net~~ SIP/2.0
Via: SIP/2.0/UDP scscf2.home1.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:pcscf2.home1.net~~[5555::eee:fff:aaa:bbb]~~
From:
To:
Call-ID:
Cseq:
Rack:
Content-Length:
```

35~~7~~. **200 OK (MT to S-S#2) – see example in table 7.3.5.1-35~~7~~ (related to table 7.3.5.1-34~~6~~)**

The terminating endpoint responds to the PRACK request (34~~7~~) with a 200 OK response.

Table 7.3.5.1-35~~7~~: 200 OK (MT to S-S#2)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home1.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

36~~8~~. **200 OK (S-CSCF to S-CSCF) – see example in table 7.3.5.1-36~~8~~**

S-CSCF#2 forwards the 200 OK response to S-CSCF#1.

Table 7.3.5.1-38~~6~~: 200 OK (S-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

37~~9~~. 200 OK (S-S#2 to MO) – see example in table 7.3.5.1-37~~9~~

S-CSCF#1 forwards the 200 OK response to the originating endpoint.

Table 7.3.5.1-37~~9~~: 200 OK (S-S#2 to MO)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

38~~40~~. 200 OK (MT to S-S#2) – see example in table 7.3.5.1-38~~40~~ (related to table 7.3.5.1-10)

The final response, 200 OK, is sent by the terminating endpoint over the signalling path. This is typically generated when the subscriber has accepted the incoming session attempt. The response is sent to S-CSCF#2 per the termination procedure.

Table 7.3.5.1-38~~40~~: 200 OK (MT to S-S#2)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home1.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home1.net;branch=871y12.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:~~876t12.1@~~pcscf2.home1.net;lr, sip:~~764z87.1@~~scscf2.home1.net;lr,
    sip:~~332b23.1@~~scscf1.home1.net;lr, sip:~~431h23.1@~~pcscf1.home1.net;lr
From:
To:
Call-ID:
CSeq: 127 INVITE
Contact: sip:[5555::eee:fff:aaa:bbb]
~~Content-Type: application/sdp~~
Content-Length: 0~~(...)~~

~~v=0~~
~~o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd~~
~~s=-~~
~~c=IN IP6 5555::eee:fff:aaa:bbb~~
~~t=907165275 0~~
~~m=video 0 RTP/AVP 99~~
~~m=video 0 RTP/AVP 99~~
~~m=audio 6544 RTP/AVP 97~~
~~b=AS:25.4~~
~~a=rtpmap:97 AMR~~
~~a=fmtp:97 mode-set=0,2,5,7; maxframes=2~~
~~a=qos:success sendrecv~~
~~m=audio 0 RTP/AVP 97 96 0 15~~
```

~~41. **Service Control**~~

~~S-CSCF#2 performs whatever service control logic is appropriate for this session completion.~~

39~~42~~. 200 OK (S-CSCF to I-CSCF) – see example in table 7.3.5.1-39~~42~~

The 200 OK response is forwarded to the I-CSCF.

Table 7.3.5.1-39~~42~~: 200 OK (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf2_s.home1.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
m=
```

40~~3~~. **200 OK (I-CSCF to S-CSCF) – see example in table 7.3.5.1-40~~3~~**

The 200 OK response is forwarded to S-CSCF#1.

Table 7.3.5.1-40~~3~~: 200 OK (I-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
m=
```

~~44. **Service Control**~~

~~S-CSCF#1 performs whatever service control logic is appropriate for this session completion.~~

41~~5~~. **200 OK (S-S#2 to MO) – see example in table 7.3.5.1-41~~5~~**

The 200 OK response is returned to the originating endpoint, by the origination procedure.

Table 7.3.5.1-41~~5~~: 200 OK (S-S#2 to MO)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
From:
```

```
To:
Call-ID:
CSeq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
m=
```

42~~6~~. **ACK (MO to S-S#2) – see example in table 7.3.5.1-42~~6~~**

The originating endpoint sends the final acknowledgement to S-CSCF#1 by the origination procedures.

Table 7.3.5.1-42~~6~~: ACK (MO to S-S#2)

```
ACK sip:[5555::eee:fff:aaa:bbb]scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:scscf1.home1.net;lr,sip:764z87.1@scscf2.home1.net;lr, sip:876t12.1@pcscf2.home1.net;lr,
sip:[5555::eee:fff:aaa:bbb]
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 127 ACK
Content-Length: 0
```

43~~7~~. **ACK (S-CSCF to S-CSCF) – see example in table 7.3.5.1-43~~7~~**

S-CSCF#1 forwards the ACK request to S-CSCF#2.

Table 7.3.5.1-43~~7~~: ACK (S-CSCF to S-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]scscf2.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scsf2.home1.net;lr,sip:876t12.1@pcscf2.home1.net;lr, sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Content-Length:
```

44~~8~~. **ACK (S-S#2 to MT) – see example in table 7.3.5.1-44~~8~~**

S-CSCF#2 forwards the ACK request to the terminating endpoint, as per the termination procedure.

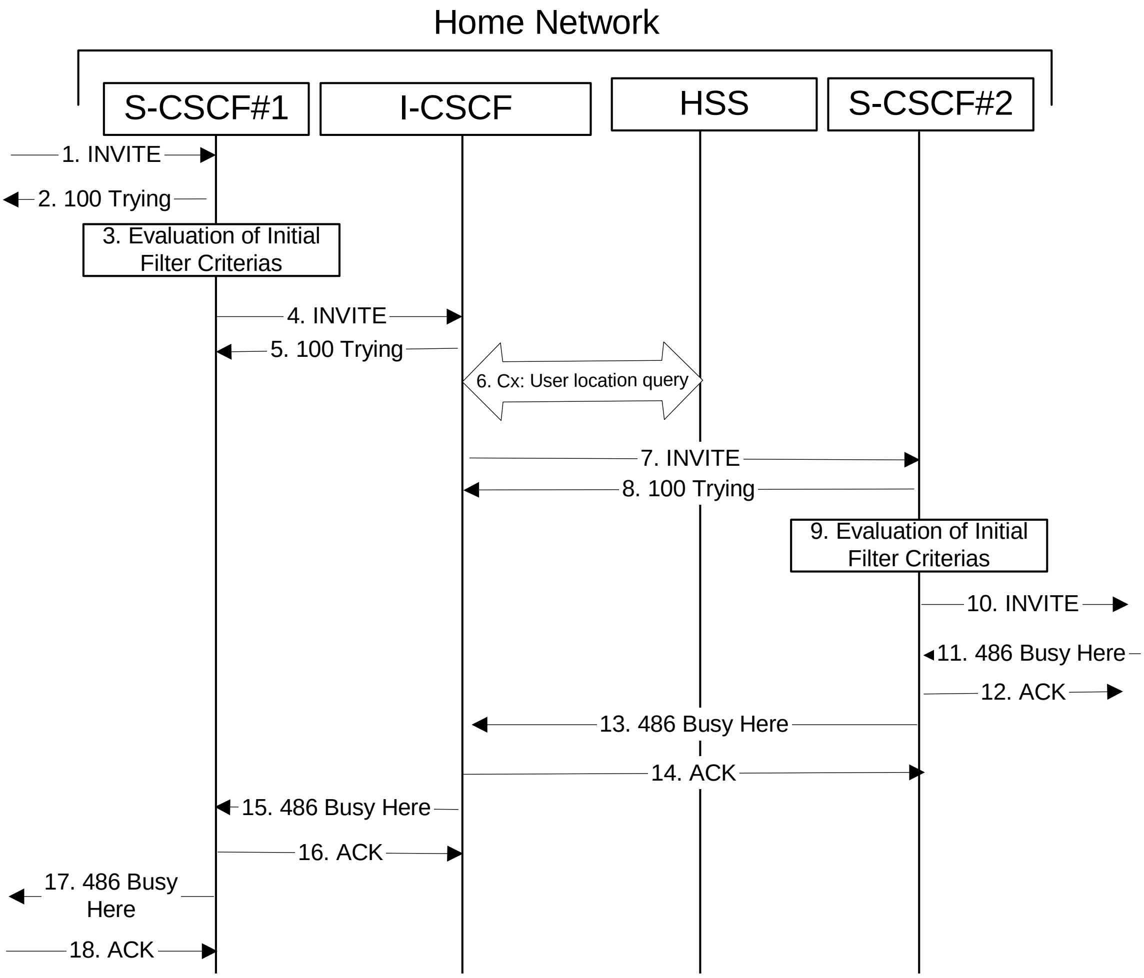
Table 7.3.5.1-44~~8~~: ACK (S-S#2 to MT)

```
ACK sip:[5555::eee:fff:aaa:bbb]pcscf2.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home1.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:pcscf2.home1.net;lr[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
```

```
Content-Length:
```

7.3.5.2 (S-S#2) Single network operator performing origination and termination, terminating UE is busy, and not able or not willing to answer the call (MO#2, MT#2 assumed)

Figure 7.3.5.2-1 shows the subscriber that originated a session with one of the MO procedures had the attempt fail due to an error detected in the termination procedure. In this flow, 486 error response is shown as the example.


Home Network
S-CSCF#1
I-CSCF
HSS
S-CSCF#2
1. INVITE
2. 100 Trying
3. Evaluation of Initial Filter Criterias
4. INVITE
5. 100 Trying
6. Cx: User location query
7. INVITE
8. 100 Trying
9. Evaluation of Initial Filter Criterias
10. INVITE
11. 486 Busy Here
12. ACK
13. 486 Busy Here
14. ACK
15. 486 Busy Here
16. ACK
17. 486 Busy Here
18. ACK

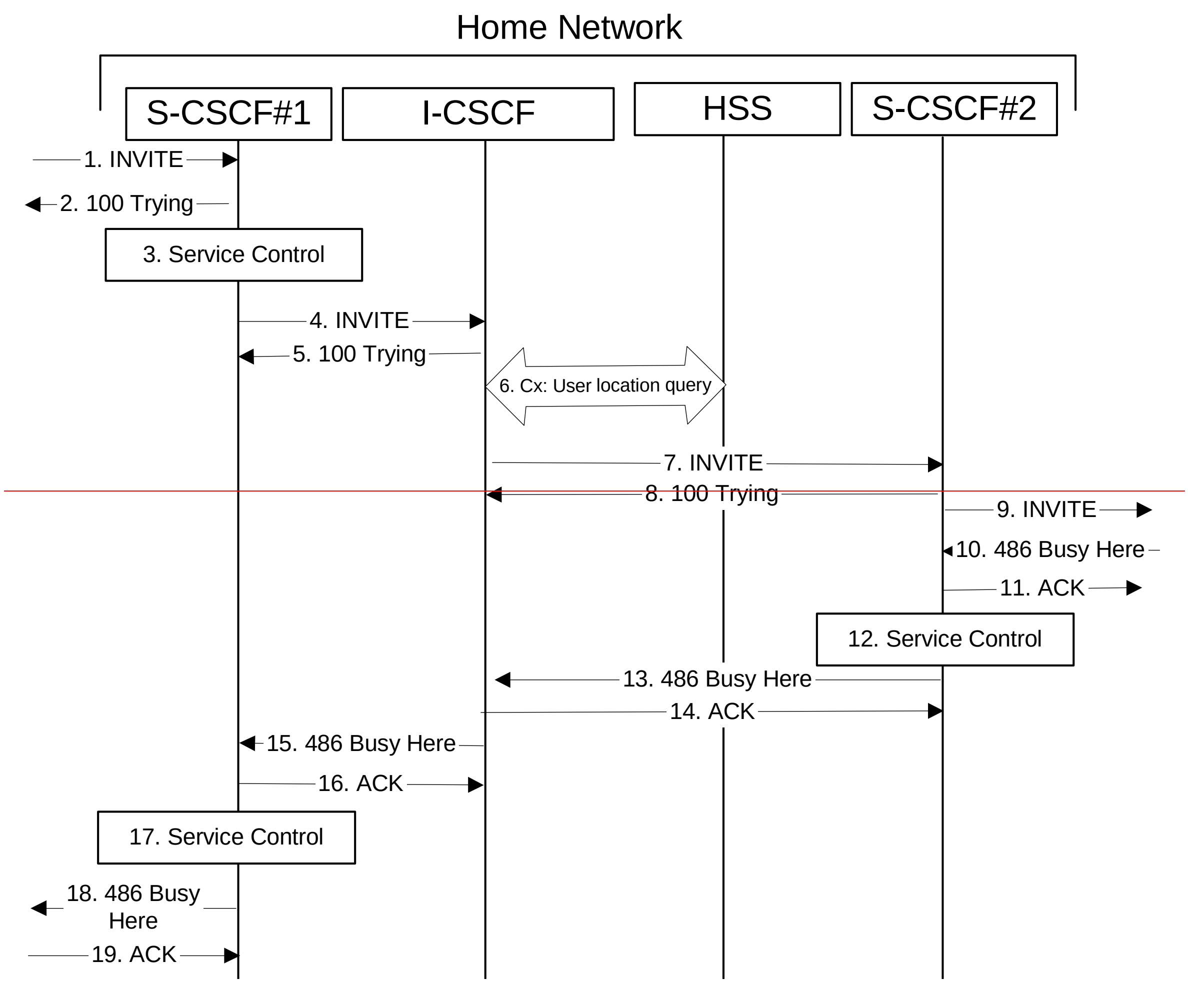


Figure 7.3.5.2: (S-S#2) Single network operator performing origination and termination, terminating UE is busy, and not able or not willing to answer the call (MO#2, MT#2 assumed)

1-10~~9~~. The same as described in flow 1-8 in subclause 7.3.5

11~~0~~. 486 Busy Here (MT to S-CSCF) – see example in table 7.3.5.2-11~~0~~

The termination procedure detected some error situation, and returned a SIP 486 Busy Here response.

NOTE: The error response may be other error responses like "403 Service Denied", "480 Temporarily Unavailable", "580 Precondition Failure", or others. For this example, "486 Busy" is shown.

Table 7.3.5.2-11~~0~~: 486 Busy Here (MT to S-CSCF)

```
SIP/2.0 486 Busy Here
Via: SIP/2.0/UDP scscf2.home1.net;branch=764z87.1,  SIP/2.0/UDP icscf2_s.home1.net;branch=871y12.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd])
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B; seq=72))@localhost>;
    tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost; tag=1234
Contact: sip:[5555::eee:fff:aaa:bbb]
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 127 INVITE
Retry-After:3600
Content-Length: 0
```

12~~1~~. ACK (S-CSCF to MT) – see example in table 7.3.5.2-12~~1~~

Upon receive the 486 response from the MT procedure, S-CSCF sends ACK.

Table 7.3.5.2-12~~1~~: ACK (S-CSCF to MT)

```
ACK sip:[5555::eee:fff:aaa:bbb]~~pcscf2.home1.net~~ SIP/2.0
Via: SIP/2.0/UDP sip:scscf2.home1.net;branch=764z87.1
Max-Forwards: 70
Route: sip:pcscf2.home1.net;lr
From:
To:
Call-ID:
CSeq: 127 ACK
Content-Length: 0
```

~~12. **Service Control**~~

~~S-CSCF performs whatever service control is appropriate for this failed session attempt.~~

13. **486 Busy Here (S-CSCF to I-CSCF) – see example in table 7.3.5.2-13**

The S-CSCF returned a SIP error response to I-CSCF.

Table 7.3.5.2-13: 486 Busy Here (S-CSCF to I-CSCF)

```
SIP/2.0 486 Busy Here
Via:  SIP/2.0/UDP icscf2_s.home1.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd])
From:
To:
Call-ID:
CSeq:
Contact: sip:[5555::eee:fff:aaa:bbb]
Retry-After:3600
Content-Length: 0
```

14. **ACK (I-CSCF to S-CSCF) – see example in table 7.3.5.2-14**

Upon receive the 486 response from the S-CSCF procedure, I-CSCF sends ACK.

Table 7.3.5.2-14: ACK (I-CSCF to S-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]~~scscf2.home1.net~~ SIP/2.0
Via:  SIP/2.0/UDP icscf2_s.home1.net;branch=871y12.1
Max-Forwards: 70
Route: sip:scscf2.home1.net;lr
From:
To:
Call-ID:
CSeq: 127 ACK
Content-Length: 0
```

15. **486 Busy Here (I-CSCF to S-CSCF) – see example in table 7.3.5.2-15 (related to table 7.3.5.2-42)**

The I-CSCF returned a SIP error response to S-CSCF.

Table 7.3.5.2-15: 486 Busy Here (I-CSCF to S-CSCF)

```
SIP/2.0 486 Busy Here
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd])
From:
To:
Call-ID:
CSeq:
Contact:
Retry-After:3600
Content-Length: 0
```

16. **ACK (S-CSCF to I-CSCF) – see example in table 7.3.5.2-16**

Upon receive the 486 response from the S-CSCF procedure, I-CSCF sends ACK.

Table 7.3.5.2-16: ACK (S-CSCF to I-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]+1-212-555-2222@home1.net;user=phone SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
Max-Forwards: 70
Route: sip:icscf2_s.home1.net;lr
From:
To:
Call-ID:
CSeq: 127 ACK
Content-Length: 0
```

~~17. **Service Control**~~

~~S-CSCF performs whatever service control is appropriate for this failed session attempt.~~

178. **486 Busy Here (S-CSCF to MO) – see example in table 7.3.5.2-178**

The S-CSCF returned a SIP error response to the appropriate MO procedure.

Table 7.3.5.2-178: 486 Busy Here (S-CSCF to MO)

```
SIP/2.0 486 Busy Here
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd])
From:
To:
Contact:
Call-ID:
CSeq:
Retry-After:3600
Content-Length: 0
```

189. **ACK (MO to S-CSCF) – see example in table 7.3.5.2-189**

Upon receiving the 486 response from the S-CSCF, the MO procedure sends ACK.

Table 7.3.5.2-189: ACK (MO to S-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
Max-Forwards: 70
Route: scscf1.home1.net;lr
From:
To:
Call-ID:
CSeq: 127 ACK
Content-Length: 0
```

7.3.5.3 Origination failure (not provided)

An example of this flow is not shown in the present document.

7.4.2.4 Mobile termination, roaming, terminal is out of radio coverage (MO#2, S-S#2 assumed)

An example of this flow is not shown in the present document.

7.4.3 MT#2

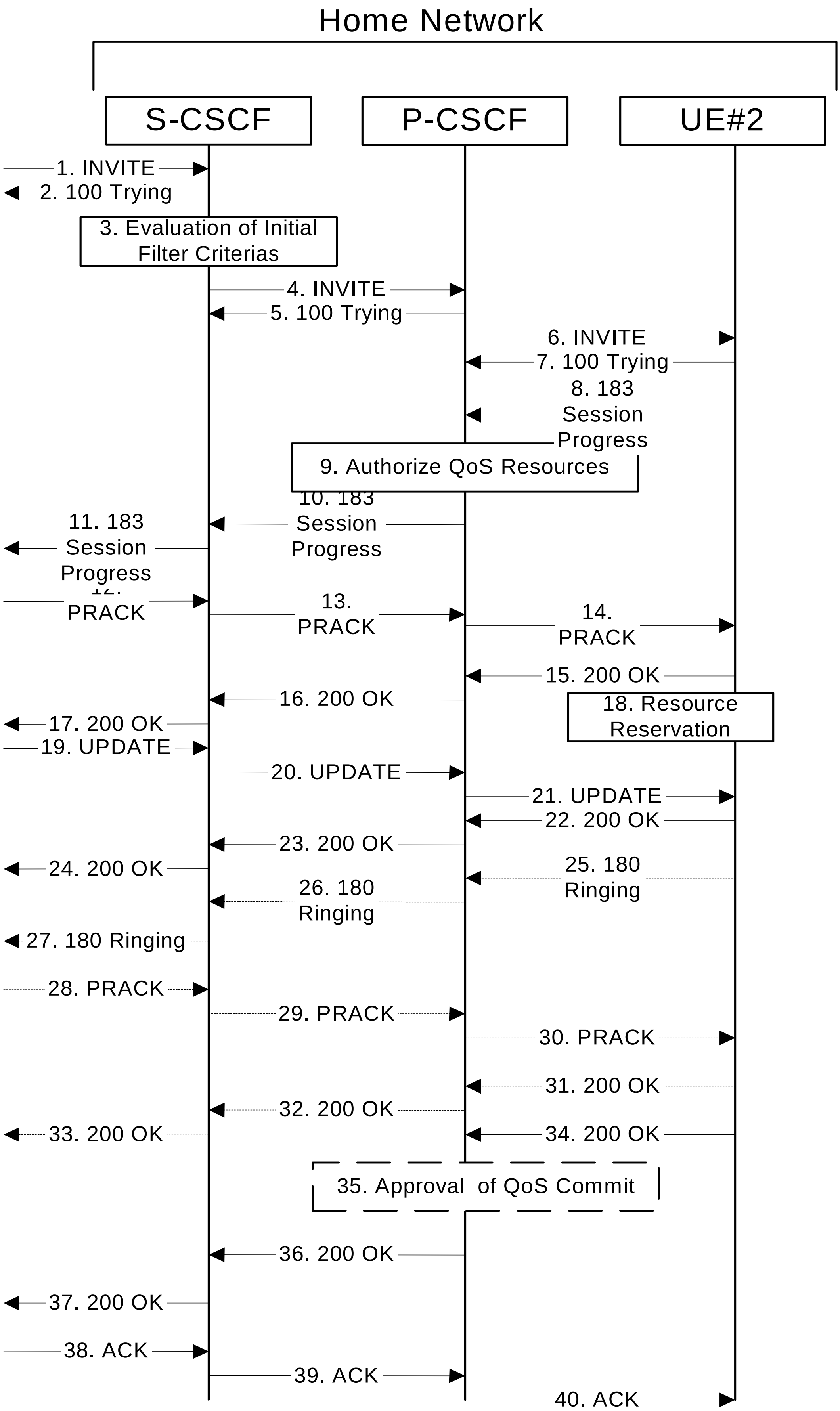
7.4.3.1 (MT#2) Mobile termination, located in home network (MO#2, S-S#2 assumed)

Figure 7.4.3.1-1 shows a termination procedure which applies to subscribers located in their home service area.

The UE is located in the home network, and determines the P-CSCF via the CSCF discovery procedure. During registration, the home network allocates a S-CSCF in the home network, S-CSCF.

When registration is complete, S-CSCF knows the name/address of P-CSCF, and P-CSCF knows the name/address of the UE.

NOTE: Although S-S#2 flow is assumed, home2.net is used in the Via, Record-Route and Route headers in order to be more generic and clearly identify the originating and terminating nodes. In the S-S#2 scenario home2.net = home1.net.


Home Network
S-CSCF
P-CSCF
UE#2
1. INVITE
2. 100 Trying
3. Evaluation of Initial Filter Criterias
4. INVITE
5. 100 Trying
6. INVITE
7. 100 Trying
8. 183 Session Progress
9. Authorize QoS Resources
10. 183 Session Progress
11. 183 Session Progress
12. PRACK
13. PRACK
14. PRACK
15. 200 OK
16. 200 OK
17. 200 OK
18. Resource Reservation
19. UPDATE
20. UPDATE
21. UPDATE
22. 200 OK
23. 200 OK
24. 200 OK
25. 180 Ringing
26. 180 Ringing
27. 180 Ringing
28. PRACK
29. PRACK
30. PRACK
31. 200 OK
32. 200 OK
33. 200 OK
34. 200 OK
35. Approval of QoS Commit
36. 200 OK
37. 200 OK
38. ACK
39. ACK
40. ACK

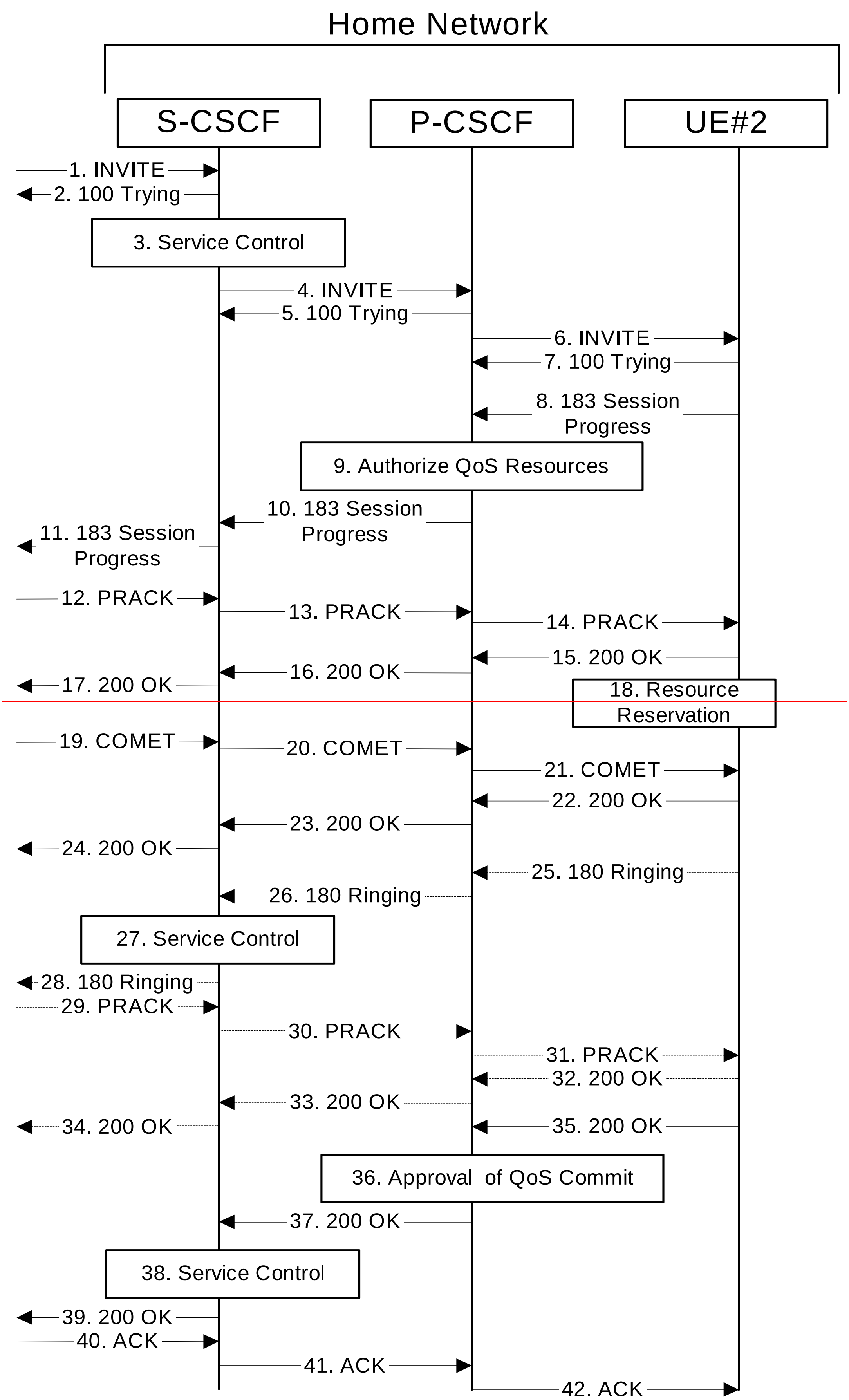


Figure 7.4.3.1-1: MT#2

Procedure MT#2 is as follows:

1. **INVITE (S-S to MT#2) – see example in table 7.4.3.1-1**

   The calling party sends the INVITE request, via one of the origination procedures and via one of the S-CSCF to S-CSCF procedures, to the S-CSCF for the terminating subscriber.

Table 7.4.3.1-1: INVITE (S-S to MT#2)

```
INVITE sip:user2_public1@home2.net~~+1-212-555-2222@home2.net;user=phone~~~~scscf2.home1.net~~ SIP/2.0
Via: SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Record-Route: sip:~~332b23.1@~~scscf1.home1.net;lr,~~ ~~sip:~~431h23.1@~~pcscf1.home1.net;lr
Route: sip:sip:scscf2.home1.net;lr~~+1-212-555-2222@home2.net;user=phone~~
~~Supported: 100rel~~
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>~~;privacy=off~~;screen=yes
~~Anonymity~~RPID-Privacy: privacy=Off;party=calling
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
    seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 127 INVITE
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
~~a=qos:mandatory sendrecv~~
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
~~a=qos:mandatory sendrecv~~
```

SDP The SDP contains the complete set of supported codecs from the session originator, as restricted by the originating network operator. The "m=" lines for the video media streams show a port number zero, which removes them from the negotiation.

Upon receipt of the INVITE, the S-CSCF stores the following information about this session, for use in providing enhanced services or in possible error recovery actions – see example in table 7.4.3.1-1b.

Table 7.4.3.1-1b: Storage of information at S-CSCF

```
Request-URI: sip: user2_public1@home2.net~~+1-212-555-2222@home2.net;user=phone~~
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
seq=72))@localhost>; tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
CSeq(2dest): 127 INVITE
CSeq(2orig): none
Route(2orig): sip: ~~223b23.1@~~scscf1.home1.net, sip:pcscf1.home1.net,~~ ~~
~~sip:[5555::aaa:bbb:ccc:ddd]~~
~~Route(2dest): sip:pcscf2.home2.net, sip:[5555::eee:fff:aaa:bbb]~~
Contact(orig): sip:[5555::aaa:bbb:ccc:ddd]
```

2. **100 Trying (MT#2 to S-S) – see example in table 7.4.3.1-2**

S-CSCF responds to the INVITE request (1) with a 100 Trying provisional response.

Table 7.4.3.1-2: 100 Trying (MT#2 to S-S)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

3. **Evaluation of initial filter criterias**

S-CSCF validates the service profile of this subscriber, and evaluates the initial filter criterias.~~**Service Control**~~

~~S-CSCF validates the service profile, and performs any termination service control required for this subscriber.~~

~~S-CSCF examines the media parameters, and removes any choices that the destination subscriber does not have authority to request.~~

~~For this example, assume the destination subscriber is not allowed stereo, so only a single audio stream is permitted.~~

4. **INVITE (S-CSCF to P-CSCF) – see example in table 7.4.3.1-4**

S-CSCF remembers (from the registration procedure) the next hop CSCF for this UE. It forwards the INVITE request to the P-CSCF.

S-CSCF examines the media parameters, and removes any choices that the destination subscriber does not have authority to request. For this example, assume the destination subscriber is not allowed stereo, so only a single audio stream is permitted.

Table 7.4.3.1-4: INVITE (S-CSCF to P-CSCF)

```
INVITE sip:[5555::eee:fff:aaa:bbb]~~pcscf2.home2.net~~ SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1
    SIP/2.0/UDP  scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 66
Route: sip:pcscf2.home2.net;lr~~[5555::eee:fff:aaa:bbb]~~
Record-Route: sip:~~764z87.1@~~scscf2.home2.net;lr,~~ ~~sip:~~332b23.1@~~scscf1.home1.net;lr,~~ ~~
    sip:~~431h23.1@~~pcscf1.home1.net;lr
~~Supported: ~~
Remote-Party-ID:
~~Anonymity~~RPID-Privacy:
From:
To:
Call-ID:
```

```
Cseq:
Require:
Supported:
Contact:
P-Called-Party-ID: <siptel:+1-212-555-2222@home1.net;user=phone>
Content-Type:
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=qos:mandatory sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 0 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
```

~~**Request-URI:**~~ ~~Built from the registration information.~~

Route: Built from the ~~Contact address~~Path header stored at registration.

P-Called-Party-ID: Includes the dialled URL with its parameters.

Via:, Record-Route: S-CSCF adds itself in the Record-Route and Via headers.

SDP The SDP contains the restricted set of codecs allowed by the network operator. The "m=" lines for the second audio stream shows a port number zero, which removes it from the negotiation.

~~Upon receipt of the INVITE, the~~ P-CSCF ~~removes the Record-Route headers, calculates the proper Route header to add to future requests, and~~ saves ~~that~~ information from the received INVITE request~~without passing it to UE~~. The saved value of the information for this session is – see example in table 7.4.3.1-4b.

Table 7.4.3.1-4b: Storage of information at P-CSCF

```
Request-URI: sip:+1-212-555-2222@home2.net;user=phone [5555::eee:fff:aaa:bbb]
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
     seq=72))@localhost>; tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
CSeq(2dest): 127 INVITE
CSeq(2orig): none
Route(2dest): sip:[5555::eee:fff:aaa:bbb]
```

```
Route(2orig): sip:~~764z87.1@~~scscf2.home2.net, sip:~~332b23.1@~~scscf1.home1.net,
sip:~~431h23.1@~~pcscf1.home1.net
Contact(orig): sip:[5555::aaa:bbb:ccc:ddd]
```

5. **100 Trying (P-CSCF to S-CSCF) – see example in table 7.4.3.1-5**

   P-CSCF responds to the INVITE request (4) with a 100 Trying provisional response.

Table 7.4.3.1-5: 100 Trying (P-CSCF to S-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

6. **INVITE (P-CSCF to UE) – see example in table 7.4.3.1-6**

   P-CSCF examines the media parameters, and removes any that the network operator decides, based on local policy, not to allow on the network.

   For this example, assume the network operator does not allow 64 kb/s audio, so the PCMU codec is removed.

   P-CSCF removes the Record-Route and Via headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.~~The P-CSCF extract the UE address from the Route header value and place it into the Request-URI.~~

Table 7.4.3.1-6: INVITE (P-CSCF to UE)

```
INVITE sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1
~~Media-Authorization: 0020000100100101706366322e78797a2e6e6574000c02013331533134363231~~
~~Supported: ~~
Max-Forwards: 65
Remote-Party-ID:
~~Anonymity~~RPID-Privacy:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
P-Called-Party-ID:
P-Media-Authorization: 0020000100100101706366322e78797a2e6e6574000c02013331533134363231
Content-Type:
Content-Length:

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99:MPV
m=audio 3456 RTP/AVP 97 96 15
```

```
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 0 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 3456 RTP/AVP 97
b=AS:25.4 96 15
a=qos:mandatory sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 0 RTP/AVP 97 96 0 15
```

~~P-CSCF removes the Record-Route and Via headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE. The saved value of the Route header is:~~

```
Route: sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net,
       sip:431h23.1@pcscf1.home1.net
```

Via: P-CSCF removes the Via headers, and generates a locally unique token to identify the saves values. It inserts this as a branch value on its Via header.

~~Media-~~P-Media-Authorization: A P-CSCF generated authorization token. This particular example shows a Policy-Element generated by "pcf2.xyz.net" with credentials "31S14621".

SDP The SDP contains the restricted set of codecs allowed by the network operator. The "m=" lines for the first audio stream no longer contains codec "0" (PCMU), which removes it from the negotiation.

7. **100 Trying (UE to P-CSCF) – see example in table 7.4.3.1-7**

UE may optionally send a 100 Trying provisional response to P-CSCF.

Table 7.4.3.1-7: 100 Trying (UE to P-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

8. **183 Session Progress (UE to P-CSCF) – see example in table 7.4.3.1-8**

UE#2 determines the complete set of codecs that it is capable of supporting for this session. It determines the intersection with those appearing in the SDP in the INVITE request. For each media flow that is not supported, UE#2 inserts a SDP entry for media (m= line) with port=0. For each media flow that is supported, UE#2 inserts a SDP entry with an assigned port and with the codecs in common with those in the SDP from UE#1.

For this example, assume UE#2 supports both AMR and G726, but not G728 (code 15).

UE responds with a 183 Session Progress response containing SDP back to the originator. This SDP may represent one or more media for a multimedia session. This response is sent to P-CSCF.

Table 7.4.3.1-8: 183 Session Progress (UE to P-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1
Remote-Party-ID: "John Smith" <tel:+1-212-555-2222>;privacy=off
AnonymityRPID-Privacy: privacy=Off;party=called
Require: 100rel
From:
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost; tag=314159
Call-ID:
CSeq:
Require: 100rel
Contact: sip:[5555::eee:fff:aaa:bbb]
RSeq: 9021
Content-Disposition: precondition
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97 96
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=conf:qos remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=qos:mandatory sendrecv confirm
a=rtpmap:96 G726-32/8000
m=audio 0 RTP/AVP 97 96 0 15
```

Remote-Party-ID: Identifies the answering subscriber. It contains the public user identity, and the name of the answering party.

To: A tag is added to the To header.

Contact: Contains a SIP URL with ~~Is the SIP URL that contains~~ the IP address or FQDN of the terminating UE.

SDP The SDP contains the subset of codecs supported by UE. It requests a confirmation of the QoS preconditions for establishing the session

Upon receipt of the 183 Session Progress, the P-CSCF stores the following information about this session, for use in providing enhanced services or in possible error recovery actions – see example in table 7.4.3.1-8b.

Table 7.4.3.1-8b: Storage of information at P-CSCF

```
Request-URI: sip:[5555::eee:fff:aaa:bbb]+1-212-555-2222@home2.net;user=phone
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
seq=72))@localhost>; tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost; tag=314159
```

```
Call-ID: cb03a0s09a2sdfglkj490333
CSeq(2dest): 127 INVITE
CSeq(2orig): none
Route(2orig): sip:scscf2.home2.net, sip:scscf1.home1.net, sip:pcscf1.home1.net
Contact(dest): sip:[5555::eee:fff:aaa:bbb]
Contact(orig): sip:[5555::aaa:bbb:ccc:ddd]
```

9. **Authorize QoS Resources**

P-CSCF authorizes the resources necessary for this session. The approval of QoS commitment either happens at this stage or after 200 OK of INVITE (34) based on operator local policy.

10. **183 Session Progress (P-CSCF to S-CSCF) – see example in table 7.4.3.1-10**

P-CSCF forwards the 183 Session Progress response to S-CSCF.

Table 7.4.3.1-10: 183 Session Progress (P-CSCF to S-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd])
Record-Route: sip:876t12.1@pcscf2.home2.net;lr, sip:764z87.1@scscf2.home2.net;lr,
    sip:332b23.1@scscf1.home1.net;lr, sip:431h23.1@pcscf1.home1.net;lr
Remote-Party-ID:
AnonymityRPID-Privacy:
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Disposition: 
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

P-CSCF restores the Via headers and Record-Route headers from the branch value in its Via.

Upon receipt of the 183 Session Progress, the S-CSCF stores the following information about this session, for use in providing enhanced services or in possible error recovery actions – see example in table 7.4.3.1-10b.

Table 7.4.3.1-10b: Storage of information at S-CSCF

```
Request-URI: sipsip:user2_public1@home2.net +1-212-555-2222@home2.net;user=phone
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
seq=72))@localhost>; tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhostCall-ID:
cb03a0s09a2sdfglkj490333
CSeq(2dest): 127 INVITE
CSeq(2orig): none
Route(2dest): sip:pcscf2.home2.net
Route(2orig): sip:scscf1.home1.net, sip:pcscf1.home1.net
```

```
Contact(dest): sip:[5555::eee:fff:aaa:bbb]
Contact(orig): sip:[5555::aaa:bbb:ccc:ddd]
```

11. **183 Session Progress (MT#2 to S-S) – see example in table 7.4.3.1-11**

S-CSCF forwards the 183 Session Progress response to the originator, per the S-CSCF to S-CSCF procedure.

Table 7.4.3.1-11: 183 Session Progress (MT#2 to S-S)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
Remote-Party-ID: "John Smith" <tel:+1-212-555-2222>~~;privacy=off~~;screen=yes
~~Anonymity~~RPID-Privacy:
~~Require:~~
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
~~Content-Disposition: ~~
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
a=
m=
```

12. **PRACK (S-S to MT#2) – see example in table 7.4.3.1-12**

The originating endpoint sends a PRACK request containing the final SDP to be used in this session, via the S-CSCF to S-CSCF procedure, to S-CSCF.

Table 7.4.3.1-12: PRACK (S-S to MT#2)

```
PRACK sip:[5555::eee:fff:aaa:bbb]~~scscf2.home2.net~~ SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scscf2.home2.net;lr,sip:~~876t12.1@~~pcscf2.home2.net;lr~~, sip:[5555::eee:fff:aaa:bbb]~~
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 128 PRACK
Require: precondition
Rack: 9021 127 INVITE
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
```

```
m=video 0 RTP/AVP 99
m=audio 3456 RTP/AVP 97
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
~~a=qos:mandatory sendrecv~~
m=audio 0 RTP/AVP 97 96 0 15
```

13. **PRACK (S-CSCF to P-CSCF) – see example in table 7.4.3.1-13**

S-CSCF forwards the PRACK request to P-CSCF.

Table 7.4.3.1-13: PRACK (S-CSCF to P-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb]~~pcscf2.home2.net~~ SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:pcscf2.home2.net;lr~~[5555::eee:fff:aaa:bbb]~~
From:
To:
Call-ID:
Cseq:
Require:
Rack:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

14. **PRACK (P-CSCF to UE) – see example in table 7.4.3.1-14**

P-CSCF forwards the PRACK request to UE.

Table 7.4.3.1-14: PRACK (P-CSCF to UE)

```
PRACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1
Max-Forwards: 66
From:
To:
Call-ID:
Cseq:
Require:
Rack:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
```

```
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

Via: P-CSCF removes the Via headers, and generates a locally unique token to identify the saved values. It inserts this as a branch value on its Via header.

15. **200 OK (UE to P-CSCF) – see example in table 7.4.3.1-15**

UE acknowledges the PRACK request (14) with a 200 OK response.

Table 7.4.3.1-15: 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1
From:
To:
Call-ID:
CSeq:
Content-Type: application/sdp
Content-Length: 0(…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=conf:qos remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
m=audio 0 RTP/AVP 97 96 0 15
```

16. **200 OK (P-CSCF to S-CSCF) – see example in table 7.4.3.1-16**

P-CSCF forwards the 200 OK response to S-CSCF.

Table 7.4.3.1-16: 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
```

```
a=
a=
a=
a=
a=
a=
a=
m=
```

17. **200 OK (MT#2 to S-S) – see example in table 7.4.3.1-17**

    S-CSCF forwards the 200 OK response to the originator, per the S-CSCF to S-CSCF procedure.

Table 7.4.3.1-17: 200 OK (MT#2 to S-S)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]

From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

18. **Resource Reservation**

    UE initiates the reservation procedures for the resources needed for this session.

19. **~~COMET~~UPDATE (S-S to MT#2) – see example in table 7.4.3.1-19**

    When the originating endpoint has completed its resource reservation, it sends the ~~COMET~~UPDATE request to S-CSCF, via the S-CSCF to S-CSCF procedures.

Table 7.4.3.1-19: ~~COMET~~UPDATE (S-S to MT#2)

```
COMETUPDATE sip:[5555::eee:fff:aaa:bbb]scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Route: sip: scscf2.home2.net;lr,sip:876t12.1@pcscf2.home2.net;lr, sip:[5555::eee:fff:aaa:bbb]
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 129 COMETUPDATE
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
```

```
m-video 0 RTP/AVP 99
m=audio 3456 RTP/AVP 97
b=AS:25.4
a=curr:qos local sendrecv
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=qos:success sendonly
m=audio 0 RTP/AVP 97 96 0 15
```

20. **~~COMET~~UPDATE (S-CSCF to P-CSCF) – see example in table 7.4.3.1-20**

S-CSCF forwards the ~~COMET~~UPDATE request to P-CSCF.

Table 7.4.3.1-20: ~~COMET~~UPDATE (S-CSCF to P-CSCF)

```
COMETUPDATE sip:[5555::eee:fff:aaa:bbb]pcscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:pcscf2.home2.net;lr[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

21. **~~COMET~~UPDATE (P-CSCF to UE) – see example in table 7.4.3.1-21**

P-CSCF forwards the ~~COMET~~UPDATE request to UE.

Table 7.4.3.1-21: ~~COMET~~UPDATE (P-CSCF to UE)

```
COMETUPDATE sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1
Max-Forwards: 66
From:
To:
Call-ID:
Cseq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
```

```
a=
a=
a=
a=
a=
a=
m=
```

Via: P-CSCF removes the Via headers, and generates a locally unique token to identify the saved values. It inserts this as a branch value on its Via header.

22. **200 OK (UE to P-CSCF) – see example in table 7.4.3.1-22**

UE acknowledges the ~~COMET~~UPDATE request (21) with a 200 OK response.

Table 7.4.3.1-22: 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1
From:
To:
Call-ID:
CSeq:
Content-Type: application/sdp
Content-Length: 0(…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
m=audio 0 RTP/AVP 97 96 0 15
```

23. **200 OK (P-CSCF to S-CSCF) – see example in table 7.4.3.1-23**

P-CSCF forwards the 200 OK response to S-CSCF.

Table 7.4.3.1-23: 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length: 0

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
```

```
a=
a=
m=
```

24. **200 OK (MT#2 to S-S) – see example in table 7.4.3.1-24**

S-CSCF forwards the 200 OK response to the originator, per the S-CSCF to S-CSCF procedure.

Table 7.4.3.1-24: 200 OK (MT#2 to S-S)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
m=
```

25. **180 Ringing (UE to P-CSCF) – see example in table 7.4.3.1-25**

Before proceeding with session establishment, the UE waits for two events. First, the resource reservation initiated in step #17~~8~~ must complete successfully. Second, the resource reservation initiated by the originating endpoint must complete successfully (which is indicated by message #20~~1~~ received by UE). The UE may now immediately accept the session (and proceed with step #34~~5~~), or alert the destination subscriber of an incoming session attempt; if the latter it indicates this to the calling party by a 180 Ringing provisional response sent to P-CSCF.

Table 7.4.3.1-25: 180 Ringing (UE to P-CSCF)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1
~~Require: 100rel~~
From:
To:
Call-ID:
CSeq:
Require:
Contact: sip:[5555::eee:fff:aaa:bbb]
RSeq: 9022
Content-Length: 0
```

26. **180 Ringing (P-CSCF to S-CSCF) – see example in table 7.4.3.1-26**

P-CSCF forwards the 180 Ringing response to S-CSCF.

Table 7.4.3.1-26: 180 Ringing (P-CSCF to S-CSCF)

```
SIP/2.0 180 Ringing
```

```
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:876t12.1@pcscf2.home2.net;lr, sip:764z87.1@scscf2.home2.net;lr,
    sip:332b23.1@scscf1.home1.net;lr, sip:431h23.1@pcscf1.home1.net;lr
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Length:
```

~~27. **Service Control**~~

~~The S-CSCF validates the service profile and performs any service control required for this subscriber.~~

27~~8~~. **180 Ringing (MT#2 to S-S) – see example in table 7.4.3.1-27~~8~~**

S-CSCF forwards the 180 Ringing response to the originating endpoint, per the S-CSCF to S-CSCF procedure.

Table 7.4.3.1-27~~8~~: 180 Ringing (MT#2 to S-S)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
Require:
From:
To:
Call-ID:
CSeq:
Require:
Contact:
RSeq:
Content-Length:
```

28~~9~~. **PRACK (S-S to MT#2) – see example in table 7.4.3.1-28~~9~~**

The originator acknowledges the 180 Ringing response (27~~8~~) with a PRACK request.

Table 7.4.3.1-28~~9~~: PRACK (S-S to MT#2)

```
PRACK sip:[5555::eee:fff:aaa:bbb]scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip: scscf2.home2.net;lr,sip:876t12.1@pcscf2.home2.net;lr, sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq: 130 PRACK
Rack: 9022 127 INVITE
Content-Length: 0
```

29~~30~~. **PRACK (S-CSCF to P-CSCF) – see example in table 7.4.3.1-29~~30~~**

S-CSCF forwards the PRACK request to P-CSCF.

Table 7.4.3.1-2930: PRACK (S-CSCF to P-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb]pcscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:pcscf2.home2.net ;lr[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Rack:
Content-Length:
```

301. **PRACK (P-CSCF to UE) – see example in table 7.4.3.1-301**

P-CSCF forwards the PRACK request to UE.

Table 7.4.3.1-301: PRACK (P-CSCF to UE)

```
PRACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1
Max-Forwards: 66
From:
To:
Call-ID:
Cseq:
Rack:
Content-Length:
```

Via: P-CSCF removes the Via headers, and generates a locally unique token to identify the saved values. It inserts this as a branch value on its Via header.

312. **200 OK (UE to P-CSCF) – see example in table 7.4.3.1-312**

UE acknowledges the PRACK request (31) with a 200 OK response.

Table 7.4.3.1-312: 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

323. **200 OK (P-CSCF to S-CSCF) – see example in table 7.4.3.1-323**

P-CSCF forwards the 200 OK response to S-CSCF.

Table 7.4.3.1-323: 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

334. **200 OK (MT#2 to S-S) – see example in table 7.4.3.1-334**

S-CSCF forwards the 200 OK response to the session originator, per the S-CSCF to S-CSCF procedures.

Table 7.4.3.1-33~~4~~: 200 OK (MT#2 to S-S)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

34~~5~~. **200 OK (UE to P-CSCF) – see example in table 7.4.3.1-34~~5~~**

When the called party answers, the UE sends a 200 OK final response to the INVITE request (6) to P-CSCF, and starts the media flow(s) for this session.

Table 7.4.3.1-34~~5~~: 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1
From:
To:
Call-ID:
CSeq: 127 INVITE
Contact: sip:[5555::eee:fff:aaa:bbb]
Content-Type: application/sdp
Content-Length: (...)0

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97
b=AS:25.4
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=qos:success sendrecv
m=audio 0 RTP/AVP 97 96 0 15
```

35~~6~~. **Approval of QoS Commit**

The P-CSCF approves the commitment of the QoS resources if it was not approved already in step (9).

36~~7~~. **200 OK (P-CSCF to S-CSCF) – see example in table 7.4.3.1-36~~7~~**

P-CSCF indicates the resources reserved for this session should now be committed, and sends the 200 OK final response to S-CSCF.

Table 7.4.3.1-3~~7~~6: 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP icscf2.home2.net, SIP/2.0/UDP
    scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP
    [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:876t12.1@pcscf2.home2.net;lr, sip:764z87.1@scscf2.home2.net;lr, 
    sip:332b23.1@scscf1.home1.net;lr, sip:431h23.1@pcscf1.home1.net;lr
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type: 
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
m=
```

~~38. **Service Control**~~

~~S-CSCF performs whatever service control is required for the session completion.~~

3~~9~~7. **200 OK (MT#2 to S-S) – see example in table 7.4.3.1-3~~9~~7**

S-CSCF forwards the 200 OK final response along the signalling path back to the session originator, as per the S-CSCF to S-CSCF procedure.

Table 7.4.3.1-3~~9~~7: 200 OK (MT#2 to S-S)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1,SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
From:
To:
Call-ID:
CSeq:
Contact:
Content-Type: 
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
m=
```

38~~40~~. **ACK (S-S to MT#2) – see example in table 7.4.3.1-38~~40~~**

The calling party responds to the 200 OK final response (3~~9~~7) with an ACK request which is sent to S-CSCF via the S-CSCF to S-CSCF procedure.

Table 7.4.3.1-38~~40~~: ACK (S-S to MT#2)

```
ACK sip:[5555::eee:fff:aaa:bbb]~~scscf2.home2.net~~ SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scscf2.home2.net;lr,sip:~~876t12.1@~~pcscf2.home2.net;lr~~, sip:[5555::eee:fff:aaa:bbb]~~
From:
To:
Call-ID:
Cseq: 127 ACK
Content-Length: 0
```

39~~41~~. **ACK (S-CSCF to P-CSCF) – see example in table 7.4.3.1-39~~41~~**

S-CSCF forwards the ACK request to P-CSCF.

Table 7.4.3.1-39~~41~~: ACK (S-CSCF to P-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]~~pcscf2.home2.net~~ SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:pcscf2.home2.net;lr ~~[5555::eee:fff:aaa:bbb]~~
From:
To:
Call-ID:
Cseq:
Content-Length:
```

40~~2~~. **ACK (P-CSCF to UE) – see example in table 7.4.3.1-40~~2~~**

P-CSCF forwards the ACK request to UE.

Table 7.4.3.1-40~~2~~: ACK (P-CSCF to UE)

```
ACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1
Max-Forwards: 66
From:
To:
Call-ID:
Cseq:
Content-Length:
```

Via: P-CSCF removes the Via headers, and generates a locally unique token to identify the saved values. It inserts this as a branch value on its Via header.

7.4.3.2 UE-detected failure/resource failure (not provided)

An example of this flow is not shown in the present document.

7.4.3.3 Origination failure (not provided)

An example of this flow is not shown in the present document.

3GPP TSG-CN1 Meeting #24 **Tdoc N1-021413~~205~~**
Budapest, Hungary, 13. – 17. May 2002

CR-Form-v5

CHANGE REQUEST

⌘ 24.228	CR 020	⌘ rev	2 ~~1~~	⌘	Current version:	5.0.0	⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [ ] Radio Access Network [ ] Core Network [X]

Title:	⌘	Session Redirection Flow Update
Source:	⌘	AT&T Wireless
Work item code:	⌘	IMS-CCR
Date:	⌘	02-05-2002
Category:	⌘	**F**
Release:	⌘	REL-5

Use one of the following categories:
- ***F*** *(correction)*
- ***A*** *(corresponds to a correction in an earlier release)*
- ***B*** *(addition of feature),*
- ***C*** *(functional modification of feature)*
- ***D*** *(editorial modification)*

Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:
- *2 (GSM Phase 2)*
- *R96 (Release 1996)*
- *R97 (Release 1997)*
- *R98 (Release 1998)*
- *R99 (Release 1999)*
- *REL-4 (Release 4)*
- *REL-5 (Release 5)*

Reason for change: ⌘ Update based on the latest IETF RFCs and I-Ds, correction of mistakes

Summary of change: ⌘ The updated flow contains the following major changes:
- Loose routing adopted (change of Request-URI, Route header fields)
- UPDATE method + Manyfolks-05 adopted (change of the figures, SDP, Require and Supported header fields; Content-disposition header field removed)
- Max-Forwards header field added to every request
- Branch parameters deleted from Route and Record-Route header fields

- Anonymity header fields deleted (privacy-04)
- RPID-Privacy header field added (privacy-04)
- Media-Authorization header field changed to P-Media-Authorization (call-auth-04)

- 'Service Control' changed to 'Evaluation of initial filter criterias' for INVITE,

- editorial corrections

  mistakes
  update of the description text
  update of the header descriptions
  SDP update (missing parameters added)

Consequences if not approved: ⌘ 24.228 call flows are not standard compliant

Clauses affected: ⌘ 10.4

Other specs affected: ⌘ [X] Other core specifications ⌘ 24.229
[ ] Test specifications

	☐ O&M Specifications	
Other comments: ⌘		

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

10.4 Session redirection procedures

10.4.1 Introduction

This subclause gives signalling flows for the procedures for performing session redirection. The decision to redirect a session to a different destination may be made for different reasons by a number of different functional elements, and at different points in the establishment of the session.

Three cases of session redirection prior to bearer establishment are presented, and one case of session redirection after bearer establishment.

These cases enable the typical services of "Session Forward Unconditional", "Session Forward Busy", "Session Forward Variable", "Selective Session Forwarding", and "Session Forward No Answer", though it is important to recognise that the implementation is significantly different from the counterparts in the CS domain.

10.4.2 Session redirection initiated by S-CSCF to IM CN subsystem (MO#2, MT#2 assumed)

One of the entities in a basic session that may initiate a redirection is the S-CSCF of the destination subscriber. The subscriber profile information obtained from the HSS by the 'Cx-pull' during registration may contain complex logic and triggers causing session redirection. S-CSCF#2 sends the SIP INVITE request to the I-CSCF for the new destination (I-CSCF#F in the figure), who forwards it to S-CSCF#F, who forwards it to the new destination.

In cases when the destination subscriber is not currently registered in the IM CN subsystem, the I-CSCF may assign a temporary S-CSCF to perform the service control on behalf of the intended destination. This temporary S-CSCF takes the role of S-CSCF#2 in figure 10.4.2-1.

The service implemented by figure 10.4.2-1 is typically "Session Forward Unconditional", "Session Forward Variable" or "Selective Session Forwarding". S-CSCF#2 may also make use of knowledge of current sessions in progress at the UE, and implement "Session Forwarding Busy" in this way.

There are 9 distinct signalling flows for this session redirection, as follows:

- Single network operator performing origination, forwarding, and termination.
- One network operator performing origination and forwarding, separate network operator performing termination, with a THIG between to maintain configuration independence.
- One network operator performing origination and forwarding, separate network operator performing termination, without a THIG between.
- One network operator performing origination, second network operator performing forwarding and termination, with a THIG between to maintain configuration independence.
- One network operator performing origination, second network operator performing forwarding and termination, without a THIG between.
- One network operator performing origination, second network operator performing forwarding, and third network operator performing termination, without any THIGs between them.
- One network operator performing origination, second network operator performing forwarding, and third network operator performing termination, with a THIG between first two to maintain configuration independence
- One network operator performing origination, second network operator performing forwarding, and third network operator performing termination, with a THIG between second and third to maintain configuration independence.
- One network operator performing origination, second network operator performing forwarding, and third network operator performing termination, with a THIG between all three to maintain configuration independence.

Further, it is possible that a session will be redirected multiple times, so the above list generalizes to include multiple forwarding elements.

All of these Session-Redirection procedures can be combined with MO#1a, MO#1b, or MO#2 for session origination, and with MT#1a, MT#1b, or MT#2 for session termination.

Only the first case is shown here, with a single network operator performing origination, forwarding, and termination. The additional cases can be derived from the procedures shown here and in S-S#1a, and S-S#1b.

This case is shown in the signalling flow in figure 10.4.2-1.

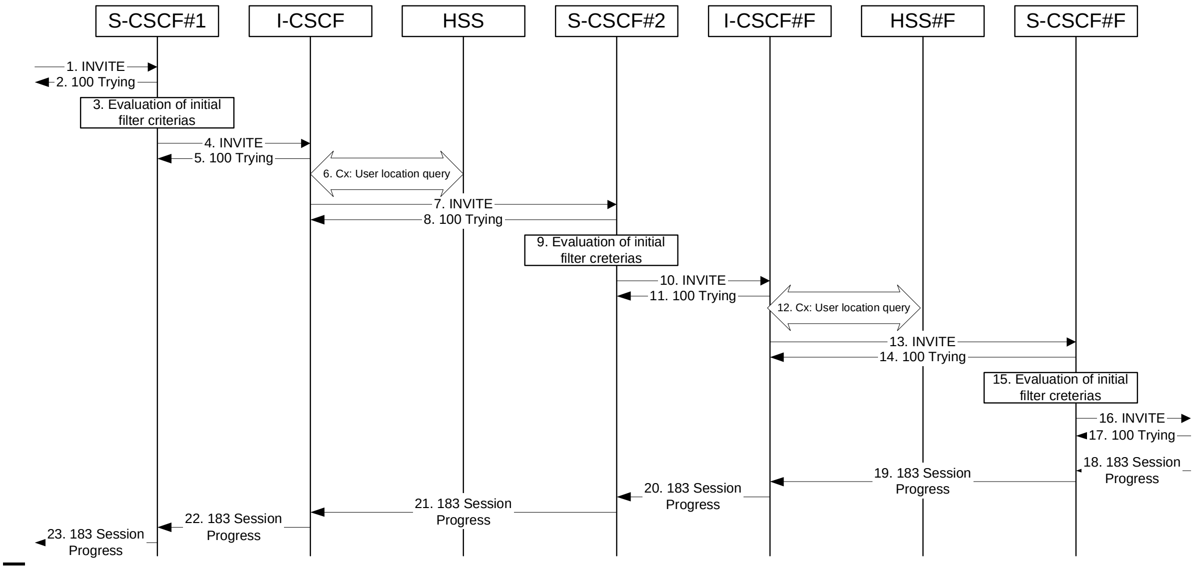


Figure 10.4.2-1: Session redirection initiated by S-CSCF to IM CN subsystem

The IM CN subsystem - Session Redirection Procedure is as follows:

1. **INVITE (MO to S-CSCF) – see example in table 10.4.2-1**

   The INVITE request is sent from the UE to S-CSCF#1 by the procedures of the originating signalling flow.

Table 10.4.2-1: INVITE (MO to S-CSCF)

```
INVITE siptel:scscf1.+1-212-555-2222home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Record-Route: sip:pcscf1.home1.net;lr
Route: sip:scscf1.home1.net;lr+1-212-555-2222@home2.net;user=phone
Supported: 100rel
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>;privacy=off
RPID-Privacy: privacy=off;party=calling
Proxy-Require: privacy
Anonymity: Off
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 127 INVITE
Require: precondition
Supported: 100rel
Contact: sip:[5555::aaa:bbb:ccc:ddd]%5b5555%3a%3aaaa%3abbb%3accc%3addd%5d@pcscf1.home1.net
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 3400 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
```

```
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99 MPV
m=video 3402 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99 MPV
m=audio 3456 RTP/AVP 97 3 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
a=qos:mandatory sendrecv
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
```

2. **100 Trying (S-CSCF to MO) – see example in table 10.4.2-2**

   S-CSCF#1 responds to the INVITE request (1) with a 100 Trying provisional response.

Table 10.4.2-2: 100 Trying (S-CSCF to MO)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

3. **~~Service Control~~Evaluation of initial filter criterias**

   ~~S-CSCF#1 performs whatever service control logic is appropriate for this session attempt.~~S-CSCF#1 validates the servie profile of this subscriber and evaluates the intial filter criterias. For this example, assume no Application Server involvement.

4. **INVITE (S-CSCF to I-CSCF) – see example in table 10.4.2-4**

   S-CSCF#1 performs an analysis of the destination address, and determines the network operator to whom the destination subscriber belongs. Since it is a destination served by the same network operator, S-CSCF#1 forwards the INVITE request directly to I-CSCF in the same network.

   S-CSCF examines the media parameters, and removes any choices that the subscriber does not have authority to request. For this example, assume the subscriber is not allowed video. S-CSCF removes the stream by seting the port number for that stream to zero.

Table 10.4.2-4: INVITE (S-CSCF to I-CSCF)

```
INVITE siptel:+1-212-555-22223333@home.net;user=phone SIP/2.0
Via: SIP/2.0/UDP sip:scscf1.home1.net SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP
    [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Record-Route: sip:332b23.1@scscf1.home1.net;lr, sip:pcscf1.home1.net;lr
Supported:
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>
RPID-Privacy:
```

```
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length:

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99 MPV
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99 MPV
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
```

Request-URI: In the case where the Request-URI~~Route header~~ of the incoming INVITE request to S-CSCF contains a TEL-URL [5], it has to be translated to a globally routable SIP-URL before applying it as Request-URI of the outgoing INVITE request. For this address translation the S-CSCF shall use the services of an ENUM-DNS protocol according to RFC 2916 [6], or any other suitable translation database. Database aspects of ENUM are outside the scope of this specification.

5. **100 Trying (I-CSCF to S-CSCF) – see example in table 10.4.2-5**

I-CSCF responds to the INVITE request (4) by sending a 100 Trying provisional response to S-CSCF#1.

Table 10.4.2-5: 100 Trying (I-CSCF to S-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

6. **Cx: User Location Query procedure**

The I-CSCF sends a query to the HSS to find out the S-CSCF of the called user. The HSS responds with the address of the current S-CSCF for the terminating subscriber.

For detailed message flows see 3GPP TS 29.228 [11].

Table 7.3.2-6a provides the parameters in the SIP INVITE request (flow 4), which are sent to the HSS.

Table 7.3.2-6b provides the parameters sent from the HSS that need to be mapped to SIP INVITE (flow 7) and sent to S-CSCF.

7. **INVITE (I-CSCF to S-CSCF) – see example in table 10.4.2-7**

I-CSCF forwards the INVITE request to the S-CSCF (S-CSCF#2) that will handle the session termination.

Table 10.4.2-7: INVITE (I-CSCF to S-CSCF)

```
INVITE ~~sip~~tel:~~scscf2.home2.net~~+1-212-555-2222 SIP/2.0
Via: SIP/2.0/UDP icscf2_s.home1.net, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd])
Max-Forwards: 67
Record-Route: sip:scscf1.home1.net;lr, sip:pcscf1.home1.net;lr
Route: sip:scscf2.home1.net;lr~~+1-212-555-2222@home2.net;user=phone~~
~~Record-Route: sip:332b23.1@scscf1.home1.net~~
~~Supported:~~
Remote-Party-ID: ~~"John Doe" <tel:+1-212-555-1111>;privacy=off;screen=yes~~
RPID-Privacy:
~~Proxy-Require:~~
~~Anonymity:~~
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

NOTE 1: The I-CSCF does not add itself to the Record-Route header, as it has no need to remain in the signalling path once the session is established.

8. **100 Trying (S-CSCF to I-CSCF) – see example in table 10.4.2-8**

S-CSCF#2 responds to the INVITE request (7) with a 100 Trying provisional response.

Table 10.4.2-8: 100 Trying (S-CSCF to I-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP icscf2_s.home1.net, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd])
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

9. **~~Service Control~~Evaluation of initial filter criterias**

S-CSCF#2 validates the service profile of this subscriber and evaluates the initial filter criterias.~~performs whatever service control logic is appropriate for this session attempt~~. Based on some service-specific criterion, S-CSCF#2 decides to redirect this session attempt to a new IM CN subsystem destination, at the URL sip:+1-212-555-3333@home1.net;user=phone.

10. **INVITE (S-CSCF to I-CSCF) – see example in table 10.4.2-10**

S-CSCF#2 performs an analysis of the destination address, and determines the new destination is served by the same network operator. S-CSCF#2 forwards the INVITE request directly to to I-CSCF#F (which may be different than I-CSCF#1 consulted earlier).

Table 10.4.2-10: INVITE (S-CSCF to I-CSCF)

```
INVITE siptel:+1-212-555-3333@home.net;user=phone SIP/2.0
Via: SIP/2.0/UDP sip:scscf2.home12.net, SIP/2.0/UDP icscf2_s.home1.net;branch=09a238.1, SIP/2.0/UDP
    sip:scscf1.home1.net SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP
    [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 66
Record-Route: sip:764z87.1@scscf2.home12.net;lr, sip:332b23.1@scscf1.home1.net;lr,
sip:pcscf1.home1.net;lr
Supported:
Remote-Party-ID:
RPID-Privacy:
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
```

```
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

Request-URI: In the case where the Request-URI~~Route header~~ of the incoming INVITE request to S-CSCF contains a TEL-URL [5], it has to be translated to a globally routable SIP-URL before applying it as Request-URI of the outgoing INVITE request. For this address translation the S-CSCF shall use the services of an ENUM-DNS protocol according to RFC 2916 [6], or any other suitable translation database. Database aspects of ENUM are outside the scope of this specification.

11. **100 Trying (I-CSCF to S-CSCF) – see example in table 10.4.2-11**

I-CSCF responds to the INVITE request (10) by sending a 100 Trying provisional response to S-CSCF#1.

Table 10.4.2-11: 100 Trying (I-CSCF to S-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP scscf2.home1~~2~~.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

12. **Cx: User Location Query procedure**

The I-CSCF sends a query to the HSS to find out the S-CSCF of the called user. The HSS responds with the address of the current S-CSCF for the terminating subscriber.

For detailed message flows see 3GPP TS 29.228 [11].

Table 7.3.2-6a provides the parameters in the SIP INVITE request (flow 10), which are sent to the HSS.

Table 7.3.2-6b provides the parameters sent from the HSS that need to be mapped to SIP INVITE (flow 13) and sent to S-CSCF.

13. **INVITE (I-CSCF to S-CSCF) – see example in table 10.4.2-13**

I-CSCF forwards the INVITE request to the S-CSCF (S-CSCF#F) that will handle the session termination.

Table 10.4.2-13: INVITE (I-CSCF to S-CSCF)

```
INVITE ~~sip~~tel:+1-212-555-3333~~scscff.home.net~~ SIP/2.0
Via: SIP/2.0/UDP icscff.home1.net, SIP/2.0/UDP scscf2.home1~~2~~.net;branch=764z87.1, SIP/2.0/UDP
    icscf2_s.home1.net, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 65
~~Route: sip:+1-212-555-2222@home2.net;user=phone~~
Record-Route: ~~sip:764z87.1~~@scscf2.home1~~2~~.net;lr, ~~sip:332b23.1~~@scscf1.home1.net;lr,
pcscf1.home1.net;lr
```

```
Route: sip:scscff.home1.net;lr
~~Supported:~~
Remote-Party-ID:
RPID-Privacy:
~~Proxy-Require:~~
~~Anonymity:~~
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

NOTE 2: The I-CSCF does not add itself to the Record-Route header, as it has no need to remain in the signalling path once the session is established.

14. **100 Trying (S-CSCF to I-CSCF) – see example in table 10.4.2-14**

S-CSCF#2 responds to the INVITE request with a 100 Trying provisional response.

Table 10.4.2-14: 100 Trying (S-CSCF to I-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP icscff.home.net, SIP/2.0/UDP scscf2.home1~~2~~.net;branch=764z87.1, SIP/2.0/UDP
    icscf2_s.home1.net, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

15. **~~Service Control~~Evaluation of initial filter criterias**

S-CSCF#F validates the service profile of this subscriber and evaluates the initial filter criterias~~performs whatever service control is appropriate for this termination session~~.

16. **INVITE (S-CSCF to MT) – see example in table 10.4.2-16**

S-CSCF#2 forwards the INVITE request, as determined by the termination procedure. S-CSCF#F remembers (from the registration procedure) the UE Contact address and the next hop CSCF for this UE.

S-CSCF#F examines the media parameters, and removes any choices that the destination subscriber does not have authority to request. For this example, assume the destination subscriber is not allowed stereo, so only a single audio stream is permitted.

Table 10.4.2-16: INVITE (S-CSCF to MT)

```
INVITE sip:[5555::eee:fff:aaa:bbb]%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net SIP/2.0
Via: SIP2.0/UDP scscff.home1.net, SIP/2.0/UDP icscff.home1.net, SIP/2.0/UDP
    scscf2.home12.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home1.net, SIP/2.0/UDP
    scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP
    [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 64
Route: sip:+1-212-555-3333@home.net;user=phone
Record-Route: sip:scscff.home.net;lr, sip:764z87.1@scscf2.home2.net;lr,
sip:332b23.1@scscf1.home1.net;lr, pcscf1.home1.net;lr
Route: sip:pcscff.home1.net;lr
Supported:
Remote-Party-ID:
RPID-Privacy:
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length:

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
b=
a=
a=
a=
a=
a=
m=video 0 RTP/AVP 99
b=
a=
a=
a=
a=
a=
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 0 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
```

```
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
```

17. **100 Trying (MT to S-CSCF) – see example in table 10.4.2-17**

S-CSCF#2 receives a 100 Trying provisional response to the INVITE request, as specified by the termination procedures.

Table 10.4.2-17: 100 Trying (MT to S-S#2)

```
SIP/2.0 100 Trying
Via: SIP2.0/UDP scscff.home1.net, SIP/2.0/UDP icscff.home1.net, SIP/2.0/UDP
    scscf2.home12.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home1.net, SIP/2.0/UDP
    scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP
    [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

18. **183 Session Progress (MT to S-CSCF) – see example in table 10.4.2-18**

The media stream capabilities of the destination are returned along the signalling path, in a 183 Session Progress provisional response, as per the termination procedure.

Table 10.4.2-18: 183 Session Progress (MT to S-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP2.0/UDP scscff.home1.net, SIP/2.0/UDP icscff.home1.net, SIP/2.0/UDP
    scscf2.home12.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home1.net, SIP/2.0/UDP
    scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP
    [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:pcscff.home1.net;lr, sip:scscff.home1.net;lr, sip:764z87.1@scscf2.home12.net;lr,
sip:332b23.1@scscf1.home1.net;lr, sip:pcscf1.home1.net;lr
Remote-Party-ID: "John Smith" <tel:+1-212-555-3333>;privacy=off
RPID-Privacy: privacy=off;party=called
Anonymity: Off
Require: 100rel
From:
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost; tag=314159
Call-ID:
CSeq:
Require: 100rel
Supported: update
Contact: sip:[5555::eee:fff:aaa:bbb]%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home2.net
RSeq: 9021
Content-Disposition: precondition
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::eee:fff:aaa:bbb
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 6544 RTP/AVP 97 96
b=AS:25.4 3
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos mandatory remote sendrecv
a=conf:qos remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
a=qos:mandatory sendrecv confirm
m=audio 0 RTP/AVP 97 96 0 15
```

19. **183 Session Progress (S-CSCF to I-CSCF) – see example in table 10.4.2-19**

S-CSCF#2 forwards the 183 Session Progress provisional response to I-CSCF.

Table 10.4.2-19: 183 Session Progress (S-CSCF to I-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP icscff.home1.net, SIP/2.0/UDP scscf2.home12.net;branch=764z87.1, SIP/2.0/UDP
    icscf2_s.home1.net, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:scscff.home.net, sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net
Remote-Party-ID: "John Smith" <tel:+1-212-555-3333>
RPID-Privacy: screen=yes
Anonymity:
Require:
From:
To:
Call-ID:
CSeq:
Require:
Supported:
Contact:
RSeq:
Content-Disposition:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
a=
m=
```

20. **183 Session Progress (I-CSCF to S-CSCF) – see example in table 10.4.2-20**

I-CSCF forwards the 183 Session Progress provisional response to S-CSCF#1.

Table 10.4.2-20: 183 Session Progress (I-CSCF to S-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP scscf2.home12.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home1.net, SIP/2.0/UDP
    scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP
    [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:scscff.home.net, sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net
Remote-Party-ID:
RPID-Privacy:
Anonymity:
Require:
From:
To:
Call-ID:
CSeq:
Require:
Supported:
Contact:
RSeq:
Content-Disposition:
Content-Type:
Content-Length:

v=
```

```
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
a=
m=
```

21. **183 Session Progress (S-CSCF to I-CSCF) – see example in table 10.4.2-21**

S-CSCF#2 forwards the 183 Session Progress provisional response to I-CSCF.

Table 10.4.2-21: 183 Session Progress (S-CSCF to I-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP icscf2_s.home1.net, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd])
Record-Route: sip:scscff.home.net, sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net
Remote-Party-ID: "John Smith" <tel:+1-212-555-3333>;privacy=off;screen=yes
RPID-Privacy:
Anonymity:
Require:
From:
To:
Call-ID:
CSeq:
Require:
Supported:
Contact:
RSeq:
Content-Disposition:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
a=
m=
```

22. **183 Session Progress (I-CSCF to S-CSCF) – see example in table 10.4.2-22**

I-CSCF forwards the 183 Session Progress provisional response to S-CSCF#1.

Table 10.4.2-22: 183 Session Progress (I-CSCF to S-CSCF)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd])
Record-Route: sip:scscff.home.net, sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net
```

```
Remote-Party-ID:
RPID-Privacy:
Anonymity:
Require:
From:
To:
Call-ID:
CSeq:
Require:
Supported:
Contact:
RSeq:
Content-Disposition:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

23. **183 Session Progress (S-CSCF to MO) – see example in table 10.4.2-23**

S-CSCF#1 forwards the 183 Session Progress to the originator, as per the originating procedure.

Table 10.4.2-23: 183 Session Progress (S-CSCF to MO)

```
SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:scscff.home.net, sip:764z87.1@scscf2.home2.net, sip:332b23.1@scscf1.home1.net
Remote-Party-ID:
RPID-Privacy:
Anonymity:
Require:
From:
To:
Call-ID:
CSeq:
Require:
Supported:
Contact:
RSeq:
Content-Disposition:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
m=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
```

10.4.3 Session redirection initiated by S-CSCF to CS-domain (S-S#2, MT#2 assumed)

The S-CSCF in the scenario above may determine that the session is to be redirected to a CS-domain endpoint, or to the PSTN. It recognizes this situation by the redirected URL being a tel: URL.

For the simplest configuration (Mobile located in home service area (MO#2), initiating a session to a destination served by same network operator(S-S#2)), the handling of redirection to a tel: URL is shown in figure 10.4.3-1. Other cases, which include roaming, PSTN origination, destinations served by other network operators, and THIGs, are handled in a similar manner.

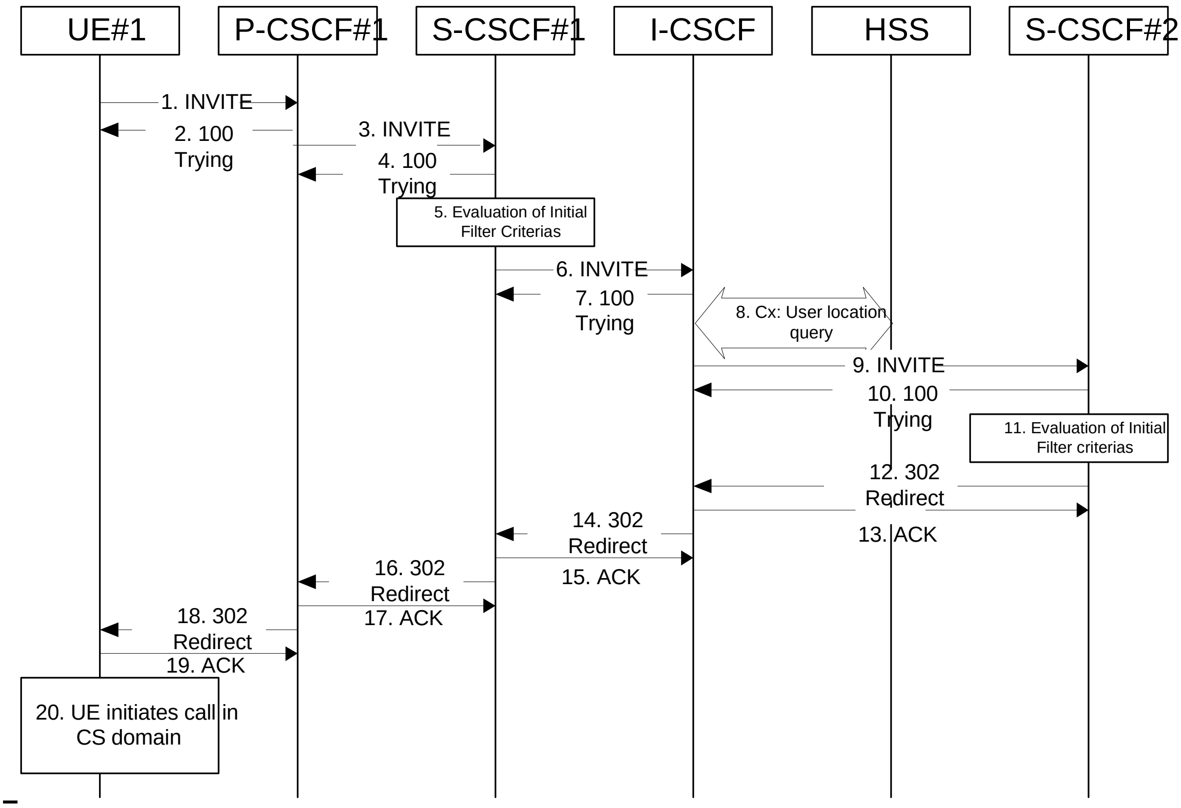


Figure 10.4.3-1: Session redirection initiated by S-CSCF to CS-Domain

Step-by-step processing is as follows:

1. **INVITE (UE to P-CSCF) – see example in table 10.4.3-1**

   UE sends the INVITE request, containing an initial SDP, to the P-CSCF determined via the CSCF discovery mechanism.

Table 10.4.3-1: INVITE (UE to P-CSCF)

INVITE ~~sip~~tel:+1-212-555-2222~~@home1.net;user=phone~~ SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
~~Supported: 100rel~~
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>~~;privacy=off~~
RPID-Privacy: privacy=off;party=calling
~~Proxy-Require: privacy~~
~~Anonymity: Off~~
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
    seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 127 INVITE
Require: precondition
Supported: 100rel
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 3400 RTP/AVP 98 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:98 H261
a=rtpmap:99 MPV
m=video 3402 RTP/AVP 98 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:98 H261
a=rtpmap:99 MPV
m=audio 3456 RTP/AVP 97~~ 3~~ 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
~~a=qos:mandatory sendrecv~~
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000

Request-URI: Contains the keyed number from the user. This is specified by the UE as sip:<keyed number>@home1.net. This is in accordance to standard IETF procedure for specifying dialled digits.

Via: Contains the IP address or FQDN of the originating UE.

Remote-Party-ID: Contains the originator's public user identity. The Display name is optional.

~~**Proxy-Require:** The sip privacy draft specifies that the usage of the Remote-Party-Id MUST be accompanied by a Proxy-Require header specifying "privacy" in all INVITE requests.~~

From:/To:/Call-ID: Follow the recommendations of draft-ietf-sip-privacy [13]~~-01~~, even though anonymity is not being requested for this session.

Cseq: is a~~A~~ random starting number.

Contact: is a SIP URL that contains ~~T~~the IP address or FQDN of the originating UE.

2. **100 Trying (P-CSCF to UE) – see example in table 10.4.3-2**

P-CSCF responds to the INVITE request (1) with a 100 Trying provisional response.

Table 10.4.3-2: 100 Trying (P-CSCF to UE)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

3. **INVITE (P-CSCF to S-CSCF) – see example in table 10.4.3-3**

P-CSCF remembers (from the registration procedure) the request routing for this UE. This becomes a Route header in the request. This next hop is the S-CSCF within the home network.

~~P-CSCF rewrites the Contact header, with a locally defined value that identifies the UE.~~ P-CSCF adds itself to the Record-Route header and ~~, and adds a~~ Via header.

P-CSCF examines the media parameters, and removes any choices that the network operator decides based on local policy, not to allow on the network. For this example, assume the network operator disallows H261 video encoding.

The INVITE request is forwarded to the S-CSCF.

Table 10.4.3-3: INVITE (P-CSCF to S-CSCF)

```
INVITE ~~sip~~tel:+1-212-555-2222~~scscf1.home1.net~~ SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Record-Route: sip:pcscf1.home1.net;lr
Route: sip:scscf1.home1.net;lr~~+1-212-555-2222@home1.net;user=phone~~
~~Supported:~~
Remote-Party-ID:
RPID-Privacy:
~~Proxy-Require:~~
~~Anonymity:~~
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length:

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 3400 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99 MPV
m=video 3402 RTP/AVP 99
b=AS:54.6
```

```
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99 MPV
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
```

~~**Request-URI:** The first component in the remembered Path header from Registration.~~

Route: Contains the ~~remaining~~ elements from the Path header from Registration~~, with the initial Request-URI (received from the UE) appended as the final component~~.

SDP: The SDP contains the restricted set of codecs allowed by the network operator. The “m=” lines for the video media streams no longer list codec 98 (H261).

4. **100 Trying (S-CSCF to P-CSCF) – see example in table 10.4.3-4**

   S-CSCF responds to the INVITE request (3) with a 100 Trying provisional response.

Table 10.4.3-4: 100 Trying (S-CSCF to P-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

5. **Evaluation of initial filter criterias~~Service Control~~**

   S-CSCF validates the service profile of this subscriber and evaluates the initial filter criterias.~~, and performs any origination service control required for this subscriber.~~

6. **INVITE (S-CSCF to I-CSCF) – see example in table 10.4.3-6**

   S-CSCF examines the media parameters, and removes any choices that the subscriber does not have authority to request. For this example, assume the subscriber is not allowed video. S-CSCF removes the stream by seting the port number for that stream to zero.

   S-CSCF forwards the INVITE request, as specified by the S-CSCF to S-CSCF procedures.

Editor’s Note: Need for additional headers to transport e.g. Billing-Correlation-Identifier is FFS.

Table 10.4.3-6: INVITE (S-CSCF to I-CSCF)

```
INVITE siptel:+1-212-555-2222@home1.net;user=phone SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Record-Route: sip:332b23.1@scscf1.home1.net;lr, sip:pcscf1.home1.net;lr
Supported:
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>;privacy=off;screen=yes
RPID-Privacy: screen=yes
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length:

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99 MPV
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99 MPV
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
b=
a=
a=
a=
a=
```

Request-URI: In the case where the Request-URI~~Route header~~ of the incoming INVITE request to S-CSCF contains a TEL-URL [5], it has to be translated to a globally routable SIP-URL before applying it as Request-URI of the outgoing INVITE request. For this address translation the S-CSCF shall use the services of an ENUM-DNS protocol according to RFC 2916 [6], or any other suitable translation database. Database aspects of ENUM are outside the scope of this specification.

7. **100 Trying (I-CSCF to S-CSCF) – see example in table 10.4.3-7**

S-CSCF receives a 100 Trying provisional response, as specified by the S-CSCF to S-CSCF procedures.

Table 10.4.3-7: 100 Trying (I-CSCF to S-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

8. **Cx: User Location Query procedure**

The I-CSCF sends a query to the HSS to find out the S-CSCF of the called user. The HSS responds with the address of the current S-CSCF for the terminating subscriber.

For detailed message flows see 3GPP TS 29.228 [11].

Table 7.3.2-6a provides the parameters in the SIP INVITE request (flow 6), which are sent to the HSS.

Table 7.3.2-6b provides the parameters sent from the HSS that need to be mapped to SIP INVITE (flow 9) and sent to S-CSCF.

9. **INVITE (I-CSCF to S-CSCF) – see example in table 10.4.3-9**

I-CSCF forwards the INVITE request to the S-CSCF (S-CSCF#2) that will handle the session termination.

Table 10.4.3-9: INVITE (I-CSCF to S-CSCF)

```
INVITE siptel:+1-212-555-2222scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP icscf2_s.home1.net;branch=09a238.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd])
Max-Forwards: 67
Route: sip:+1-212-555-2222@home1.net;user=phone
Record-Route: sip:332b23.1@scscf1.home1.net;lr, sip:pcscf1.home1.net;lr
Route: sip:scscf2.home1.net;lr
Supported:
Remote-Party-ID:
RPID-Privacy:
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
```

```
a=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

NOTE: The I-CSCF does not add itself to the Record-Route header, as it has no need to remain in the signalling path once the session is established.

10. **100 Trying (S-CSCF to I-CSCF) – see example in table 10.4.3-10**

S-CSCF#2 responds to the INVITE request with a 100 Trying provisional response.

Table 10.4.3-10: 100 Trying (S-CSCF to I-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP icscf2_s.home1.net;branch=09a238.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

11. **~~Service Control~~Evaluation of initial filter criterias**

S-CSCF#2 validates the service profile of this subscriber and evaluates the initial filter criterias.~~performs whatever service control logic is appropriate for this session attempt.~~ Based on some service-specific criterion, S-CSCF#2 decides to redirect this session attempt to a CS-domain endpoint, at the URL tel:+1-212-555-3333.

12. **~~302 Redirect~~302 Moved Temporarily (S-CSCF to I-CSCF) – see example in table 10.4.3-12**

S-CSCF#2 sends a ~~302 Redirect~~302 Moved Temporarily response to I-CSCF, containing the new destination.

Table 10.4.3-12: ~~302 Redirect~~302 Moved Temporarily (S-CSCF to I-CSCF)

```
SIP/2.0 302 Redirect302 Moved Temporarily
Via: SIP/2.0/UDP icscf2_s.home1.net;branch=09a238.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact: tel:+1-212-555-3333
Content-Length: 0
```

13. **ACK (I-CSCF to S-CSCF) – see example in table 10.4.3-13**

I-CSCF acknowledges receipt of the ~~302 Redirect~~302 Moved Temporarily response by sending an ACK request to S-CSCF#2.

Table 10.4.3-13: ACK (I-CSCF to S-CSCF)

```
ACK sip:scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP icscf2_s.home1.net;branch=09a238.1
From:
To:
```

```
Call-ID:
Cseq:
Content-Length:
```

14. **~~302 Redirect~~302 Moved Temporarily (I-CSCF to S-CSCF) – see example in table 10.4.3-14**

I-CSCF sends a ~~302 Redirect~~302 Moved Temporarily response to S-CSCF#1, containing the new destination.

Table 10.4.3-14: ~~302 Redirect~~302 Moved Temporarily (I-CSCF to S-CSCF)

```
SIP/2.0 302 Redirect302 Moved Temporarily
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact:
Content-Length: 0
```

15. **ACK (S-CSCF to I-CSCF) – see example in table 10.4.3-15**

S-CSCF#1 acknowledges receipt of the ~~302 Redirect~~302 Moved Temporarily response by sending an ACK request to I-CSCF.

Table 10.4.3-15: ACK (S-CSCF to I-CSCF)

```
ACK sip:icscf2_s.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
From:
To:
Call-ID:
Cseq:
Content-Length:
```

16. **~~302 Redirect~~302 Moved Temporarily (S-CSCF to P-CSCF) – see example in table 10.4.3-16**

S-CSCF#1 sends a ~~302 Redirect~~302 Moved Temporarily response to P-CSCF, containing the new destination.

Table 10.4.3-16: ~~302 Redirect~~302 Moved Temporarily (S-CSCF to P-CSCF)

```
SIP/2.0 302 Redirect302 Moved Temporarily
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact:
Content-Length: 0
```

17. **ACK (P-CSCF to S-CSCF) – see example in table 10.4.3-17**

P-CSCF acknowledges receipt of the ~~302 Redirect~~302 Moved Temporarily response by sending an ACK request to S-CSCF#1.

Table 10.4.3-17: ACK (P-CSCF to S-CSCF)

```
ACK sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1
From:
To:
Call-ID:
Cseq:
Content-Length:
```

18. **~~302 Redirect~~302 Moved Temporarily (P-CSCF to UE) – see example in table 10.4.3-18**

P-CSCF sends a ~~302 Redirect~~302 Moved Temporarily response to UE, containing the new destination.

Table 10.4.3-18: ~~302 Redirect~~302 Moved Temporarily (P-CSCF to UE)

```
SIP/2.0 302 Redirect302 Moved Temporarily
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact:
Content-Length: 0
```

19. **ACK (UE to P-CSCF) – see example in table 10.4.3-19**

UE acknowledges receipt of the ~~302 Redirect~~302 Moved Temporarily response by sending an ACK request to P-CSCF.

Table 10.4.3-19: ACK (UE to P-CSCF)

```
ACK siptel:+1-212-555-2222@home1.net;user=phone SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Cseq:
Content-Length:
```

20. **UE initiates session in CS domain**

UE initiates a session to the new destination given in the Contact header, using mechanisms of the CS domain.

10.4.4 Session redirection initiated by S-CSCF to general endpoint (S-S#2, MT#2 assumed)

The S-CSCF in the scenario above may determine that the session is to be redirected to an endpoint outside the IP MultiMedia System and outside the CS-domain. Examples of these destinations include web pages, email addresses, etc. It recognizes this situation by the redirected URL being other than a sip: or tel: URL.

For the simplest configuration (Mobile located in home service area (MO#2), initiating a session to a destination served by same network operator(S-S#2)), the handling of redirection to a general URL is shown in figure 10.4.4-1. Other cases, which include roaming, PSTN origination, destinations served by other network operators, and THIGs, are handled in a similar manner.

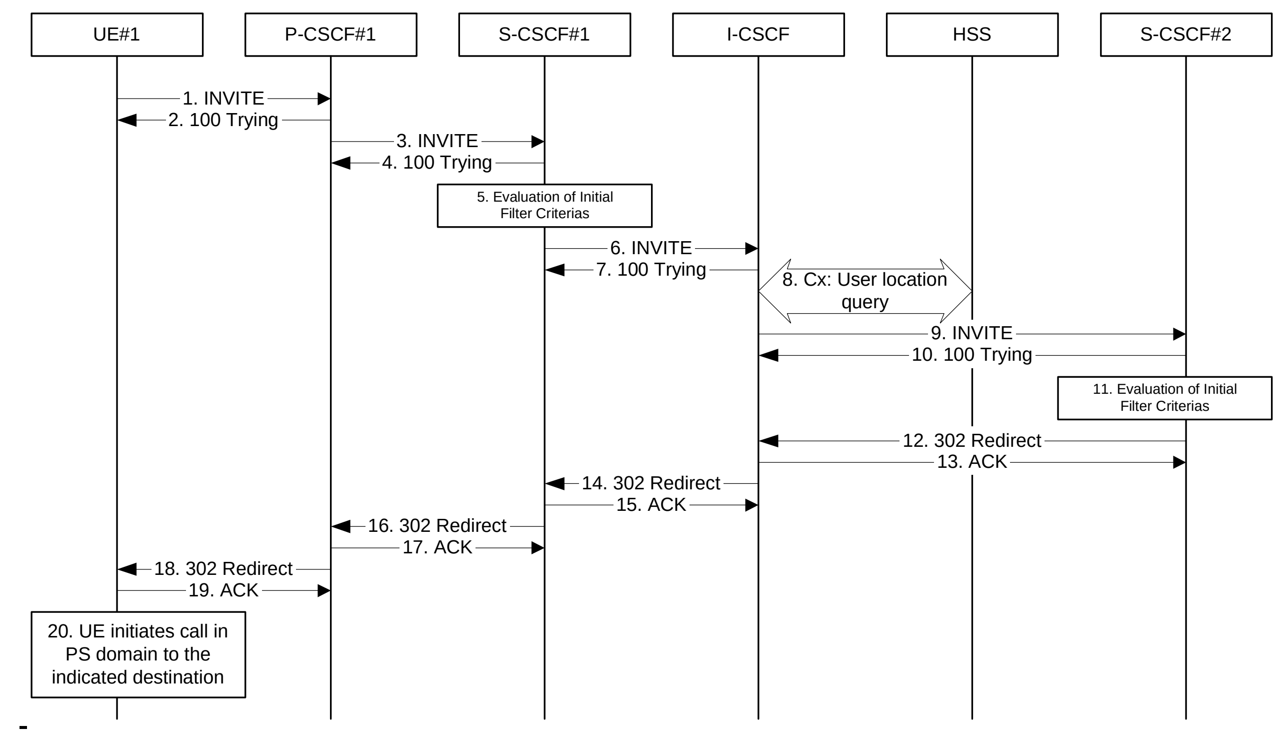


Figure 10.4.4-1: Session redirection initiated by S-CSCF to general endpoint

Step-by-step processing is as follows:

1. **INVITE (UE to P-CSCF) – see example in table 10.4.4-1**

   UE sends the INVITE request, containing an initial SDP, to the P-CSCF determined via the CSCF discovery mechanism.

Table 10.4.4-1: INVITE (UE to P-CSCF)

```
INVITE siptel:+1-212-555-2222@home2.net;user=phone SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
Supported: 100rel
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>;privacy=off
RPID-Privacy: privacy=off;party=calling
Proxy-Require: privacy
Anonymity: Off
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 127 INVITE
Require: precondition
Supported: 100rel
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 3400 RTP/AVP 98 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:98 H261
a=rtpmap:99 MPV
m=video 3402 RTP/AVP 98 99
b=AS:54.6
```

```
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:98 H261
a=rtpmap:99 MPV
m=audio 3456 RTP/AVP 97 3 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
a=qos:mandatory sendrecv
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
```

Request-URI: Contains the keyed number from the user. This is specified by the UE as sip:<keyed number>@home1.net. This is in accordance to standard IETF procedure for specifying dialled digits.

Via: Contains the IP address or FQDN of the originating UE.

Remote-Party-ID: Contains the originator's public user identity. The Display name is optional.

~~**Proxy-Require:** The sip privacy draft specifies that the usage of the Remote-Party-Id MUST be accompanied by a Proxy-Require header specifying "privacy" in all INVITE requests.~~

From:/To:/Call-ID: Follow the recommendations of draft-ietf-sip-privacy [13]~~-01~~, even though anonymity is not being requested for this session.

Cseq: is a~~A~~ random starting number.

Contact: is a SIP URL that contains ~~T~~the IP address or FQDN of the originating UE.

2. **100 Trying (P-CSCF to UE) – see example in table 10.4.4-2**

   P-CSCF responds to the INVITE request (1) with a 100 Trying provisional response.

Table 10.4.4-2: 100 Trying (P-CSCF to UE)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

3. **INVITE (P-CSCF to S-CSCF) – see example in table 10.4.4-3**

   P-CSCF remembers (from the registration procedure) the request routing for this UE. This becomes a Route header in the request. This next hop is the S-CSCF within the home network.

   ~~P-CSCF rewrites the Contact header, with a locally defined value that identifies the UE.~~ P-CSCF adds itself to the Record-Route header and~~, and adds a~~ Via header.

   P-CSCF examines the media parameters, and removes any choices that the network operator decides based on local policy, not to allow on the network. For this example, assume the network operator disallows H261 video encoding.

The INVITE request is forwarded to the S-CSCF.

Table 10.4.4-3: INVITE (P-CSCF to S-CSCF)

```
INVITE ~~sip~~tel:+1-212-555-2222~~scscf1.home1.net~~ SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Record-Route: sip:pcscf1.home1.net;lr
Route: sip:scscf1.home1.net;lr ~~+1-212-555-2222@home1.net;user=phone~~
~~Supported:~~
Remote-Party-ID:
RPID-Privacy:
~~Proxy-Require:~~
~~Anonymity:~~
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:~~ sip:%5b5555%3a%3aaaa%3abbb%3accc%3addd%5d@pcscf1.home1.net~~
Content-Type:
Content-Length:

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 3400 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99 MPV
m=video 3402 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99 MPV
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
```

~~**Request-URI:** The first component in the remembered Path header from Registration.~~

Route: Contains the~~ remaining~~ elements from the Path header from Registration~~, with the initial Request-URI (received from the UE) appended as the final component~~.

SDP: The SDP contains the restricted set of codecs allowed by the network operator. The “m=” lines for the video media streams no longer list codec 98 (H261).

4. **100 Trying (S-CSCF to P-CSCF) – see example in table 10.4.4-4**

S-CSCF responds to the INVITE request (3) with a 100 Trying provisional response.

Table 10.4.4-4: 100 Trying (S-CSCF to P-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

5. **Evaluation of initial filter criterias~~Service Control~~**

S-CSCF validates the service profile of this subscriber and evaluates the initial filter criterias.~~, and performs any origination service control required for this subscriber.~~

6. **INVITE (S-CSCF to I-CSCF) – see example in table 10.4.4-6**

S-CSCF examines the media parameters, and removes any choices that the subscriber does not have authority to request. For this example, assume the subscriber is not allowed video. S-CSCF removes the stream by seting the port number for that stream to zero.

S-CSCF forwards the INVITE request, as specified by the S-CSCF to S-CSCF procedures.

Editor's Note: Need for additional headers to transport e.g. Billing-Correlation-Identifier is FFS.

Table 10.4.4-6: INVITE (S-CSCF to I-CSCF)

```
INVITE siptel:+1-212-555-2222@home2.net;user=phone SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Record-Route: sip:332b23.1@scscf1.home1.net;lr, sip:pcscf1.home1.net;lr
Supported:
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>;privacy=off;screen=yes
RPID-Privacy: screen=yes
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length:

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99 MPV
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99 MPV
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
```

```
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
b=
a=
a=
a=
a=
```

Request-URI: In the case where the Request-URI~~Route header~~ of the incoming INVITE request to S-CSCF contains a TEL-URL [5], it has to be translated to a globally routable SIP-URL before applying it as Request-URI of the outgoing INVITE request. For this address translation the S-CSCF shall use the services of an ENUM-DNS protocol according to RFC 2916 [6], or any other suitable translation database. Database aspects of ENUM are outside the scope of this specification.

7. **100 Trying (I-CSCF to S-CSCF) – see example in table 10.4.4-7**

   S-CSCF receives a 100 Trying provisional response, as specified by the S-CSCF to S-CSCF procedures.

Table 10.4.4-7: 100 Trying (I-CSCF to S-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

8. **Cx: User Location Query procedure**

   The I-CSCF sends a query to the HSS to find out the S-CSCF of the called user. The HSS responds with the address of the current S-CSCF for the terminating subscriber.

   For detailed message flows see 3GPP TS 29.228 [11].

   Table 7.3.2-6a provides the parameters in the SIP INVITE request (flow 6), which are sent to the HSS.

   Table 7.3.2-6b provides the parameters sent from the HSS that need to be mapped to SIP INVITE (flow 9) and sent to S-CSCF.

9. **INVITE (I-CSCF to S-CSCF) – see example in table 10.4.4-9**

   I-CSCF forwards the INVITE request to the S-CSCF (S-CSCF#2) that will handle the session termination.

Table 10.4.4-9: INVITE (I-CSCF to S-CSCF)

```
INVITE siptel:+1-212-555-2222scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP icscf2_s.home1.net, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd])
Max-Forwards: 67
Route: sip:+1-212-555-2222@home2.net;user=phone
Record-Route: sip:332b23.1@scscf1.home1.net;lr, sip:pcscf1.home1.net;lr
Route: sip:scscf2.home1.net;lr
Supported:
Remote-Party-ID:
RPID-Privacy:
```

```
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
a=
a=
a=
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

NOTE: The I-CSCF does not add itself to the Record-Route header, as it has no need to remain in the signalling path once the session is established.

10. **100 Trying (S-CSCF to I-CSCF) – see example in table 10.4.4-10**

S-CSCF#2 responds to the INVITE request with a 100 Trying provisional response.

Table 10.4.4-10: 100 Trying (S-CSCF to I-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP icscf2_s.home1.net, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

11. **~~Service Control~~ Evaluation of initial filter criterias**

S-CSCF#2 validates the service profile of this subscriber and evaluates the initial filter criterias.~~performs whatever service control logic is appropriate for this session attempt.~~ Based on some service-specific criterion, S-CSCF#2 decides to redirect this session attempt to a PS-domain endpoint, at the URL mailto:alienblaster@home.net.

12. **~~302 Redirect~~302 Moved Temporarily (S-CSCF to I-CSCF) – see example in table 10.4.4-12**

S-CSCF#2 sends a ~~302 Redirect~~302 Moved Temporarily response to I-CSCF, containing the new destination.

Table 10.4.4-12: ~~302 Redirect~~302 Moved Temporarily (S-CSCF to I-CSCF)

```
SIP/2.0 302 Redirect302 Moved Temporarily
Via: SIP/2.0/UDP icscf2_s.home1.net, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact: mailto:alienblaster@home.net
Content-Length: 0
```

13. **ACK (I-CSCF to S-CSCF) – see example in table 10.4.4-13**

I-CSCF acknowledges receipt of the ~~302 Redirect~~302 Moved Temporarily response by sending an ACK request to S-CSCF#2.

Table 10.4.4-13: ACK (I-CSCF to S-CSCF)

```
ACK sip:scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP icscf2_s.home1.net
From:
To:
Call-ID:
Cseq:
Content-Length:
```

14. **~~302 Redirect~~302 Moved Temporarily (I-CSCF to S-CSCF) – see example in table 10.4.4-14**

I-CSCF sends a ~~302 Redirect~~302 Moved Temporarily response to S-CSCF#1, containing the new destination.

Table 10.4.4-14: ~~302 Redirect~~302 Moved Temporarily (I-CSCF to S-CSCF)

```
SIP/2.0 302 Redirect302 Moved Temporarily
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact:
Content-Length: 0
```

15. **ACK (S-CSCF to I-CSCF) – see example in table 10.4.4-15**

S-CSCF#1 acknowledges receipt of the ~~302 Redirect~~302 Moved Temporarily response by sending an ACK request to I-CSCF.

Table 10.4.4-15: ACK (S-CSCF to I-CSCF)

```
ACK sip:icscf2_s.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
From:
To:
Call-ID:
Cseq:
Content-Length:
```

16. **~~302 Redirect~~302 Moved Temporarily (S-CSCF to P-CSCF) – see example in table 10.4.4-16**

S-CSCF#1 sends a ~~302 Redirect~~302 Moved Temporarily response to P-CSCF, containing the new destination.

Table 10.4.4-16: ~~302 Redirect~~302 Moved Temporarily (S-CSCF to P-CSCF)

```
SIP/2.0 302 Redirect302 Moved Temporarily
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact:
Content-Length: 0
```

17. **ACK (P-CSCF to S-CSCF) – see example in table 10.4.4-17**

P-CSCF acknowledges receipt of the ~~302 Redirect~~302 Moved Temporarily response by sending an ACK request to S-CSCF#1.

Table 10.4.4-17: ACK (P-CSCF to S-CSCF)

```
ACK sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1
From:
To:
Call-ID:
Cseq:
Content-Length:
```

18. **~~302 Redirect~~302 Moved Temporarily (P-CSCF to UE) – see example in table 10.4.4-18**

P-CSCF sends a ~~302 Redirect~~302 Moved Temporarily response to UE, containing the new destination.

Table 10.4.4-18: ~~302 Redirect~~302 Moved Temporarily (P-CSCF to UE)

```
SIP/2.0 302 Redirect302 Moved Temporarily
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact:
Content-Length: 0
```

19. **ACK (UE to P-CSCF) – see example in table 10.4.4-19**

UE acknowledges receipt of the ~~302 Redirect~~302 Moved Temporarily response by sending an ACK request to P-CSCF.

Table 10.4.4-19: ACK (UE to P-CSCF)

```
ACK sip:token6@pcscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Cseq:
Content-Length:
```

20. **UE initiates session in PS domain**

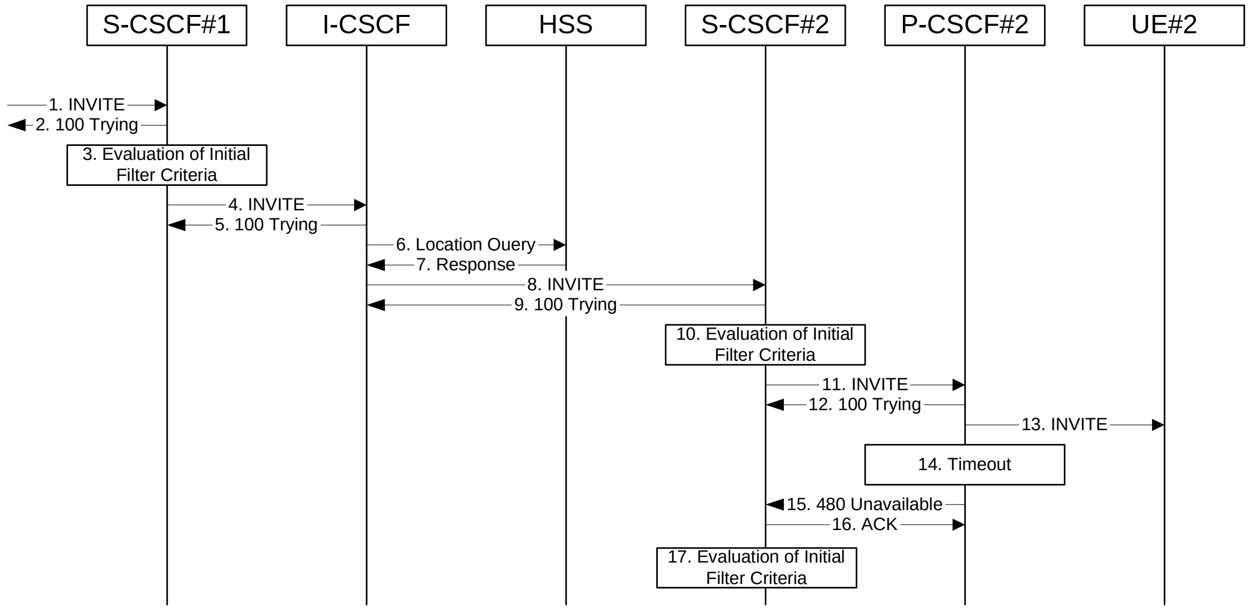
UE initiates a session to the new destination given in the Contact header, using mechanisms of the PS domain.

10.4.5 Session redirection initiated by P-CSCF (S-S#2, MT#2 assumed)

One of the entities in a basic session that may initiate a redirection is the P-CSCF of the destination subscriber. In handling of an incoming session setup attempt, the P-CSCF normally sends the INVITE request to the destination UE, and retransmits it as necessary until obtaining an acknowledgement indicating reception by the UE.

In cases when the destination subscriber is not currently reachable in the IM CN subsystem (due to such factors as roaming outside the service area or loss of battery, but the registration has not yet expired), the P-CSCF may initiate a redirection of the session. The P-CSCF informs the S-CSCF of this redirection, without specifying the new location; S-CSCF determines the new destination and performs according to subclauses 10.4.2, 10.4.3, or 10.4.4, based on the type of destination.

This is shown in figure 10.4.5-1.



-

Figure 10.4.5-1: Session redirection initiated by P-CSCF

Beginning with step #8, the step-by-step processing is as follows:

8. **INVITE (I-CSCF to S-CSCF) – see example in table 10.4.5-8**

   The calling party sends the INVITE request, via one of the origination procedures and via one of the S-CSCF to S-CSCF procedures, to the S-CSCF for the terminating subscriber.

Table 10.4.5-8: INVITE (I-CSCF to S-CSCF)

```
INVITE siptel:+1-212-555-2222@home2.net;user=phone SIP/2.0
Via: SIP/2.0/UDP icscf2_s.home1.net;branch=09a238.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Record-Route: sip:332b23.1@scscf1.home1.net;lr, sip:pcscf1.home1.net;lr
Route: sip:scscf2.home1.net;lr
Supported: 100rel
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>;privacy=off;screen=yes
RPID-Privacy: screen=yes
Proxy-Require: privacy
Anonymity: Off
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
    seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 127 INVITE
Require:
Supported:
Contact: sip:%5b5555%3a%3aaaa%3abbb%3accc%3addd%5d@pcscf1.home1.net
Content-Type: application/sdp
Content-Length: (…)
```

```
v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99 MPV
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99 MPV
m=audio 3456 RTP/AVP 97 3 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
a=qos:mandatory sendrecv
```

9. **100 Trying (S-CSCF to I-CSCF) – see example in table 10.4.5-9**

S-CSCF responds to the INVITE request (8) with a 100 Trying provisional response.

Table 10.4.5-9: 100 Trying (S-CSCF to I-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP icscf2_s.home1.net;branch=09a238.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

10. **~~Service Control~~Evaluation of initial filter criterias**

S-CSCF validates the service profile of this subscriber and evaluates the initial filter criterias.~~, and performs any termination service control required for this subscriber.~~

11. **INVITE (S-CSCF to P-CSCF) – see example in table 10.4.5-11**

S-CSCF remembers (from the registration procedure) the UE Contact address and the next hop CSCF for this UE. It forwards the INVITE request to the P-CSCF.

S-CSCF#F examines the media parameters, and removes any choices that the destination subscriber does not have authority to request. For this example, assume the destination subscriber is not allowed stereo, so only a single audio stream is permitted.

Table 10.4.5-11: INVITE (S-CSCF to P-CSCF)

```
INVITE sip:[5555::eee:fff:aaa:bbb]%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home1.net, SIP/2.0/UDP icscf2_s.home1.net;branch=09a238.1, SIP/2.0/UDP
    scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP
    [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 66
Route: sip:+1-212-555-2222@home2.net;user=phone
Record-Route: sip:scscf2.home1.net;lr, sip:332b23.1@scscf1.home1.net;lr, sip:pcscf1.home1.net;lr
Route: sip:pcscf1.home1.net;lr
Supported:
Remote-Party-ID:
RPID-Privacy:
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length:

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
m=video 0 RTP/AVP 99
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 0 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
```

Route: Built from the Path header stored at registration.~~registration information, (pcscf and UE contact name), followed by the initial Request-URI from the incoming INVITE request. The first component of the Route header, pcscf, is moved to the Request-URI of the request.~~

Via:/Record-Route: S-CSCF adds itself~~ in the Record-Route and Via headers~~.

SDP The SDP contains the restricted set of codecs allowed by the network operator. The "m=" lines for the second audio stream shows a port number zero, which removes it from the negotiation.

12. **100 Trying (P-CSCF to S-CSCF) – see example in table 10.4.5-12**

P-CSCF responds to the INVITE request (11) with a 100 Trying provisional response.

Table 10.4.5-12: 100 Trying (P-CSCF to S-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP scscf2.home1.net, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
```

```
Call-ID:
CSeq:
Content-Length: 0
```

13. **INVITE (P-CSCF to UE) – see example in table 10.4.5-13**

P-CSCF examines the media parameters, and removes any that the network operator decides, based on local policy, not to allow on the network.

For this example, assume the network operator does not allow 64 kb/s audio, so the PCMU codec is removed.

P-CSCF removes the Record-Route and Via headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.

~~P-CSCF determines the UE address from the value of the Request-URI (which was previously returned by P-CSCF as a contact header value in the registration procedure), and forwards the INVITE request to the UE.~~

Table 10.4.5-13: INVITE (P-CSCF to UE)

```
INVITE sip:[5555::eee:fff:aaa:bbb]+1-212-555-2222@home2.net;user=phone SIP/2.0
Via: SIP/2.0/UDP pcscf2.home1.net;branch=token1
P-Media-Authorization: 0020000100100101706366312e78797a2e6e6574000c02013942563330373200
Max-Forwards: 65
Supported:
Remote-Party-ID:
RPID-Privacy:
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact: token1@pcscf2.home1.net
Content-Type:
Content-Length:

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
b=
a=
a=
a=
a=
a=
m=video 0 RTP/AVP 99
b=
a=
a=
a=
a=
a=
m=audio 3456 RTP/AVP 97 96 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 0 RTP/AVP 97 96 0 15
b=
a=
a=
a=
a=
a=
a=
```

```
a=
```

~~- P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE. The saved value of the Route header is:~~

```
Route: sip:scscf2.home1.net, sip:332b23.1@scscf1.home1.net,
 sip:%5b5555%3a%3aaaa%3abbb%3accc%3addd%5d@pcscf1.home1.net
```

~~**Contact:** A locally unique token to identify the saved routing information.~~

Via: P-CSCF removes the Via headers, and generates a locally unique token to identify the saves values. It inserts this as a branch value on its Via header.

P-Media-Authorization: A P-CSCF generated authorization token. This particular example shows a Policy-Element generated by "pcf2.xyz.net" with credentials "31S14621".

SDP The SDP contains the restricted set of codecs allowed by the network operator. The "m=" lines for the first audio stream no longer contains codec "0" (PCMU), which removes it from the negotiation.

14. **Timeout**

P-CSCF never receives any response from UE#2, and assumes it is unreachable.

15. **480 Temporarily Unavailable (P-CSCF to S-CSCF) – see example in table 10.4.5-15**

P-CSCF sends a 480 Temporarily Unavailable response to S-CSCF.

Table 10.4.5-15: 480 Temporarily Unavailable (P-CSCF to S-CSCF)

```
SIP/2.0 480 Temporarily Unavailable
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

16. **ACK (S-CSCF to P-CSCF) – see example in table 10.4.5-16**

S-CSCF acknowledges receipt of the 480 Temporarily Unavailable response (15) by sending an ACK request to P-CSCF.

Table 10.4.5-16: ACK (S-CSCF to P-CSCF)

```
ACK sip:[5555::eee:fff:aaa:bbb]%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home12.net;branch=764z87.1
From:
To:
Call-ID:
Cseq:
Content-Length:
```

17. ~~**Service Control**~~ **Evaluation of initial filter criterias**

S-CSCF validates the service profile of this subscriber and evaluates the initial filter criterias.

S-CSCF#2 determines the proper redirection action to take for this session, based on the subscriber profile and network operator policy.

- If the session is being redirected to a sip URL, then the signalling flow continues with step #11 of subclause 10.4.2.

- If the session is being redirected to a tel URL, then the signalling flow continues with step #13 of subclause 10.4.3.
- If the session is being redirected to a general URL, then the signalling flow continues with step #13 of subclause 10.4.4.

10.4.6 Session redirection initiated by UE (S-S#2, MT#2 assumed)

The next entity in a basic session that may initiate a redirection is the UE of the destination subscriber. The UE may implement customer-specific feature processing, and base its decision to redirect this session on such things as identity of caller, current sessions in progress, other applications currently being accessed, etc. UE sends the SIP Redirect response to its P-CSCF, who forwards back along the signalling path to S-CSCF#1, who initiates a session to the new destination.

The service implemented by this signalling flow is typically "Session Forward Busy", "Session Forward Variable" or "Selective Session Forwarding".

This is shown in figure 10.4.6-1.

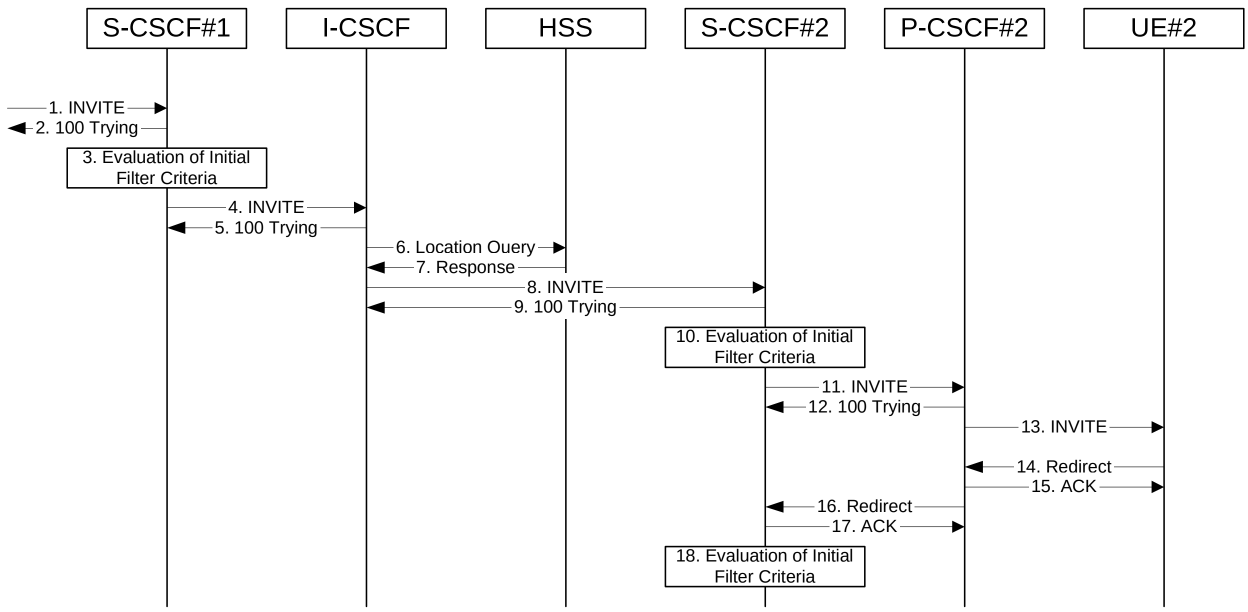


Figure 10.4.6-1: Session redirection initiated by UE

Beginning with step #8, the step-by-step processing is as follows:

8. **INVITE (I-CSCF to S-CSCF) – see example in table 10.4.6-8**

   The calling party sends the INVITE request, via one of the origination procedures and via one of the S-CSCF to S-CSCF procedures, to the S-CSCF for the terminating subscriber.

Table 10.4.6-8: INVITE (I-CSCF to S-CSCF)

```
INVITE siptel:+1-212-555-2222@home1.net;user=phone SIP/2.0
Via: SIP/2.0/UDP icscf2_s.home1.net;branch=09a238.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Record-Route: sip:332b23.1@scscf1.home1.net;lr, sip:431h23.1@pcscf1.home1.net;lr
Supported: 100rel
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>;privacy=off;screen=yes
RPID-Privacy:
Proxy-Require: privacy
Anonymity: Off
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
    seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
```

```
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 127 INVITE
Require:
Supported:
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99 MPV
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99 MPV
m=audio 3456 RTP/AVP 97 3 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 3458 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
a=qos:mandatory sendrecv
```

9. **100 Trying (S-CSCF to I-CSCF) – see example in table 10.4.6-9**

   S-CSCF responds to the INVITE request (8) with a 100 Trying provisional response.

Table 10.4.6-9: 100 Trying (S-CSCF to I-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP icscf2_s.home1.net;branch=09a238.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

10. **~~Service Control~~Evaluation of initial filter criterias**

    S-CSCF validates the service profile of this subscriber and evaluates the initial filter criterias.~~, and performs any termination service control required for this subscriber.~~

11. **INVITE (S-CSCF to P-CSCF) – see example in table 10.4.6-11**

    S-CSCF remembers (from the registration procedure) the UE Contact address and the next hop CSCF for this UE. It forwards the INVITE request to the P-CSCF.

S-CSCF#F examines the media parameters, and removes any choices that the destination subscriber does not have authority to request. For this example, assume the destination subscriber is not allowed stereo, so only a single audio stream is permitted.

Table 10.4.6-11: INVITE (S-CSCF to P-CSCF)

```
INVITE sip:[5555::eee:fff:aaa:bbb]pcscf2.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home1.net;branch=492e09.1, SIP/2.0/UDP icscf2_s.home1.net;branch=09a238.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 66
Route: sip:+1-212-555-2222@home1.net;user=phone
Record-Route: sip:492e09.1@scscf2.home1.net;lr, sip:332b23.1@scscf1.home1.net;lr,
sip:431h23.1@pcscf1.home1.net;lr
Supported:
Remote-Party-ID:
RPID-Privacy:
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length:

v=0
o==- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99 MPV
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99 MPV
m=audio 3456 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 0 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=
b=
a=
a=
a=
a=
```

Route: Built from the Path header stored at registration. ~~registration information, (pcscf and UE contact name), followed by the initial Request-URI from the incoming INVITE request.~~

~~The first component of the Route header, pcscf, is moved to the Request-URI of the request.~~

Via:/Record-Route: S-CSCF adds itself~~ in the Record-Route and Via headers~~.

SDP The SDP contains the restricted set of codecs allowed by the network operator. The "m=" lines for the second audio stream shows a port number zero, which removes it from the negotiation.

12. **100 Trying (P-CSCF to S-CSCF) – see example in table 10.4.6-12**

P-CSCF responds to the INVITE request (11) with a 100 Trying provisional response.

Table 10.4.6-12: 100 Trying (P-CSCF to S-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP scscf2.home1.net;branch=492e09.1, SIP/2.0/UDP icscf2_s.home1.net;branch=09a238.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

13. **INVITE (P-CSCF to UE) – see example in table 10.4.6-13**

P-CSCF examines the media parameters, and removes any that the network operator decides, based on local policy, not to allow on the network.

For this example, assume the network operator does not allow 64 kb/s audio, so the PCMU codec is removed.

P-CSCF removes the Record-Route and Via headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.

~~P-CSCF determines the UE address from the value of the Request-URI (which was previously returned by P-CSCF as a contact header value in the registration procedure), and forwards the INVITE request to the UE.~~

Table 10.4.6-13: INVITE (P-CSCF to UE)

```
INVITE sip:[5555::eee:fff:aaa:bbb]:+1-212-555-2222@home1.net;user=phone SIP/2.0
Via: SIP/2.0/UDP pcscf2.home1.net;branch=39z58a.1
P-Media-Authorization: 0020000100100101706366312e78797a2e6e6574000c02013942563330373200
Max-Forwards: 65
Supported:
Remote-Party-ID:
RPID-Privacy:
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length:

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99 MPV
```

```
m=video 0 RTP/AVP 99
b=AS:54.6
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:99 MPV
m=audio 3456 RTP/AVP 97 96 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=audio 0 RTP/AVP 97 96 0 15
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
m=
b=
a=
a=
a=
a=
```

~~P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE. The saved value of the Route header is:~~

```
Route: sip:492e09.1@scscf2.home1.net, sip:332b23.1@scscf1.home1.net,
    sip:431h23.1@pcscf1.home1.net
```

~~**Contact:** A locally unique token to identify the saved routing information.~~

Via: P-CSCF removes the Via headers, and generates a locally unique token to identify the saves values. It inserts this as a branch value on its Via header.

P-Media-Authorization: A P-CSCF generated authorization token. This particular example shows a Policy-Element generated by "pcf2.xyz.net" with credentials "31S14621".

SDP The SDP contains the restricted set of codecs allowed by the network operator. The "m=" lines for the first audio stream no longer contains codec "0" (PCMU), which removes it from the negotiation.

14. **~~302 Redirect~~302 Moved Temporarily (UE to P-CSCF) – see example in table 10.4.6-14**

UE sends a ~~302 Redirect~~302 Moved Temporarily response to UE, specifying a new destination.

Table 10.4.6-14: ~~302 Redirect~~302 Moved Temporarily (UE to P-CSCF)

```
SIP/2.0 302 Redirect302 Moved Temporarily
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact: sip:+1-212-555-3333@home1.net;user=phone
Content-Length: 0
```

15. **ACK (P-CSCF to UE) – see example in table 10.4.6-15**

S-CSCF acknowledges receipt of the ~~302 Redirect~~302 Moved Temporarily response (15) by sending an ACK request to P-CSCF.

Table 10.4.6-15: ACK (P-CSCF to UE)

```
ACK sip:[5555::eee:fff:aaa:bbb]+1-212-555-2222@home1.net;user=phone SIP/2.0
Via: SIP/2.0/UDP pcscf2.home1.net;branch=39z58a.1
From:
To:
Call-ID:
Cseq:
Content-Length:
```

16. **~~302 Redirect~~302 Moved Temporarily (P-CSCF to S-CSCF) – see example in table 10.4.6-16**

P-CSCF sends a ~~302 Redirect~~302 Moved Temporarily response to S-CSCF, with the new destination.

Table 10.4.6-16: ~~302 Redirect~~302 Moved Temporarily (P-CSCF to S-CSCF)

```
SIP/2.0 302 Redirect302 Moved Temporarily
Via: SIP/2.0/UDP scscf2.home1.net;branch=492e09.1, SIP/2.0/UDP icscf2_s.home1.net;branch=09a238.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact:
Content-Length:
```

17. **ACK (S-CSCF to P-CSCF) – see example in table 10.4.6-17**

S-CSCF acknowledges receipt of the ~~302 Redirect~~302 Moved Temporarily response (16) by sending an ACK request to P-CSCF.

Table 10.4.6-17: ACK (S-CSCF to P-CSCF)

```
ACK sip:pcscf2.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home12.net;branch=764z87.1
From:
To:
Call-ID:
Cseq:
Content-Length:
```

18. **~~Service Control~~ Evaluation of initial filter criterias**

S-CSCF validates the service profile of this subscriber and evaluates the initial filter criterias.

S-CSCF#2 determines the proper redirection action to take for this session, based on the subscriber profile and network operator policy.

- If the session is being redirected to a sip URL, then the signalling flow continues with step #11 of subclause 10.4.2.
- If the session is being redirected to a tel URL, then the signalling flow continues with step #13 of subclause 10.4.3.
- If the session is being redirected to a general URL, then the signalling flow continues with step #13 of subclause 10.4.4.

10.4.7 Session redirection initiated after bearer establishment

The UE of the destination subscriber may request the session be redirected after a customer-specified ringing interval. The UE may also implement customer-specific feature processing, and base its decision to redirect this session on such things as the identity of caller, current sessions in progress, other applications currently being accessed, etc. The UE sends the SIP Redirect response to its P-CSCF, who forwards back along the signalling path to the originating endpoint, who initiates a session to the new destination.

The service implemented by this signalling flow is typically "Session Forward No Answer".

Redirection to another I CN subsystem endpoint (e.g. a sip: URL) is shown in figure 10.4.7-1. The figure starts at the point in the session establishment when the destination is known, resources have been reserved, and the destination subscriber is being alerted. If the desire for redirection was known earlier than this point, the procedures of Subclause 10.4.6 would be followed instead.

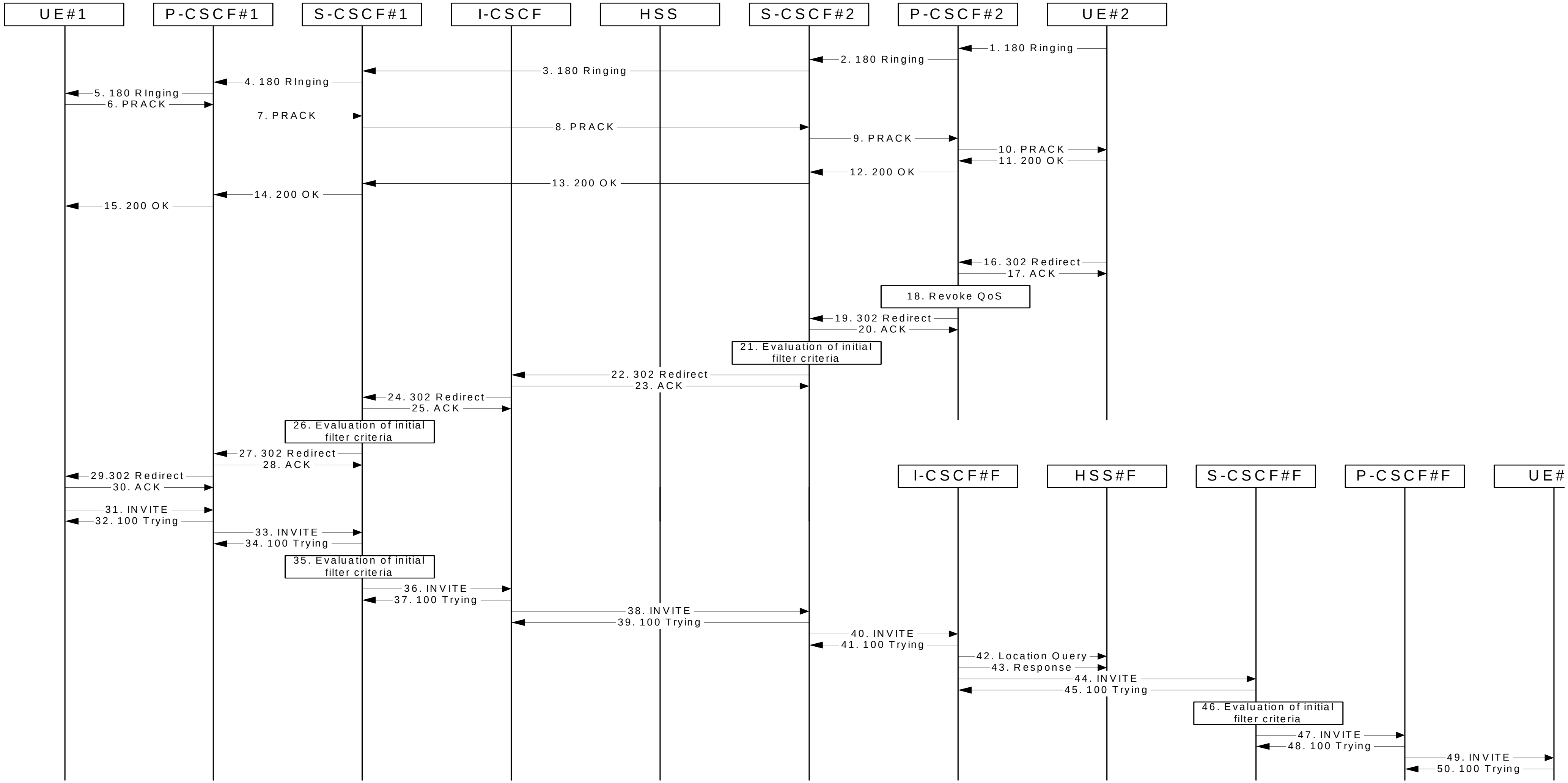


Figure 10.4.7-1: Session redirection after bearer establishment

Step-by-step processing is as follows:

1. **180 Ringing (UE to P-CSCF) – see example in table 10.4.7-1**

   Depending on the type of codec change being performed, alerting may be required at the destination UE. If so, UE#2 sends a 180 Ringing provisional response to the originator, through P-CSCF#2.

Table 10.4.7-1: 180 Ringing (UE to P-CSCF)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP pcscf2.home1.net;branch=token3
Require: 100rel
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
    seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 131 INVITE
Contact: sip:[5555::eee:fff:aaa:bbb]
RSeq: 19
Content-Length: 0
```

2. **180 Ringing (P-CSCF to S-CSCF) – see example in table 10.4.7-2**

   P-CSCF#2 sends the 180 Ringing response to S-CSCF#2.

Table 10.4.7-2: 180 Ringing (P-CSCF to S-CSCF)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP scscf2.home1.net, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:pcscf2.home1.net:lr, sip:scscf2.home1.net;lr,
sip:332b23.1@scscf1.home1.net;lr, sip:pcscf1.home1.net;lr
Require:
From:
To:
Call-ID:
CSeq:
Contact:
RSeq:
Content-Length:
```

3. **180 Ringing (S-CSCF to S-CSCF) – see example in table 10.4.7-3**

   S-CSCF#2 sends the 180 Ringing response to S-CSCF#1.

Table 10.4.7-3: 180 Ringing (S-CSCF to S-CSCF)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:scscf2.home1.net, sip:332b23.1@scscf1.home1.net
Require:
From:
To:
Call-ID:
CSeq:
Contact:
RSeq:
Content-Length:
```

4. **180 Ringing (S-CSCF to P-CSCF) – see example in table 10.4.7-4**

S-CSCF#1 sends the 180 Ringing response to P-CSCF#1.

Table 10.4.7-4: 180 Ringing (S-CSCF to P-CSCF)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route:
Require:
From:
To:
Call-ID:
CSeq:
Contact:
RSeq:
Content-Length:
```

5. **180 Ringing (P-CSCF to UE) – see example in table 10.4.7-5**

P-CSCF#1 sends the 180 Ringing response to UE#1.

Table 10.4.7-5: 180 Ringing (P-CSCF to UE)

```
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Require:
From:
To:
Call-ID:
CSeq:
Contact: sip:token4@pcscf1.home1.net
RSeq:
Content-Length:
```

6. **PRACK (UE to P-CSCF) – see example in table 10.4.7-6**

UE#1 sends the PRACK request to UE#2, along the signalling path established by the INVITE request.

Table 10.4.7-6: PRACK (UE to P-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb]token4@pcscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: "Alien Blaster" <sip:B36(SHA-1(555-1111; time=36123E5B;
seq=72))@localhost>;tag=171828
To: <sip:B36(SHA-1(555-2222; time=36123E5B; seq=73))@localhost>;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 130 PRACK
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Rack: 19 131 INVITE
Content-Length: 0
```

Request-URI: Takes the value of the Contact header of the 180 Ringing response.

Via:, Contact: Take the value of either the IP address or FQDN of the UE.

From:/To:/Call-ID: Copied from the 180 Ringing response so that they include any revised tag parameters.

Cseq: Takes a higher value than in the previous request.

7. **PRACK (P-CSCF to S-CSCF) – see example in table 10.4.7-7**

   P-CSCF#1 sends the PRACK request to S-CSCF#1, along the signalling path established by the INVITE request.

Table 10.4.7-7: PRACK (P-CSCF to S-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb]scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:scscf1.home1.net;lr, sip:scscf2.home1.net;lr,
sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home1.net;lr
From:
To:
Call-ID:
Cseq:
Contact: sip:%5b5555%3a%3aaaa%3abbb%3accc%3addd%5d@pcscf1.home1.net
Rack:
Content-Length:
```

Route: P-CSCF adds a Route header, with the saved value from the previous response. ~~P-CSCF identifies the proper saved value by the Request-URI.~~

8. **PRACK (S-CSCF to S-CSCF) – see example in table 10.4.7-8**

   S-CSCF#1 sends the PRACK request to S-CSCF#2, along the signalling path established by the INVITE request.

Table 10.4.7-8: PRACK (S-CSCF to S-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb]scscf2.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scscf2.home2.net;lr,
sip:%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home1.net;lr
Record-Route: sip:332b23.1@scscf1.home1.net
From:
To:
Call-ID:
Cseq:
Contact:
Rack:
Content-Length:
```

9. **PRACK (S-CSCF to P-CSCF) – see example in table 10.4.7-9**

   S-CSCF#2 sends the PRACK request to P-CSCf#2, along the signalling path established by the INVITE request.

Table 10.4.7-9: PRACK (S-CSCF to P-CSCF)

```
PRACK sip:[5555::eee:fff:aaa:bbb]%5b5555%3a%3aeee%3afff%3aaaa%3abbb%5d@pcscf2.home1.net
SIP/2.0
Via: SIP/2.0/UDP scscf2.home1.net, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: pcscf2.home1.net;lr
Record-Route: sip:scscf2.home1.net, sip:332b23.1@scscf1.home1.net
From:
To:
Call-ID:
Cseq:
```

```
Contact:
Rack:
Content-Length:
```

10. **PRACK (P-CSCF to UE) – see example in table 10.4.7-10**

P-CSCF#2 sends the PRACK request to UE#2, along the signalling path established by the INVITE request.

Table 10.4.7-10: PRACK (P-CSCF to UE)

```
PRACK sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home1.net;branch=token4
From:
To:
Call-ID:
Cseq:
Contact: token4@pcscf2.home1.net
Rack:
Content-Length:
```

P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.

~~**Contact:** A locally unique token to identify the saved routing information.~~

Via: P-CSCF removes the Via headers, and generates a locally unique token to identify the saved values. It inserts this as a branch value on its Via header.

11. **200 OK (UE to P-CSCF) – see example in table 10.4.7-11**

UE#2 responds to the PRACK request (10) with a 200 OK response to P-CSCF#2.

Table 10.4.7-11: 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf2.home1.net;branch=token4
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

12. **200 OK (P-CSCF to S-CSCF) – see example in table 10.4.7-12**

P-CSCF#2 sends the 200 OK response to S-CSCF#2.

Table 10.4.7-12: 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home1.net, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:scscf2.home1.net, sip:332b23.1@scscf1.home1.net
From:
To:
Call-ID:
CSeq:
Content-Length:
```

13. **200 OK (S-CSCF to S-CSCF) – see example in table 10.4.7-13**

S-CSCF#2 sends the 200 OK response to S-CSCF#1.

Table 10.4.7-13: 200 OK (S-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:scscf2.home1.net, sip:332b23.1@scscf1.home1.net
From:
To:
Call-ID:
CSeq:
Contact:
Content-Length:
```

14. **200 OK (S-CSCF to P-CSCF) – see example in table 10.4.7-14**

S-CSCF#1 sends the 200 OK response to P-CSCF#1.

Table 10.4.7-14: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Record-Route: sip:scscf2.home1.net, sip:332b23.1@scscf1.home1.net
From:
To:
Call-ID:
CSeq:
Contact:
Content-Length:
```

15. **200 OK (P-CSCF to UE) – see example in table 10.4.7-15**

P-CSCF#1 sends the 200 OK response to UE#1.

Table 10.4.7-15: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact: sip:token5@pcscf1.home1.net
Content-Length:
```

P-CSCF removes the Record-Route headers, calculates the proper Route header to add to future requests, and saves that information without passing it to UE.

~~**Contact:** A locally unique token to identify the saved routing information~~

16. **~~302 Redirect~~302 Moved Temporarily (UE to P-CSCF) – see example in table 10.4.7-16**

Based on some service criterion, such as a timeout value, UE#2 decides to redirect this session request to another destination. UE#2 sends a ~~302 Redirect~~302 Moved Temporarily response to P-CSCF, containing the new destination. For this example, consider the new destination to be <sip:+1-212-555-3333@home.net;user=phone>.

Table 10.4.7-16: ~~302 Redirect~~302 Moved Temporarily (S-CSCF to I-CSCF)

```
SIP/2.0 302 Redirect302 Moved Temporarily
Via: SIP/2.0/UDP pcscf2.home1.net, SIP/2.0/UDP scscf2.home1.net, SIP/2.0/UDP
    icscf2_s.home1.net, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact: siptel:+1-212-555-3333@home.net;user=phone
Content-Length: 0
```

17. **ACK (P-CSCF to UE) – see example in table 10.4.7-17**

P-CSCF acknowledges receipt of the ~~302 Redirect~~302 Moved Temporarily response (16) by sending an ACK request to UE#2.

Table 10.4.7-17: ACK (I-CSCF to S-CSCF)

```
ACK sip:+1-212-555-2222@home2.net SIP/2.0
Via: SIP/2.0/UDP pcscf2.home1.net
From:
To:
Call-ID:
Cseq:
Content-Length:
```

18. **Revoke QoS**

P-CSCF revokes any authorization is had made for Quality of Service for this session.

19. **~~302 Redirect~~302 Moved Temporarily (P-CSCF to S-CSCF) – see example in table 10.4.7-19**

P-CSCF#2 sends a ~~302 Redirect~~302 Moved Temporarily response to S-CSCF#2, containing the new destination.

Table 10.4.7-19: ~~302 Redirect~~302 Moved Temporarily (P-CSCF to S-CSCF)

```
SIP/2.0 302 Redirect302 Moved Temporarily
Via: SIP/2.0/UDP scscf2.home1.net, SIP/2.0/UDP icscf2_s.home1.net, SIP/2.0/UDP
    scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact:
Content-Length:
```

20. **ACK (S-CSCF to P-CSCF) – see example in table 10.4.7-20**

S-CSCF acknowledges receipt of the ~~302 Redirect~~302 Moved Temporarily response (19) by sending an ACK request to P-CSCF#2.

Table 10.4.7-20: ACK (S-CSCF to P-CSCF)

```
ACK sip:pcscf2.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home1.net
From:
To:
Call-ID:
Cseq:
```

```
Content-Length:
```

21. ~~**Service Control**~~ **Evaluation of initial filter criterias**

S-CSCF validates the service profile of this subscriber, and evaluates the initial filter criterias.

~~S-CSCF#2 performs whatever service control is appropriate for this redirected session.~~

If UE#2 has not subscribed to a session redirection service, then S-CSCF#2 may change the error response to a 480 Temporarily Unavailable.

S-CSCF#2 generates a private URL containing the new destination, and places this new value as the Contact header in the response. Attempts to initiate a session to this destination shall be restricted to a short time period.

22. ~~**302 Redirect**~~**302 Moved Temporarily (S-CSCF to I-CSCF) – see example in table 10.4.7-22**

S-CSCF#2 sends a ~~302 Redirect~~302 Moved Temporarily response to I-CSCF, containing the updated destination.

Table 10.4.7-22: ~~302 Redirect~~302 Moved Temporarily (S-CSCF to I-CSCF)

```
SIP/2.0 302 Redirect302 Moved Temporarily
Via: SIP/2.0/UDP icscf2_s.home1.net, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact: sip:Token(tel:+1-212-555-3333@home.net;user=phone)@scscf2.home1.net;tokenized-
by=scscf2.home1.net
Content-Length:
```

23. **ACK (I-CSCF to S-CSCF) – see example in table 10.4.7-23**

I-CSCF acknowledges receipt of the ~~302 Redirect~~302 Moved Temporarily response (22) by sending an ACK request to S-CSCF#2.

Table 10.4.7-23: ACK (I-CSCF to S-CSCF)

```
ACK sip:scscf2.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf2_s.home1.net
From:
To:
Call-ID:
Cseq:
Content-Length:
```

24. ~~**302 Redirect**~~**302 Moved Temporarily (I-CSCF to S-CSCF) – see example in table 10.4.7-24**

I-CSCF may (based on operator preferences) update the new destination address, in order to hide the S-CSCF address and maintain configuration independence. If so, it generates a new private URL with its own hostname. I-CSCF sends a ~~302 Redirect~~302 Moved Temporarily response to S-CSCF#1, containing the new destination.

Table 10.4.7-24: ~~302 Redirect~~302 Moved Temporarily (I-CSCF to S-CSCF)

```
SIP/2.0 302 Redirect302 Moved Temporarily
```

```
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact: sip:Token(token(siptel:+1-212-555-
3333@home.net;user=phone)@scscf2.home1.net;tokenized-
by=scscf2.home1.netuser=private)@icscf2_s.home1.net;tokenized-
by=icscf2_s.home1.netuser=private
Content-Length: 0
```

25. **ACK (S-CSCF to I-CSCF) – see example in table 10.4.7-25**

S-CSCF#1 acknowledges receipt of the ~~302 Redirect~~302 Moved Temporarily response (24) by sending an ACK request to I-CSCF.

Table 10.4.7-25: ACK (S-CSCF to I-CSCF)

```
ACK sip:icscf2_s.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1
From:
To:
Call-ID:
Cseq:
Content-Length:
```

26. **~~Service Control~~ Evaluation of initial filter criterias**

S-CSCF validates the service profile of this subscriber, and evaluates the initial filter criterias.

~~S-CSCF#1 performs whatever service control is appropriate for this redirected session.~~

27. **~~302 Redirect~~302 Moved Temporarily (S-CSCF to P-CSCF) – see example in table 10.4.7-27**

S-CSCF#1 sends a ~~302 Redirect~~302 Moved Temporarily response to P-CSCF, containing the new destination.

Table 10.4.7-27: ~~302 Redirect~~302 Moved Temporarily (S-CSCF to P-CSCF)

```
SIP/2.0 302 Redirect302 Moved Temporarily
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact:
Content-Length: 0
```

28. **ACK (P-CSCF to S-CSCF) – see example in table 10.4.7-28**

P-CSCF acknowledges receipt of the ~~302 Redirect~~302 Moved Temporarily response (27) by sending an ACK request to S-CSCF#1.

Table 10.4.7-28: ACK (P-CSCF to S-CSCF)

```
ACK sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1
From:
To:
Call-ID:
```

```
Cseq:
Content-Length:
```

29. **~~302 Redirect~~302 Moved Temporarily (P-CSCF to UE) – see example in table 10.4.7-29**

P-CSCF sends a ~~302 Redirect~~302 Moved Temporarily response to UE, containing the new destination.

Table 10.4.7-29: ~~302 Redirect~~302 Moved Temporarily (P-CSCF to UE)

```
SIP/2.0 302 Redirect302 Moved Temporarily
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Contact:
Content-Length: 0
```

30. **ACK (UE to P-CSCF) – see example in table 10.4.7-30**

UE acknowledges receipt of the ~~302 Redirect~~302 Moved Temporarily response (29) by sending an ACK request to P-CSCF.

Table 10.4.7-30: ACK (UE to P-CSCF)

```
ACK sip:token6@pcscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Cseq:
Content-Length:
```

31. **INVITE (UE to P-CSCF) – see example in table 10.4.7-31**

UE sends the INVITE request, containing an initial SDP and the new destination, to the P-CSCF determined via the CSCF discovery mechanism.

Table 10.4.7-31: INVITE (UE to P-CSCF)

```
INVITE sip:Token(token(siptel:+1-212-555-
    3333@home.net;user=phone)@scscf2.home1.net;tokenized-
    by=scscf2.home1.netuser=private)@icscf2_s.home1.net;tokenized-
    by=icscf2_s.home1.netuser=private SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
Supported: 100rel
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>;privacy=off
RPID-Privacy: privacy=off
Proxy-Require: privacy
Anonymity: Off
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
    seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 127 INVITE
Require: precondition
Supported: 100rel
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=audio 3456 RTP/AVP 97 3 96
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
a=qos:mandatory sendrecv
```

Request-URI: Contains the SIP URL from the Contact header in the received 302 Moved Temporarily message~~keyed number from the user~~.

Via: Contains the IP address or FQDN of the originating UE.

Remote-Party-ID: Contains the originator's public user identity. The Display name is optional.

~~**Proxy-Require:** The sip privacy draft specifies that the usage of the Remote-Party-Id MUST be accompanied by a Proxy-Require header specifying "privacy" in all INVITE requests.~~

From:/To:/Call-ID: Follow the recommendations of draft-ietf-sip-privacy[13]~~-01~~, even though anonymity is not being requested for this session.

Cseq: is a~~A~~ random starting number.

Contact: is a SIP URL that contains ~~T~~the IP address or FQDN of the originating UE.

32. **100 Trying (P-CSCF to UE) – see example in table 10.4.7-32**

P-CSCF responds to the INVITE request (31) with a 100 Trying provisional response.

Table 10.4.7-32: 100 Trying (P-CSCF to UE)

```
SIP/2.0 100 Trying
```

```
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

33. **INVITE (P-CSCF to S-CSCF) – see example in table 10.4.7-33**

P-CSCF remembers (from the registration procedure) the request routing for this UE. This becomes a Route header in the request. This next hop is the S-CSCF within the home network.

~~P-CSCF rewrites the Contact header, with a locally defined value that identifies the UE.~~ P-CSCF adds itself to the Record-Route header, and adds a Via header.

The INVITE request is forwarded to the S-CSCF.

Table 10.4.7-33: INVITE (P-CSCF to S-CSCF)

```
INVITE sip: Token(token(tel:+1-212-555-3333)@scscf2.home1.net;tokenized-
by=scscf2.home1.net)@icscf2_s.home1.net;tokenized-by=icscf2_s.home1.net~~scscf1.home1.net~~
SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Record-Route: sip:pcscf1.home1.net;lr
Route: sip:scscf1.home1.net;lr
~~Route: sip:Token(token(sip:+1-212-555-~~
    ~~3333@home.net;user=phone)@scscf2.home1.net;user=private)@icscf2_s.home1.net;user=priv~~
    ~~ate~~
~~Supported:~~
Remote-Party-ID:
RPID-Privacy:
~~Proxy-Require:~~
~~Anonymity:~~
From:
To:
Call-ID:
Cseq:
Require: precondition
Supported: 100rel
Contact: ~~sip:%5b5555%3a%3aaaa%3abbb%3accc%3addd%5d@pcscf1.home1.net~~
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

~~**Request-URI:** The first component in the remembered Path header from Registration.~~

Route: Contains the ~~remaining~~ elements from the Path header from ~~R~~registration~~, with the initial Request-URI (received from the UE) appended as the final component~~.

SDP The set of media flows described by the SDP may be reduced based on operator policy, or due to lack of authority of the subscriber to request such a media flow. Procedures are described in subclause 10.3.5.

34. **100 Trying (S-CSCF to P-CSCF) – see example in table 10.4.7-34**

S-CSCF responds to the INVITE request (33) with a 100 Trying provisional response.

Table 10.4.7-34: 100 Trying (S-CSCF to P-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

35. **~~Service Control~~ Evaluation of initial filter criterias**

S-CSCF validates the service profile of this subscriber, and evaluates the initial filter criterias.

~~S-CSCF validates the service profile, and performs any origination service control required for this subscriber.~~

36. **INVITE (S-CSCF to I-CSCF) – see example in table 10.4.7-36**

S-CSCF forwards the INVITE request to the I-CSCF specified in the destination URL.

Editor's Note: Need for additional headers to transport e.g. Billing-Correlation-Identifier is FFS.

Table 10.4.7-36: INVITE (S-CSCF to I-CSCF)

```
INVITE sip:Token(token(~~sip~~tel:+1-212-555-
    3333~~@home.net;user=phone~~)@scscf2.home1.net;tokenized-
    by=scscf2.home1.net~~user=private~~)@icscf2_s.home1.net;tokenized-
    by=icscf2_s.home1.net~~user=private~~ SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Record-Route: sip:~~332b23.1@~~scscf1.home1.net;lr, sip:pcscf1.home1.net;lr
~~Supported:~~
Remote-Party-ID:~~ "John Doe" <tel:+1-212-555-1111>;privacy=off;screen=yes~~
RPID-Privacy: privacy=off;screen=yes
~~Proxy-Require:~~
~~Anonymity:~~
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
```

```
a=
a=
a=
a=
a=
```

Request-URI: This is the private URL obtained from the previous ~~302 Redirect~~302 Moved Temporarily response, which identifies the I-CSCF that must first translate the destination (then the S-CSCF that must further translate the destination). ~~It was copied from the Route header of the incoming request to S-CSCF#1.~~

SDP: The set of media flows described by the SDP may be reduced based on operator policy, or due to lack of authority of the subscriber to request such a media flow. Procedures are described in subclause 10.3.1.

37. **100 Trying (I-CSCF to S-CSCF) – see example in table 10.4.7-37**

I-CSCF responds to the INVITE request (36) with a 100 Trying provisional response.

Table 10.4.7-37: 100 Trying (I-CSCF to S-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

38. **INVITE (I-CSCF to S-CSCF) – see example in table 10.4.7-38**

I-CSCF translates the private portion of the URL, and determines the destination is S-CSCF2. I-CSCF forwards the INVITE request to the S-CSCF#2 that will further translate the destination.

Table 10.4.7-38: INVITE (I-CSCF to S-CSCF)

```
INVITE sip:Token(tel:+1-212-555-3333@home.net;user=phone)@scscf2.home1.net;tokenized-
by=scscf2.home1.netuser=private SIP/2.0
Via: SIP/2.0/UDP icscf2_s.home1.net, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd])
Max-Forwards: 67
Record-Route: sip:332b23.1@scscf1.home1.net;lr, sip:pcscf1.home1.net;lr
Supported:
Remote-Party-ID:
RPID-Privacy:
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
```

```
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

39. **100 Trying (S-CSCF to I-CSCF) – see example in table 10.4.7-39**

S-CSCF#2 responds to the INVITE request (38) with a 100 Trying provisional response.

Table 10.4.7-39: 100 Trying (S-CSCF to I-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP icscf2_s.home1.net, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

40. **INVITE (S-CSCF to I-CSCF) – see example in table 10.4.7-40**

S-CSCF translates the private portion of the URL, and determines the destination address. S-CSCF forwards the INVITE request to the I-CSCF#F, the entry point to the destination operator's network.

Table 10.4.7-40: INVITE (S-CSCF to I-CSCF)

```
INVITE siptel:+1-212-555-3333@home.net;user=phone SIP/2.0
Via: SIP/2.0/UDP scscf2.home1.net, SIP/2.0/UDP icscf2_s.home1.net, SIP/2.0/UDP
    scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd])
Max-Forwards: 66
Record-Route: sip:scscf2.home1.net;lr, sip:332b23.1@scscf1.home1.net;lr,
sip:pcscf1.home1.net;lr
Supported:
Remote-Party-ID:
RPID-Privacy:
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
```

```
a=
a=
a=
a=
```

41. **100 Trying (I-CSCF to S-CSCF) – see example in table 10.4.7-41**

I-CSCF#F responds to the INVITE request (40) with a 100 Trying provisional response.

Table 10.4.7-41: 100 Trying (I-CSCF to S-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP scscf2.home1.net, SIP/2.0/UDP icscf2_s.home1.net, SIP/2.0/UDP
    scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

The remainder of this session completes as shown in clause 8.

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Budapest, Hungary, 13. – 17. May 2002

Tdoc N1-021414~~206~~

CR-Form-v5

CHANGE REQUEST

⌘ **24.228**	**CR 021**	⌘ **rev**	**2** ~~**1**~~	⌘ Current version:	**5.0.0** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [ ] Radio Access Network [ ] Core Network [X]

Title:	⌘	Session Transfer Flow Update
Source:	⌘	AT&T Wireless
Work item code:	⌘	IMS-CCR
Date:	⌘	May 1, 2002
Category:	⌘	F
Release:	⌘	REL-5

Use one of the following categories:
F *(correction)*
A *(corresponds to a correction in an earlier release)*
B *(addition of feature),*
C *(functional modification of feature)*
D *(editorial modification)*
Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:
2 (GSM Phase 2)
R96 (Release 1996)
R97 (Release 1997)
R98 (Release 1998)
R99 (Release 1999)
REL-4 (Release 4)
REL-5 (Release 5)

Reason for change: ⌘ Update based on the latest IETF RFCs and I-Ds, correction of mistakes

Summary of change: ⌘ The updated flow contains the following major changes:
- Loose routing adopted (change of Request-URI, Route header fields)
- UPDATE method + Manyfolks-05 adopted (change of the figures, SDP, Require and Supported header fields; Content-disposition header field removed)
- Max-Forwards header field added to every request
- Branch parameters deleted from Route and Record-Route header fields

- Anonymity header fields deleted (privacy-04)
- RPID-Privacy header field added (privacy-04)
- Media-Authorization header field changed to P-Media-Authorization (call-auth-04)

- 'Service Control' changed to 'Evaluation of initial filter criterias' for INVITE,

- editorial corrections

mistakes
update of the description text
update of the header descriptions
SDP update (missing parameters added)

Consequences if not approved: ⌘ 24.228 call flows are not standard compliant

Clauses affected: ⌘ 10.5

Other specs affected: ⌘ [X] Other core specifications ⌘ 24.229
[ ] Test specifications

	☐ O&M Specifications	
Other comments: ⌘		

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

10.5 Session transfer procedures

10.5.1 Introduction

This subclause gives signalling flows for the procedures for performing session transfers. subclause 10.5.2 gives the procedures for a transfer that initiates a new session (i.e. to a new destination not previously involved in the session) while the transferor and the transferee do not remain in the same network. subclause 10.5.3 gives the procedures for a transfer that replaces an existing session (i.e. to a destination that was previously involved in the session) while the transferor and the transferee remain in the same network.

10.5.2 Session Transfer initiating a new session

An IM session already exists between UE#1 and UE#2. UE#2 desires UE#1 to initiate a new session to a new destination, UE#3, and terminate the existing session. The procedures for this transfer are shown in figure 10.5.2-1.

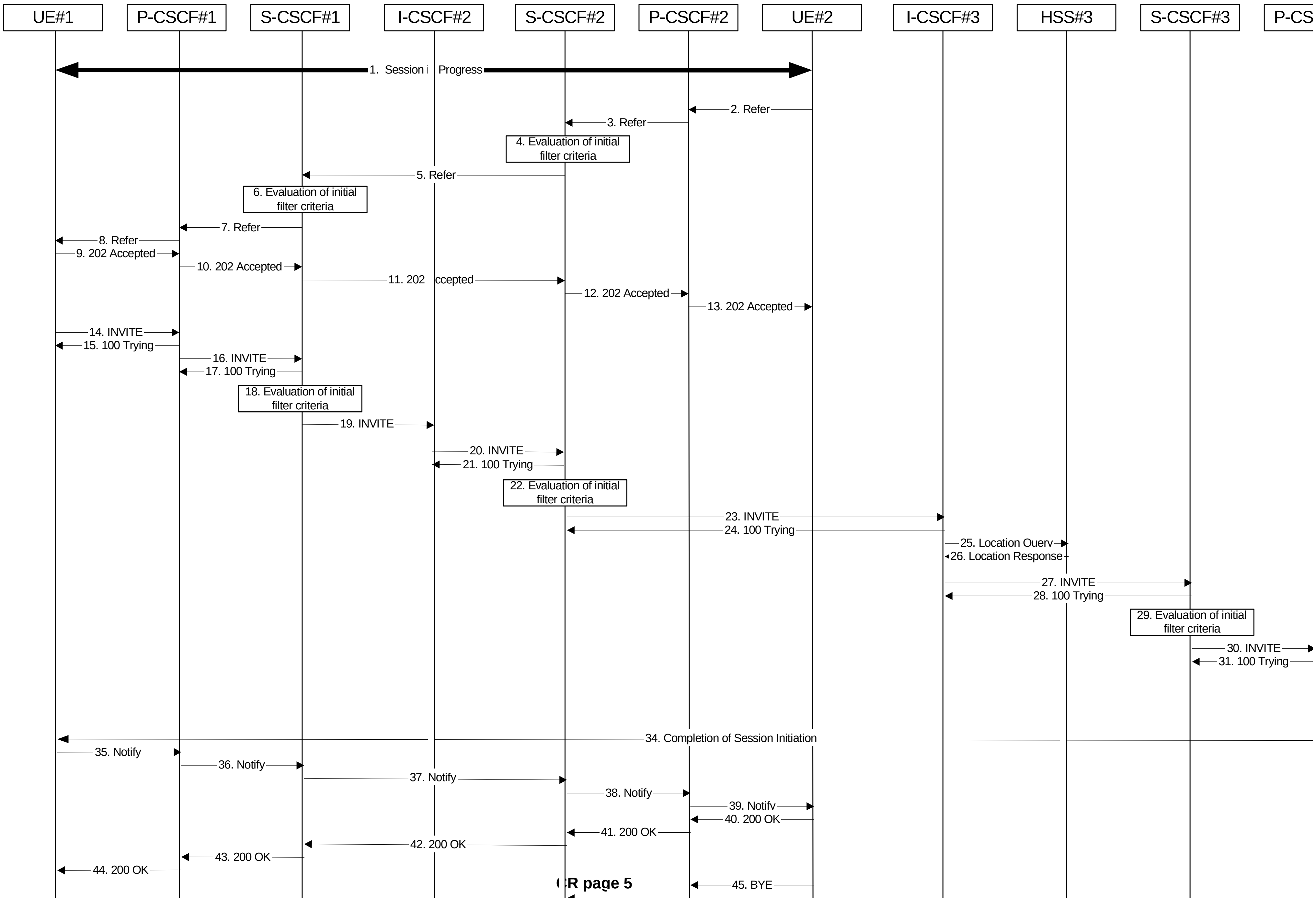

UE#1
P-CSCF#1
S-CSCF#1
I-CSCF#2
S-CSCF#2
P-CSCF#2
UE#2
I-CSCF#3
HSS#3
S-CSCF#3
P-CS
1. Session i Progress
2. Refer
3. Refer
4. Evaluation of initial filter criteria
5. Refer
6. Evaluation of initial filter criteria
7. Refer
8. Refer
9. 202 Accepted
10. 202 Accepted
11. 202 ccepted
12. 202 Accepted
13. 202 Accepted
14. INVITE
15. 100 Trying
16. INVITE
17. 100 Trying
18. Evaluation of initial filter criteria
19. INVITE
20. INVITE
21. 100 Trying
22. Evaluation of initial filter criteria
23. INVITE
24. 100 Trying
25. Location Ouerv
26. Location Response
27. INVITE
28. 100 Trying
29. Evaluation of initial filter criteria
30. INVITE
31. 100 Trying
34. Completion of Session Initiation
35. Notify
36. Notify
37. Notify
38. Notify
39. Notifv
40. 200 OK
41. 200 OK
42. 200 OK
43. 200 OK
44. 200 OK
45. BYE
CR page 5

Figure 10.5.2-1: Session Transfer initiating a new session

1. **Session in Progress**

   UE#1 initiates a multi-media session with UE#2. As a result, the state information stored at P-CSCF#2 is shown in table 10.5.2-1.

Table 10.5.2-1: State Information

```
Request-URI: ~~sip~~tel:+1-212-555-2222~~[5555::aaa:bbb:ccc:ddd]~~
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B; seq=72))@localhost>;
    tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
CSeq(2dest): 127 INVITE
CSeq(2orig): none
Route: sip:~~764z87.1~~@scscf2.home2.net;lr, sip:~~332b23.1~~@scscf1.home1.net;lr,
sip:~~431h23.1~~@pcscf1.home1.net;lr
Contac(orig): sip:[5555::aaa:bbb:ccc:ddd]
```

2. **REFER (UE to P-CSCF) – see example in table 10.5.2-2**

   UE#2 sends a Refer request to its proxy, P-CSCF#2.

Table 10.5.2-2: REFER (UE to P-CSCF)

```
REFER sip:[5555::aaa:bbb:ccc:ddd] SIP/2.0
Via: SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
Max-Forwards: 70
From: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost;tag=314159
To: "Alien Blaster" <sip:B36(SHA-1(+1-212-555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 130 REFER
Contact: sip:[5555::eee:fff:aaa:bbb]
Refer-To: tel:+1-212-555-3333~~sip:user3_public3@home3.net~~
Referred-By: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Remote-Party-ID: "John Smith" <tel:+1-212-555-2222>~~;privacy=off~~
RPID-Privacy: privacy=off
Content-Length: 0
```

Request-URI:	Contains the value of the Contact header from~~ the 200-OK response to~~ the initial INVITE.
Via:	Contains the IP address or FQDN of the originating UE.
From:/To:/Call-ID:	Contain the values previously used to establish the session, including the tag value from the response.
Cseq:	Next higher sequential value.
Contact:	is a SIP URL that contains ~~T~~the IP address or FQDN of the originating UE.

Editor's Note: Use of Remote-Party-ID in REFER is FFS.

Editor's Note: The proper value for the Referred-By header is FFS.

3. **REFER (P-CSCF to S-CSCF) – see example in table 10.5.2-3**

   P-CSCF adds a Route header, with the saved value corresponding to the session.

   P-CSCF#2 forwards the Refer request to S-CSCF#2.

Table 10.5.2-3: REFER (P-CSCF to S-CSCF)

```
REFER sip:[5555::aaa:bbb:ccc:ddd]~~scscf2.home2.net~~ SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1, SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
Max-Forwards: 69
Route: sip:scscf2.home2.net;lr, sip:~~332b23.1~~@scscf1.home1.net;lr, sip:~~431h23.1~~@pcscf1.home1.net;lr~~,~~
~~sip:[5555::aaa:bbb:ccc:ddd]~~
From:
To:
Call-ID:
```

```
Cseq:
Contact:
Refer-To:
Referred-By:
Remote-Party-ID:
RPID-Privacy:
Content-Length:
```

~~**Request-URI:** The first component of the saved Route header.~~

Route: Saved from the 200-OK response to the initial INVITE ~~(with first element moved to Request-URI).~~

Contact: Contains a SIP URL with the IP address or FQDN of the UE.~~A locally defined value that identifies the UE.~~

4. **Evaluation of initial filter criterias~~Service Control~~**

S-CSCF validates the service profile of this subscriber, and evaluates the initial filter criterias.

5. **REFER (S-CSCF to S-CSCF) – see example in table 10.5.2-5**

In order to maintain the expectation of privacy of the identity of the new destination, S-CSCF#2 converts the "Refer-To" header into a private URL. S-CSCF#2 forwards the Refer request to S-CSCF#1.

Table 10.5.2-5: REFER (S-CSCF to S-CSCF)

```
REFER sip:[5555::aaa:bbb:ccc:ddd]scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1,
    SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
Max-Forwards: 68
Route: sip:scscf1.home1.net;lr, sip:431h23.1@pcscf1.home1.net;lr, sip:[5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Cseq:
Contact:
Refer-To: sip:token(tel:+1-212-555-3333user3_public3@home3.net)@scscf2.home2.net;privatetokenized-
by=scscf2.home2.net
Referred-By:
Remote-Party-ID: "John Smith" <tel:+1-212-555-2222>;privacy=off;screen=yes
RPID-Privacy: privacy=off;screen=yes
Content-Length:
```

6. **~~Service Control~~ Evaluation of initial filter criterias**

S-CSCF validates the service profile of this subscriber, and evaluates the initial filter criterias.

7. **REFER (S-CSCF to P-CSCF) – see example in table 10.5.2-7**

S-CSCF#1 forwards the Refer request to P-CSCF#1.

Table 10.5.2-7: REFER (S-CSCF to P-CSCF)

```
REFER sip:[5555::aaa:bbb:ccc:ddd]pcscf1.home1.net SIP/2.0
Via: SIP/2.0/UDEP scscf1.home1.net, SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP
    pcscf2.home2.net;branch=876t12.1, SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
Max-Forwards: 67
Route: sip:pcscf1.home1.net;lrsip:[5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Cseq:
Contact:
Refer-To:
Referred-By:
Remote-Party-ID:
RPID-Privacy:
Content-Length:
```

8. **REFER (P-CSCF to UE) – see example in table 10.5.2-8**

P-CSCF#1 forwards the Refer request to UE#1.

Table 10.5.2-8: REFER (P-CSCF to UE)

```
REFER sip:[5555::aaa:bbb:ccc:ddd] SIP/2.0
Via: SIP/2.0/UDP pcscf12.home12.net;branch=876t12.1;branch=token1
Max-Forwards: 66
From:
To:
Call-ID:
Cseq:
Contact:
Refer-To:
Referred-By:
Remote-Party-ID:
RPID-Privacy:
Content-Length:
```

Via: P-CSCF removes the Via headers, and generates a locally unique token to identify the saved values. It inserts this as a branch value on its Via header.

9. **202-Accepted (UE to P-CSCF) – see example in table 10.5.2-9**

UE#2 acknowledges receipt of the Refer request (8) with a 202-Accepted final response, sent to P-CSCF#1.

Table 10.5.2-8: 202 Accepted (UE to P-CSCF)

```
SIP/2.0 202 Accepted
Via: SIP/2.0/UDP pcscf12.home12.net;branch=876t12.1;branch=token1
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

10. **202-Accepted (P-CSCF to S-CSCF) – see example in table 10.5.2-10**

P-CSCF#1 forwards the 202 Accepted final response to S-CSCF#1.

Table 10.5.2-10: 202 Accepted (P-CSCF to S-CSCF)

```
SIP/2.0 202 Accepted
Via: SIP/2.0/UDEP scscf1.home1.net, SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP
    pcscf2.home2.net;branch=876t12.1, SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

P-CSCF restores the Via headers from the branch value in its Via.

11. **202-Accepted (S-CSCF to S-CSCF) – see example in table 10.5.2-11**

S-CSCF#1 forwards the 202 Accepted final response to S-CSCF#2.

Table 10.5.2-11: 202 Accepted (S-CSCF to S-CSCF)

```
SIP/2.0 202 Accepted
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1,
    SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

12. **202-Accepted (S-CSCF to P-CSCF) – see example in table 10.5.2-12**

S-CSCF#2 forwards the 202 Accepted final response to P-CSCF#2.

Table 10.5.2-12: 202 Accepted (S-CSCF to P-CSCF)

```
SIP/2.0 202 Accepted
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1, SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

13. **202-Accepted (P-CSCF to UE) – see example in table 10.5.2-13**

P-CSCF#2 forwards the 202 Accepted final response to UE#2.

Table 10.5.2-13: 202 Accepted (P-CSCF to UE)

```
SIP/2.0 202 Accepted
Via: SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

14. **INVITE (UE to P-CSCF) – see example in table 10.5.2-14**

UE#1 initiates an INVITE request based on the Refer-To header URL in the REFER request. The INVITE is sent from the UE to P-CSCF#1.

Table 10.5.2-14: INVITE (UE to P-CSCF)

```
INVITE sip:token(tel:+1-212-555-3333user3_public3@home3.net)@scscf2.home2.net;tokenized-
by=scscf2.home2.netprivate SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Frwards: 70
Supported: 100rel
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>;privacy=off
RPID-Privacy: privacy=off;party=calling
Proxy-Require: privacy
Anonymity: Off
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B; seq=74))@localhost>;
    tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=75))@localhost
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 127 INVITE
Require: precondition
Supported: 100rel
Contact: sip:[5555::aaa:bbb:ccc:ddd]
Referred-By: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=audio 3456 RTP/AVP 97 3 96
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
```

```
a=rtpmap:96 G726-32/8000
a=qos:mandatory sendrecv
```

15. **100 Trying (P-CSCF to UE) – see example in table 10.5.2-15**

P-CSCF#1 responds to the INVITE request (14) with a 100 Trying provisional response.

Table 10.5.2-15: 100 Trying (P-CSCF to UE)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

16. **INVITE (P-CSCF to S-CSCF) – see example in table 10.5.2-16**

P-CSCF#1 remembers (from the registration procedure) the request routing for this UE. This becomes a Route header ~~the Request-URI~~ in the request. ~~The Request-URI of the original INVITE request (14) is copied to the Route header.~~

P-CSCF adds itself to the Record-Route header and Via header.

Table 10.5.2-16: INVITE (P-CSCF to S-CSCF)

```
INVITE sip:token(tel:+1-212-555-3333)@scscf2.home2.net;tokenized-by=scscf2.home2.net
sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:token(user3_public3@home3.net)@scscf2.home.net;private
Record-Route: sip:pcscf1.home1.net;lr
Route: sip:scscf1.home1.net;lr
Supported:
Remote-Party-ID:
RPID-Privacy:
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Referred-By:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

17. **100 Trying (S-CSCF to P-CSCF) – see example in table 10.5.2-17**

S-CSCF#1 responds to the INVITE request (16) with a 100 Trying provisional response.

Table 10.5.2-17: 100 Trying (S-CSCF to P-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

18. **~~Service Control~~ Evaluation of initial filter criterias**

S-CSCF validates the service profile of this subscriber, and evaluates the initial filter criterias.

~~S-CSCF#1 performs whatever service control logic is appropriate for this call attempt.~~

19. **INVITE (S-CSCF to I-CSCF) – see example in table 10.5.2-19**

S-CSCF#1 performs an analysis of the destination address, which is a private URL generated by S-CSCF#2. S-CSCF#1 determines the network operator to whom the destination subscriber belongs. Since (for this example) the forwarding network operator does not desire to keep their internal configuration hidden, S-CSCF#1 forwards the INVITE request directly to I-CSCF#2.

Table 10.5.2-19: INVITE (S-CSCF to I-CSCF)

```
INVITE sip:token(tel:+1-212-555-3333user3_public3@home3.net)@scscf2.home2.net;tokenized-by=scscf2.home2.netprivate SIP/2.0
Via: SIP/2.0/UDP sip:scscf1.home1.net SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP
    [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Record-Route: sip:332b23.1@scscf1.home1.net;lr, sip:431h23.1@pcscf1.home1.net;lr
Supported:
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>;privacy=off;screen=yes
RPID-Privacy: privacy=off;screen=yes
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Referred-By:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

20. **INVITE (I-CSCF to S-CSCF) – see example in table 10.5.2-20**

I-CSCF#2 performs an analysis of the destination address, which is a private URL generated by S-CSCF#2. I-CSCF#2 forwards the INVITE request directly to S-CSCF#2.

Table 10.5.2-20: INVITE (I-CSCF to S-CSCF)

```
INVITE sip:token(tel:+1-212-555-3333user3_public3@home3.net)@scscf2.home2.net;tokenized-by=scscf2.home2.netprivate SIP/2.0
Via: SIP/2.0/UDP sip:icscf2_s.home2.net, SIP/2.0/UDP sip:scscf1.home1.net SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
```

```
Max-Forwards: 67
Record-Route: sip:332b23.1@scscf1.home1.net;lr, sip:431h23.1@pcscf1.home1.net;lr
Supported:
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>;privacy=off;screen=yes
RPID-Privacy:
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Referred-By:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

NOTE 1: The I-CSCF does not add itself to the Record-Route header, as it has no need to remain in the signalling path once the session is established.

21. **100 Trying (S-CSCF to I-CSCF) – see example in table 10.5.2-21**

I-CSCF#2 responds to the INVITE request (19) by sending a 100 Trying provisional response to S-CSCF#1.

Table 10.5.2-21: 100 Trying (S-CSCF to I-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

22. **~~Service Control~~ Evaluation of initial filter criterias**

S-CSCF validates the service profile of this subscriber, and evaluates the initial filter criterias.

~~S-CSCF#2 performs whatever service control logic is appropriate for this session transfer attempt.~~

23. **INVITE (S-CSCF to I-CSCF) – see example in table 10.5.2-23**

S-CSCF#2 determines the destination address from the private URL contained in the INVITE request. Based on information in that URL, and information saved from step #4 above (implementation decision), S-CSCF#2 verifies the validity of the transfer request, and that it is within a short time delay from the REFER request.

S-CSCF#2 performs an analysis of the destination address, and determines the network operator to whom the destination subscriber belongs. Since (for this example) the forwarding network operator does not desire to keep their internal configuration hidden, S-CSCF#2 forwards the INVITE request directly to I-CSCF#3.

Table 10.5.2-23: INVITE (S-CSCF to I-CSCF)

```
INVITE tel:+1-212-555-3333~~sip:user3_public3@home3.net~~ SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 66
Record-Route: sip:~~764z87.1@~~scscf2.home2.net;lr, sip:~~332b23.1@~~scscf1.home1.net;lr,
sip:pcscf1.home1.net;lr
~~Supported:~~
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>~~;privacy=off;screen=yes~~
RPID-Privacy: privacy=off;screen=yes
Remote-Party-ID: "John Smith" <tel:+1-212-555-2222>~~;privacy=off;screen=yes;party=transferor~~
RPID-Privacy: privacy=off;screen=yes;party=transferor
~~Proxy-Require:~~
~~Anonymity:~~
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Referred-By:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

Editor's Note: Use of "party=transferor" in a separate Remote-Party-ID header is FFS.

24. **100 Trying (I-CSCF to S-CSCF) – see example in table 10.5.2-24**

I-CSCF#3 responds to the INVITE request (24) by sending a 100 Trying provisional response to S-CSCF#2.

Table 10.5.2-24: 100 Trying (I-CSCF to S-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

25. **Location Query**

I-CSCF (at the border of the terminating subscriber's network) queries the HSS for current location information. It will send "Cx-location-query" to the HSS to obtain the location information for the destination.

26. **Location Response**

HSS responds with the address of the current S-CSCF for the terminating subscriber.

27. **INVITE (I-CSCF to S-CSCF) – see example in table 10.5.2-27**

I-CSCF#3 forwards the INVITE request to the S-CSCF (S-CSCF#3) that will handle the session termination.

Table 10.5.2-27: INVITE (I-CSCF to S-CSCF)

```
INVITE tel:+1-212-555-3333~~sip:scscf3.home3.net~~ SIP/2.0
Via: SIP/2.0/UDP icscf3_s.home3.net, SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP
    icscf2_s.home2.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 65
Route: sip:scscf3.home3.net;lr~~+1-212-555-2222@home3.net;user=phone~~
Record-Route: sip:~~764z87.1@~~scscf2.home2.net;lr, sip:~~332b23.1@~~scscf1.home1.net;lr,
    sip:~~431h23.1@~~pcscf1.home1.net;lr
~~Supported:~~
Remote-Party-ID:
RPID-Privacy:
Remote-Party-ID:
RPID-Privacy:
~~Proxy-Require:~~
~~Anonymity:~~
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Referred-By:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

NOTE 2: The I-CSCF does not add itself to the Record-Route header, as it has no need to remain in the signalling path once the session is established.

28. **100 Trying (S-CSCF to I-CSCF) – see example in table 10.5.2-28**

S-CSCF#3 responds to the INVITE request (28) with a 100 Trying provisional response.

Table 10.5.2-28: 100 Trying (S-CSCF to I-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP icscf3_s.home3.net, SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP
    icscf2_s.home2.net;branch=871y12.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

29. **~~Service Control~~ Evaluation of initial filter criterias**

S-CSCF validates the service profile of this subscriber, and evaluates the initial filter criterias.

~~S-CSCF#3 performs whatever service control logic is appropriate for this session attempt.~~

30. **INVITE (S-CSCF to P-CSCF) – see example in table 10.5.2-30**

S-CSCF#3 remembers (from the registration procedure) the next hop CSCF for this UE. It forwards the INVITE request to P-CSCF#3.

Table 10.5.2-30: INVITE (S-CSCF to P-CSCF)

```
INVITE sip:[5555::aaa:bbb:ccc:fff]user3_public3@home3.net;user=phone SIP/2.0
Via: SIP/2.0/UDP scscf3.home3.net, SIP/2.0/UDP icscf3_s.home3.net, SIP/2.0/UDP
    scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP icscf2_s.home2.net;branch=871y12.1, SIP/2.0/UDP
    scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP
    [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 64
Route: sip:pcscf3.home3.net;lr
Record-Route: sip:scscf3.home3.net;lr, sip:764z87.1@scscf2.home2.net;lr,
    sip:332b23.1@scscf1.home1.net;lr, sip:431h23.1@pcscf1.home1.net;lr
Supported:
Remote-Party-ID:
RPID-Privacy:
Remote-Party-ID:
RPID-Privacy:
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Referred-By:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

31. **100 Trying (P-CSCF to S-CSCF) – see example in table 10.5.2-31**

P-CSCF#3 responds to the INVITE request (29) by sending a 100 Trying provisional response to S-CSCF#3.

Table 10.5.2-31: 100 Trying (P-CSCF to S-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP scscf3.home3.net, SIP/2.0/UDP icscf3_s.home3.net, SIP/2.0/UDP
    scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    icscf2_s.home2.net;branch=871y12.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP
    [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

32. **INVITE (P-CSCF to UE) – see example in table 10.5.2-32**

P-CSCF forwards the INVITE request to the UE.

Table 10.5.2-32: INVITE (P-CSCF to UE)

```
INVITE sip:[5555::aaa:bbb:ccc:fff]user3_public3@home3.net;user=phone SIP/2.0
Via: SIP/2.0/UDP pcscf3.home3.net;branch=token1
Max-Forwards: 63
Supported:
Remote-Party-ID:
```

```
RPID-Privacy:
Remote-Party-ID:
RPID-Privacy:
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Referred-By:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

33. **100 Trying (UE to P-CSCF) – see example in table 10.5.2-33**

    UE#3 may optionally send a 100 Trying provisional response to P-CSCF.

Table 10.5.2-33: 100 Trying (UE to P-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP pcscf3.home3.net;branch=token1
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

34. **Completion of Session Initiation**

    UE#1 and UE#3 complete the session initiation, as shown in the MO, S-S, and MT procedures.

35. **NOTIFY (UE to P-CSCF) – see example in table 10.5.2-35**

    When the session with UE#3 has been successfully established, UE#1 sends a Notify request to its proxy, P-CSCF#1.

Table 10.5.2-35: Notify (UE to P-CSCF)

```
NOTIFY sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
    seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 130 NOTIFY
Event: refer
Content-Type: application/sip message/sipfrag
Content-Length: (…)

SIP/2.0 200 OK
```

Request-URI: Contains the value of the Contact header from the 200-OK response to the initial INVITE.

Via: Contains the IP address or FQDN of the originating UE.

From:/To:/Call-ID: Contain the values previously used to establish the session, including the tag value from the response.

Cseq: Next higher sequential value.

36. **Notify (P-CSCF to S-CSCF) – see example in table 10.5.2-36**

P-CSCF adds a Route header, with the saved value corresponding to the session.

P-CSCF#1 forwards the Notify request to S-CSCF#1.

Table 10.5.2-36: Notify (P-CSCF to S-CSCF)

```
NOTIFY sip:[5555::eee:fff:aaa:bbb]scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:scscf1.home1.net;lr, sip:764z87.1@scscf2.home2.net;lr, sip:876t12.1@pcscf2.home2.net;lr,
sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Event:
Content-Type:
Content-Length:

SIP/2.0 200 OK
```

~~**Request-URI:** The first component of the saved Route header.~~

Route: Saved from the 200-OK response to the initial INVITE ~~(with first element moved to Request-URI).~~

37. **Notify (S-CSCF to S-CSCF) – see example in table 10.5.2-37**

S-CSCF#1 forwards the Notify request to S-CSCF#2.

Table 10.5.2-37: Notify (S-CSCF to S-CSCF)

```
NOTIFY sip:[5555::eee:fff:aaa:bbb]scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scscf2.home2.net;lr, sip:876t12.1@pcscf2.home2.net;lr, sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Event:
Content-Type:
Content-Length:

SIP/2.0 200 OK
```

38. **Notify (S-CSCF to P-CSCF) – see example in table 10.5.2-38**

S-CSCF#2 forwards the Notify request to P-CSCF#2.

Table 10.5.2-38: Notify (S-CSCF to P-CSCF)

```
NOTIFY sip:[5555::eee:fff:aaa:bbb]pcscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:pcscf2.home2.net;lr[5555::eee:fff:aaa:bbb]
```

```
From:
To:
Call-ID:
Cseq:
Event:
Content-Type:
Content-Length:

SIP/2.0 200 OK
```

39. **Notify (P-CSCF to UE) – see example in table 10.5.2-39**

P-CSCF#2 forwards the Notify request to UE#2.

Table 10.5.2-39: Notify (P-CSCF to UE)

```
NOTIFY sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1;branch=token1
Max-Forwards: 66
From:
To:
Call-ID:
Cseq:
Event:
Content-Type:
Content-Length:

SIP/2.0 200 OK
```

Via: P-CSCF removes the Via headers, and generates a locally unique token to identify the saved values. It inserts this as a branch value on its Via header.

40. **200-OK (UE to P-CSCF) – see example in table 10.5.2-40**

UE#2 acknowledges receipt of the Notify request (39) with a 200-OK final response, sent to P-CSCF#2.

Table 10.5.2-40: 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1;branch=token1
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

41. **200-OK (P-CSCF to S-CSCF) – see example in table 10.5.2-41**

P-CSCF#2 forwards the 200 OK final response to S-CSCF#2.

Table 10.5.2-41: 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf1.home1.net;branch=332b23.1,
    SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

P-CSCF restores the Via headers from the branch value in its Via.

42. **200-OK (S-CSCF to S-CSCF) – see example in table 10.5.2-42**

S-CSCF#2 forwards the 200 OK final response to S-CSCF#1.

Table 10.5.2-42: 200 OK (S-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

43. **200-OK (S-CSCF to P-CSCF) – see example in table 10.5.2-43**

S-CSCF#1 forwards the 200 OK final response to P-CSCF#1.

Table 10.5.2-43: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

44. **200-OK (P-CSCF to UE) – see example in table 10.5.2-44**

P-CSCF#1 forwards the 200 OK final response to UE#1.

Table 10.5.2-44: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

45. **SIP BYE (UE to P-CSCF) – see example in table 10.5.2-45**

Upon receiving the notification of successful refer operation (39), UE#2 terminates the session with UE#1.

Table 10.5.2-45: SIP BYE (UE to P-CSCF)

```
BYE sip: [5555::aaa:bbb:ccc:ddd] SIP/2.0
Via: SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
Max-Forwards: 70
From: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost;tag=314159
To: "Alien Blaster" <sip:B36(SHA-1(+1-212-555-1111; time=36123E5B; seq=72))@localhost>;tag=171828
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 131 BYE
Content-Length: 0
```

~~**Request-URI:** Contains the value of the Contact header from the initial INVITE.~~

Via: Contains the IP address or FQDN of the originating UE.

From:/To:/Call-ID: Contain the values previously used to establish the session, including the tag value from the response. Since this request is being initiated by the destination, the From and To are reversed.

Cseq: Next higher sequential value.

46. **SIP BYE (P-CSCF to S-CSCF) – see example in table 10.5.2-46**

P-CSCF adds a Route header, with the saved value corresponding to the session.

P-CSCF#2 forwards the BYE request to S-CSCF#2.

Table 10.5.2-46: SIP BYE (P-CSCF to S-CSCF)

BYE sip:[5555::aaa:bbb:ccc:ddd]~~scscf2.home2.net~~ SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1, SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
Max-Forwards: 69
Route: sip:scscf2.home2.net;lr, sip:~~332b23.1~~@scscf1.home1.net;lr, sip:~~431h23.1~~@pcscf1.home1.net;lr~~, sip: [5555::aaa:bbb:ccc:ddd]~~
From:
To:
Call-ID:
Cseq:
Content-Length:

~~**Request-URI:** The first component of the saved Route header.~~

Route: Saved from the 200-OK response to the initial INVITE ~~(with first element moved to Request-URI).~~

47. **SIP BYE (S-CSCF to S-CSCF) – see example in table 10.5.2-47**

S-CSCF#2 forwards the SIP BYE request to S-CSCF#1.

Table 10.5.2-47: SIP BYE (S-CSCF to S-CSCF)

BYE sip:[5555::aaa:bbb:ccc:ddd]~~scscf1.home1.net~~ SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1,
    SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
Max-Forwards: 68
Route: sip:scscf1.home1.net;lr, sip:pcscf1.home1.net;lr~~, sip: [5555::aaa:bbb:ccc:ddd]~~
From:
To:
Call-ID:
Cseq:
Content-Length:

48. **SIP BYE (S-CSCF to P-CSCF) – see example in table 10.5.2-48**

S-CSCF#1 forwards the SIP BYE request to P-CSCF#1.

Table 10.5.2-48: SIP BYE (S-CSCF to P-CSCF)

BYE sip:[5555::aaa:bbb:ccc:ddd]~~pcscf1.home1.net~~ SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP scscf2.home2.net;branch=764z87.1,
    SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1, SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
Max-Forwards: 67
Route: sip:pcscf1.home1.net;lr~~ [5555::aaa:bbb:ccc:ddd]~~
From:
To:
Call-ID:
Cseq:
Content-Length:

49. **SIP BYE (P-CSCF to UE) – see example in table 10.5.2-49**

P-CSCF#2 forwards the SIP BYE request to UE#2.

Table 10.5.2-49: SIP BYE (P-CSCF to UE)

BYE sip:[5555::aaa:bbb:ccc:ddd] SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1;branch=token1
Max-Forwards: 66
From:
To:
Call-ID:

```
Cseq:
Content-Length:
```

Via: P-CSCF removes the Via headers, and generates a locally unique token to identify the saved values. It inserts this as a branch value on its Via header.

50. **200-OK (UE to P-CSCF) – see example in table 10.5.2-50**

UE#2 acknowledges receipt of the SIP BYE request (49) with a 200-OK final response, sent to P-CSCF#1.

Table 10.5.2-50: 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1;branch=token1
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

51. **200-OK (P-CSCF to S-CSCF) – see example in table 10.5.2-51**

P-CSCF#1 forwards the 200 OK final response to S-CSCF#1.

Table 10.5.2-51: 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP scscf2.home2.net;branch=764z87.1,
    SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1, SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

P-CSCF restores the Via headers from the branch value in its Via.

52. **200-OK (S-CSCF to S-CSCF) – see example in table 10.5.2-52**

S-CSCF#1 forwards the 200 OK final response to S-CSCF#2.

Table 10.5.2-52: 200 OK (S-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1,
    SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

53. **200-OK (S-CSCF to P-CSCF) – see example in table 10.5.2-53**

S-CSCF#2 forwards the 200 OK final response to P-CSCF#2.

Table 10.5.2-53: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1, SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

54. **200-OK (P-CSCF to UE) – see example in table 10.5.2-54**

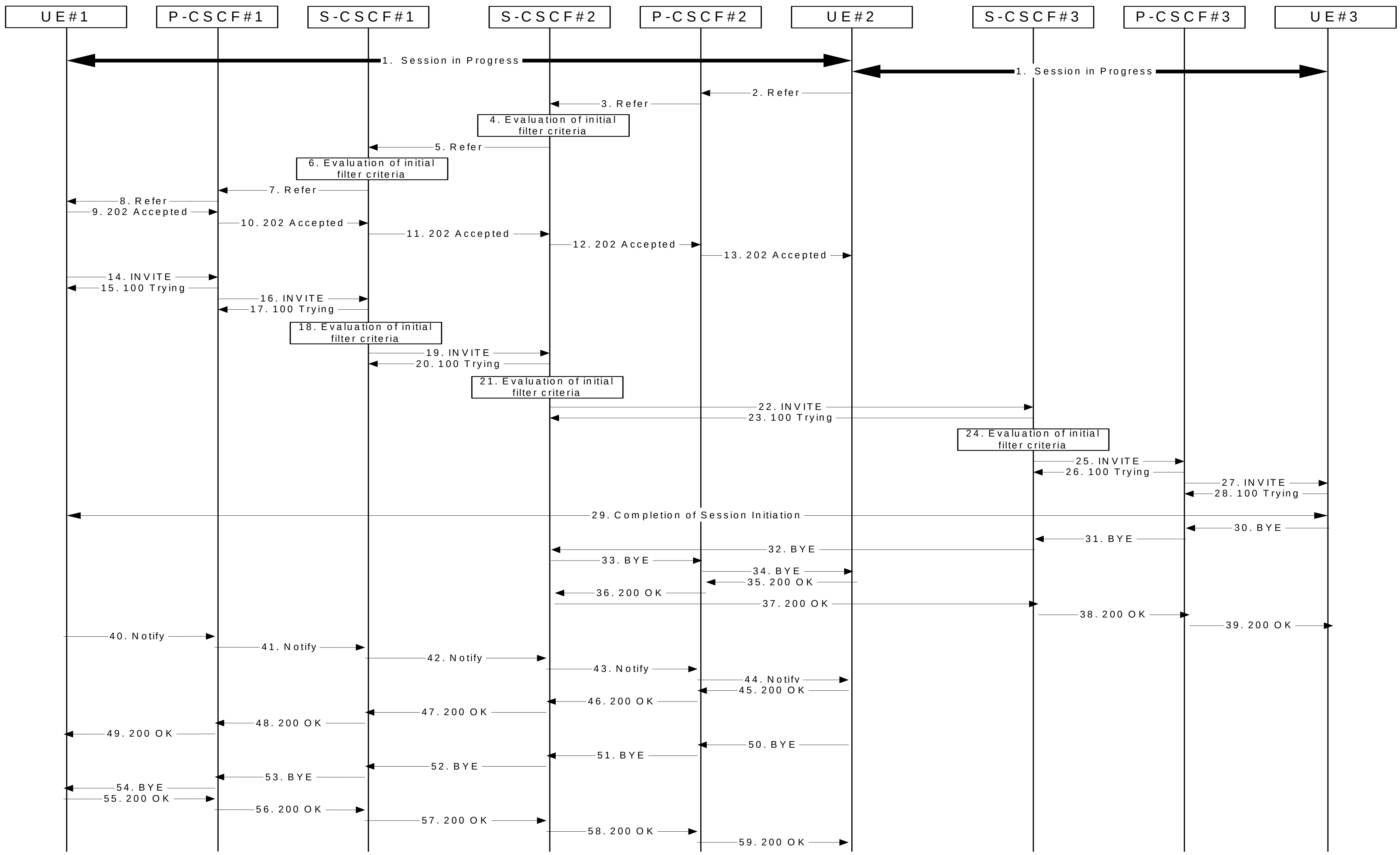
P-CSCF#2 forwards the 200 OK final response to UE#2.

Table 10.5.2-54: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

10.5.3 Session Transfer replacing an existing session

An IM session already exists between UE#1 and UE#2, and an IM session already exists between UE#2 and UE#3. UE#2 desires UE#1 to initiate a new session to destination UE#3, and terminate the existing sessions. The procedures for this transfer are shown in figure 10.5.3-1.



-

Figure 10.5.3-1: Session Transfer replacing an existing session

1. **Sessions in Progress**

   UE#1 initiates a multimedia session with UE#2. As a result, the state information stored at P-CSCF#2 is shown in table 10.5.3-1a.

Table 10.5.3-1a: State Information

```
Request-URI: siptel:+1-212-555-2222[5555::aaa:bbb:ccc:ddd]
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
    seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
CSeq(2dest): 127 INVITE
CSeq(2orig): none
Route: sip:764z87.1@scscf2.home2.net;lr, sip:332b23.1@scscf1.home1.net;lr,
sip:431h23.1@pcscf1.home1.net;lr
Contact(orig): sip:[5555::aaa:bbb:ccc:ddd]
```

   UE#2 initiates a multimedia session with UE#3. As a result, the state information stored at P-CSCF#2 is shown in table 10.5.3-1b.

Table 10.5.3-1b: State Information

```
Request-URI: siptel:+1-212-555-3333[5555::aaa:bbb:ccc:fff]
From: sip:B36(SHA-1(+1-212-555-2222; time=36123F05; seq=31))@localhost;tag=171828
To: sip:B36(SHA-1(+1-212-555-3333; time=36123F05; seq=32))@localhost;tag=314159
Call-ID: cb03a0s09a2sdfglkj490444B36(SHA-1(555-1111;time=36123E5B;seq=31))@localhost
Cseq(2dest): 127 INVITE
CSeq(2orig): none
Route: sip:764z87.1@scscf2.home2.net;lr, sip:scscf3.home3.net;lr, sip:pcscf3.home.net;lr
Contact: sip:[5555::eee:fff:aaa:bbb]
```

   UE#2 has placed both of these sessions on hold.

2. **REFER (UE to P-CSCF) – see example in table 10.5.3-2**

   UE#2 sends a Refer request to its proxy, P-CSCF#2.

Table 10.5.3-2: REFER (UE to P-CSCF)

```
REFER sip:sip:[5555::aaa:bbb:ccc:ddd] SIP/2.0
Via: SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
Max-Forwards: 70
From: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost;tag=314159
To: "Alien Blaster" <sip:B36(SHA-1(+1-212-555-1111; time=36123E5B;
seq=72))@localhost>;tag=171828
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 130 REFER
Contact: sip:[5555::eee:fff:aaa:bbb]
Refer-To: tel:+1-212-555-3333sip:user3_public3@home3.net
Replaces: B36(SHA-1(555-1111;time=36123E5B;seq=31))@localhost
cb03a0s09a2sdfglkj490333;to-tag=314149;from-tag=171828
Referred-By: sip:B36(SHA-1(+1-212-555-2222; time=36123F05; seq=31))@localhost;tag=171828
Remote-Party-ID: "John Smith" <tel:+1-212-555-2222>;privacy=off
RPID-Privacy: privacy=off
Content-Length: 0
```

Via: Contains the IP address or FQDN of the originating UE.

From:/To:/Call-ID: Contain the values previously used to establish the session, including the tag value from the response.

Cseq: Next higher sequential value.

Contact: is a SIP URL that contains ~~T~~the IP address or FQDN of the originating UE.

Editor's Note: Use of Remote-Party-ID in REFER is FFS.

Editor's Note: The proper value for the Referred-By header is FFS. The value of the From header of the session to be replaced seems most appropriate.

3. **REFER (P-CSCF to S-CSCF) – see example in table 10.5.3-3**

   P-CSCF adds a Route header, with the saved value corresponding to the session. P-CSCF#2 forwards the Refer request to S-CSCF#2.

Table 10.5.3-3: REFER (P-CSCF to S-CSCF)

```
REFER sip:[5555::aaa:bbb:ccc:ddd]scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1, SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
Max-Forwards: 69
Route: sip:scscf2.home2.net;lr, sip:332b23.1@scscf1.home1.net;lr,
sip:431h23.1@pcscf1.home1.net;lr, sip:[5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Cseq:
Contact:
Refer-To:
Referred-By:
Remote-Party-ID:
RPID-Privacy:
Content-Length:
```

~~**Request-URI:** The first component of the saved Route header.~~

Route: Saved from the 200-OK response to the initial INVITE ~~(with first element moved to Request-URI)~~.

4. ~~**Service Control**~~ **Evaluation of initial filter criterias**

   S-CSCF validates the service profile of this subscriber, and evaluates the initial filter criterias.

5. **REFER (S-CSCF to S-CSCF) – see example in table 10.5.3-5**

   In order to maintain the expectation of privacy of the identity of the new destination, S-CSCF#2 converts the "Refer-To" header into a private URL. S-CSCF#2 forwards the Refer request to S-CSCF#1.

NOTE: If the network operator desired configuration independence, the REFER would be routed through an I-CSCF before leaving the operator's network. For example, see configuration S-S#1b. That I-CSCF would convert the private URL into one that specified the I-CSCF as the hostname.

Table 10.5.3-5: REFER (S-CSCF to S-CSCF)

```
REFER sip:[5555::aaa:bbb:ccc:ddd]scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP
    pcscf2.home2.net;branch=876t12.1, SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
Max-Forwards: 68
Route: sip:scscf1.home1.net;lr, sip:pcscf1.home1.net;lr, sip:[5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Cseq:
```

Contact:
Refer-To: sip:token(tel:+1-212-555-3333~~user3_public3@home3.net~~)@scscf2.home2.net;tokenized-by=scscf2.home2.net~~private~~
Replaces: B36(SHA-1(555-1111;time=36123E5B;seq=31))@localhost;to-tag=314149;from-tag=171828
Referred-By:
Remote-Party-ID: ~~"John Smith" <tel:+1-212-555-2222>;privacy=off;screen=yes~~
RPID-Privacy: privacy=off;screen=yes
Content-Length:

6. **~~Service Control~~ Evaluation of initial filter criterias**

S-CSCF validates the service profile of this subscriber, and evaluates the initial filter criterias.

7. **REFER (S-CSCF to P-CSCF) – see example in table 10.5.3-7**

S-CSCF#1 forwards the Refer request to P-CSCF#1.

Table 10.5.3-7: REFER (S-CSCF to P-CSCF)

INVITE sip:[5555::aaa:bbb:ccc:ddd]~~pcscf1.home1.net~~ SIP/2.0
Via: SIP/2.0/UD~~E~~P scscf1.home1.net, SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1, SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
Max-Forwards: 67
Route: sip:pcscf1.home1.net;lr~~[5555::aaa:bbb:ccc:ddd]~~
From:
To:
Call-ID:
Cseq:
Contact:
Refer-To:
Referred-By:
Remote-Party-ID:
RPID-Privacy:
Content-Length:

8. **REFER (P-CSCF to UE) – see example in table 10.5.3-8**

P-CSCF#1 forwards the Refer request to UE#1.

Table 10.5.3-8: REFER (P-CSCF to UE)

REFER sip:[5555::aaa:bbb:ccc:ddd] SIP/2.0
Via: SIP/2.0/UDP pcscf1~~2~~.home1~~2~~.net;branch=876t12.1;branch=token1
Max-Forwards: 66
From:
To:
Call-ID:
Cseq:
Contact:
Refer-To:
Referred-By:
Remote-Party-ID:
RPID-Privacy:
Content-Length:

Via: P-CSCF removes the Via headers, and generates a locally unique token to identify the saved values. It inserts this as a branch value on its Via header.

9. **202-Accepted (UE to P-CSCF) – see example in table 10.5.3-9**

UE#2 acknowledges receipt of the Refer request (8) with a 202-Accepted final response, sent to P-CSCF#1.

Table 10.5.3-8: 202 Accepted (UE to P-CSCF)

```
SIP/2.0 202 Accepted
Via: SIP/2.0/UDP pcscf12.home12.net;branch=876t12.1;branch=token1
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

10. **202-Accepted (P-CSCF to S-CSCF) – see example in table 10.5.3-10**

P-CSCF#1 forwards the 202 Accepted final response to S-CSCF#1.

Table 10.5.3-10: 202 Accepted (P-CSCF to S-CSCF)

```
SIP/2.0 202 Accepted
Via: SIP/2.0/UDEP scscf1.home1.net, SIP/2.0/UDP scscf2.home2.net;branch=764z87.1,
    SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1, SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

P-CSCF restores the Via headers headers from the branch value in its Via.

11. **202-Accepted (S-CSCF to S-CSCF) – see example in table 10.5.3-11**

S-CSCF#1 forwards the 202 Accepted final response to S-CSCF#2.

Table 10.5.3-11: 202 Accepted (S-CSCF to S-CSCF)

```
SIP/2.0 202 Accepted
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP
    pcscf2.home2.net;branch=876t12.1, SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

12. **202-Accepted (S-CSCF to P-CSCF) – see example in table 10.5.3-12**

S-CSCF#2 forwards the 202 Accepted final response to P-CSCF#2.

Table 10.5.3-12: 202 Accepted (S-CSCF to P-CSCF)

```
SIP/2.0 202 Accepted
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1, SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

13. **202-Accepted (P-CSCF to UE) – see example in table 10.5.3-13**

P-CSCF#2 forwards the 202 Accepted final response to UE#2.

Table 10.5.3-13: 202 Accepted (P-CSCF to UE)

```
SIP/2.0 202 Accepted
Via: SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

P-CSCF removes the Record-Route header

14. **INVITE (UE to P-CSCF) – see example in table 10.5.3-14**

UE#1 initiates an INVITE request based on the Refer-To header URL in the REFER request. The INVITE is sent from the UE to P-CSCF#1.

Table 10.5.3-14: INVITE (UE to P-CSCF)

```
INVITE sip:token(tel:+1-212-555-3333user3_public3@home3.net)@scscf2.home2.net;tokenized-
by=scscf2.home2.netprivate SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
Supported: 100rel
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>;privacy=off
RPID-Privacy: privacy=off;party=calling
Proxy-Require: privacy
Anonymity: Off
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
    seq=74))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=75))@localhost
Call-ID: B36(SHA-1(555-1111;time=36123E5B;seq=31))@localhost
Cseq: 127 INVITE
Require: precondition
Supported: 100rel
Contact: [5555::aaa:bbb:ccc:ddd]
Referred-By: sip:B36(SHA-1(+1-212-555-2222; time=36123F05; seq=31))@localhost;tag=171828
Replaces: B36(SHA-1(555-1111;time=36123E5B;seq=31))@localhost
cb03a0s09a2sdfglkj490333;to-tag=314149;from-tag=171828
Content-Type: application/sdp
Content-Length: (…)

v=0
o=- 2987933615 2987933615 IN IP6 5555::aaa:bbb:ccc:ddd
s=-
c=IN IP6 5555::aaa:bbb:ccc:ddd
t=907165275 0
m=audio 3456 RTP/AVP 97 3 96
b=AS:25.4
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; maxframes=2
a=rtpmap:96 G726-32/8000
a=qos:mandatory sendrecv
```

15. **100 Trying (P-CSCF to UE) – see example in table 10.5.3-15**

P-CSCF#1 responds to the INVITE request (14) with a 100 Trying provisional response.

Table 10.5.3-15: 100 Trying (P-CSCF to UE)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

16. **INVITE (P-CSCF to S-CSCF) – see example in table 10.5.3-16**

P-CSCF#1 remembers (from the registration procedure) the request routing for this UE. This becomes a Route header ~~the Request-URI~~ in the request. ~~The Request-URI of the original INVITE request (14) is copied to the Route header.~~

P-CSCF adds itself to the Record-Route header and Via header.

Table 10.5.3-16: INVITE (P-CSCF to S-CSCF)

```
INVITE sip:token(tel:+1-212-555-3333)@scscf2.home2.net;tokenized-by=scscf2.home2.net
scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:token(user3_public3@home3.net)@scscf2.home2.net;private
Record-Route: sip:pcscf1.home1.net;lr
Route sip:scscf1.home1.net;lr
Supported:
Remote-Party-ID:
RPID-Privacy:
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Referred-By:
Replaces:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

17. **100 Trying (S-CSCF to P-CSCF) – see example in table 10.5.3-17**

S-CSCF#1 responds to the INVITE request (16) with a 100 Trying provisional response.

Table 10.5.3-17: 100 Trying (S-CSCF to P-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

18. ~~Service Control~~ **Evaluation of initial filter criterias**

S-CSCF validates the service profile of this subscriber, and evaluates the initial filter criterias.

~~S-CSCF#1 performs whatever service control logic is appropriate for this session attempt.~~

19. **INVITE (S-CSCF to S-CSCF) – see example in table 10.5.3-19**

S-CSCF#1 performs an analysis of the destination address, which is a private URL generated by S-CSCF#2. Since it is a destination within the same operator's network, S-CSCF#1 forwards the INVITE request directly to S-CSCF#2.

Table 10.5.3-19: INVITE (S-CSCF to S-CSCF)

```
INVITE sip:token(tel:+1-212-555-3333user3_public3@home3.net)@scscf2.home2.net;tokenized-
by=scscf2.home2.netprivate SIP/2.0
Via: SIP/2.0/UDP sip:scscf1.home1.net SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Record-Route: sip:332b23.1@scscf1.home1.net;lr, sip:431h23.1@pcscf1.home1.net;lr
Supported:
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>;privacy=off;screen=yes
RPID-Privacy: privacy=off;screen=yes
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Referred-By:
Replaces:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

20. **100 Trying (S-CSCF to S-CSCF) – see example in table 10.5.3-20**

S-CSCF#2 responds to the INVITE request (19) by sending a 100 Trying provisional response to S-CSCF#1.

Table 10.5.3-20: 100 Trying (S-CSCF to S-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

21. ~~Service Control~~ **Evaluation of initial filter criterias**

S-CSCF validates the service profile of this subscriber, and evaluates the initial filter criterias.

~~S-CSCF#2 performs whatever service control logic is appropriate for this session transfer attempt.~~

22. **INVITE (S-CSCF to S-CSCF) – see example in table 10.5.3-22**

S-CSCF#2 determines the destination address from the private URL contained in the INVITE request. Based on information in that URL, and information saved from step #4 above (implementation decision), S-CSCF#2 verifies the validity of the transfer request, and that it is within a short time delay from the REFER request.

S-CSCF#2 builds a Route header based on stored state information for the Refer'd session (as determined by the Call-ID and Referred-By values in step #4 above).

S-CSCF#2 forwards the INVITE request to S-CSCF#3.

Table 10.5.3-22: INVITE (S-CSCF to S-CSCF)

```
INVITE tel:+1-212-555-3333sip:scscf3.home3.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP
    scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:scscf3.home3.net;lr
Record-Route: sip:764z87.1@scscf2.home2.net;lr, sip:332b23.1@scscf1.home1.net;lr,
    sip:431h23.1@pcscf1.home1.net;lr
Route: sip:pcscf3.home.net, sip:user3_public3@home3.net
Supported:
Remote-Party-ID: "John Doe" <tel:+1-212-555-1111>;privacy=off;screen=yes
RPID-Privacy: privacy=off;screen=yes
Remote-Party-ID: "John Smith" <tel:+1-212-555-2222>
;privacy=off;screen=yes;party=transferor
RPID-Privacy: privacy=off;screen=yes;party=transferor
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
Supported:
Contact:
Referred-By:
Replaces:
Content-Type:
Content-Length:

v=
o=
s=
c=
```

```
t=
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

Editor's Note: Use of "party=transferor" in a separate Remote-Party-ID header is FFS.

23. **100 Trying (S-CSCF to S-CSCF) – see example in table 10.5.3-23**

S-CSCF#3 responds to the INVITE request (22) by sending a 100 Trying provisional response to S-CSCF#2.

Table 10.5.3-23: 100 Trying (S-CSCF to S-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP
    scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

24. ~~**Service Control**~~ **Evaluation of initial filter criterias**

S-CSCF validates the service profile of this subscriber, and evaluates the initial filter criterias.

~~S-CSCF#3 performs whatever service control logic is appropriate for this session attempt.~~

25. **INVITE (S-CSCF to P-CSCF) – see example in table 10.5.3-25**

S-CSCF#3 uses the Route header value to determine the next hop CSCF for this UE. It forwards the INVITE request to P-CSCF#3.

Table 10.5.3-25: INVITE (S-CSCF to P-CSCF)

```
INVITE sip:[5555::aaa:bbb:ccc:fff]pcscf3.home3.net SIP/2.0
Via: SIP/2.0/UDP scscf3.home3.net, , SIP/2.0/UDP scscf2.home2.net;branch=764z87.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 66
Route: sip:pcscf3.home3.net;lr
Record-Route: sip:scscf3.home3.net;lr, sip:764z87.1@scscf2.home2.net;lr,
    sip:332b23.1@scscf1.home1.net;lr, sip:431h23.1@pcscf1.home1.net;lr
Route: sip:user3_public3@home3.net
Supported:
Remote-Party-ID:
RPID-Privacy:
Remote-Party-ID:
RPID-Privacy:
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
```

```
Supported:
Contact:
Referred-By:
Replaces:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

26. **100 Trying (P-CSCF to S-CSCF) – see example in table 10.5.3-26**

    P-CSCF#3 responds to the INVITE request (25) by sending a 100 Trying provisional response to S-CSCF#3.

Table 10.5.3-26: 100 Trying (P-CSCF to S-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP scscf3.home3.net, SIP/2.0/UDP scscf2.home2.net;branch=764z87.1,
    SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

27. **INVITE (P-CSCF to UE) – see example in table 10.5.3-27**

    P-CSCF forwards the INVITE request to the UE.

Table 10.5.3-27: INVITE (P-CSCF to UE)

```
INVITE sip:[5555::aaa:bbb:ccc:fff]user3_public3@home3.net;user=phone SIP/2.0
Via: SIP/2.0/UDP pcscf3.home3.net;branch=token1
Max-Forwards: 65
Supported:
Remote-Party-ID:
RPID-Privacy:
Remote-Party-ID:
RPID-Privacy:
Proxy-Require:
Anonymity:
From:
To:
Call-ID:
Cseq:
Require:
```

```
Supported:
Contact:
Referred-By:
Replaces:
Content-Type:
Content-Length:

v=
o=
s=
c=
t=
m=
b=
a=
a=
a=
a=
a=
a=
a=
```

28. **100 Trying (UE to P-CSCF) – see example in table 10.5.3-28**

    UE#3 may optionally send a 100 Trying provisional response to P-CSCF.

Table 10.5.3-28: 100 Trying (UE to P-CSCF)

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP pcscf3.home3.net;branch=token1
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

29. **Completion of Session Initiation**

    UE#1 and UE#3 complete the session initiation, as shown in the MO, S-S, and MT procedures.

30. **SIP BYE (UE to P-CSCF) – see example in table 10.5.3-30**

    Upon receiving the session invitation containing Replaces header, UE#3 terminates the session with UE#2.

Table 10.5.3-30: SIP BYE (UE to P-CSCF)

```
BYE sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:fff]
Max-Forwards: 70
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
    seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 131 BYE
Content-Length: 0
```

Request-URI: Contains the value of the Contact header from the initial INVITE.

Via: Contains the IP address or FQDN of the originating UE.

From:/To:/Call-ID: Contain the values previously used to establish the session, including the tag value from the response.

Cseq: Next higher sequential value.

31. **SIP BYE (P-CSCF to S-CSCF) – see example in table 10.5.3-31**

P-CSCF adds a Route header, with the saved value corresponding to the session.

P-CSCF#3 forwards the BYE request to S-CSCF#3.

Table 10.5.3-31: SIP BYE (P-CSCF to S-CSCF)

```
BYE sip:[5555::eee:fff:aaa:bbb]scscf3.home3.net SIP/2.0
Via: SIP/2.0/UDP pcscf3.home3.net, SIP/2.0/UDP [5555::aaa:bbb:ccc:fff]
Max-Forwards: 69
Route: sip:scscf3.home3.net;lr, sip:764z87.1@scscf2.home2.net;lr,
sip:876t12.1@pcscf2.home2.net;lr,sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Content-Length:
```

~~**Request-URI:** The first component of the saved Route header.~~

Route: Saved from the 200-OK response to the initial INVITE ~~(with first element moved to Request-URI)~~.

32. **SIP BYE (S-CSCF to S-CSCF) – see example in table 10.5.3-32**

S-CSCF#3 forwards the SIP BYE request to S-CSCF#2.

Table 10.5.3-32: SIP BYE (S-CSCF to S-CSCF)

```
BYE sip:[5555::eee:fff:aaa:bbb]scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf3.home3.net, SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:fff]
Max-Forwards: 68
Route: sip:scscf2.home2.net;lr, sip:876t12.1@pcscf2.home2.net;lr
,sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Content-Length:
```

33. **SIP BYE (S-CSCF to P-CSCF) – see example in table 10.5.3-33**

S-CSCF#2 forwards the SIP BYE request to P-CSCF#2.

Table 10.5.3-33: SIP BYE (S-CSCF to P-CSCF)

```
BYE sip:[5555::eee:fff:aaa:bbb]pcscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf3.home3.net,
    SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:fff]
Max-Forwards: 67
Route: sip:pcscf2.home2.net;lr[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
```

```
Content-Length:
```

34. **SIP BYE (P-CSCF to UE) – see example in table 10.5.3-34**

P-CSCF#2 forwards the SIP BYE request to UE#2.

Table 10.5.3-34: SIP BYE (P-CSCF to UE)

```
BYE sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1;branch=token1
Max-Forwards: 66
From:
To:
Call-ID:
Cseq:
Content-Length:
```

Via: P-CSCF removes the Via headers, and generates a locally unique token to identify the saved values. It inserts this as a branch value on its Via header.

35. **200-OK (UE to P-CSCF) – see example in table 10.5.3-35**

UE#2 acknowledges receipt of the SIP BYE request (34) with a 200-OK final response, sent to P-CSCF#2.

Table 10.5.3-35: 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1;branch=token1
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

36. **200-OK (P-CSCF to S-CSCF) – see example in table 10.5.3-36**

P-CSCF#2 forwards the 200 OK final response to S-CSCF#2.

Table 10.5.3-36: 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP scscf3.home3.net,
    SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:fff]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

P-CSCF restores the Via headers from the branch value in its Via.

37. **200-OK (S-CSCF to S-CSCF) – see example in table 10.5.3-37**

S-CSCF#2 forwards the 200 OK final response to S-CSCF#3.

Table 10.5.3-37: 200 OK (S-CSCF to S-CSCF)

```
SIP/2.0 200 OK
```

```
Via: SIP/2.0/UDP scscf3.home3.net, SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:fff]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

38. **200-OK (S-CSCF to P-CSCF) – see example in table 10.5.3-38**

S-CSCF#3 forwards the 200 OK final response to P-CSCF#3.

Table 10.5.3-38: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:fff]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

39. **200-OK (P-CSCF to UE) – see example in table 10.5.3-39**

P-CSCF#3 forwards the 200 OK final response to UE#3.

Table 10.5.3-39: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:fff]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

40. **NOTIFY (UE to P-CSCF) – see example in table 10.5.3-40**

When the session with UE#3 has been successfully established, UE#1 sends a Notify request to its proxy, P-CSCF#1. The session leg identification for this Notify is taken from that used in the Refer, earlier.

Table 10.5.3-40: Notify (UE to P-CSCF)

```
NOTIFY sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 70
From: "Alien Blaster" <sip:B36(SHA-1(user1_public1@home1.net; time=36123E5B;
    seq=72))@localhost>;tag=171828
To: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost;tag=314159
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 130 NOTIFY
Event: refer
Content-Type: application/sip message/sipfrag
Content-Length: (…)

SIP/2.0 200 OK
```

Request-URI: Contains the value of the Contact header from the 200-OK response to the initial INVITE.

Via: Contains the IP address or FQDN of the originating UE.

From:/To:/Call-ID: Contain the values previously used to establish the session, including the tag value from the response.

Cseq: Next higher sequential value.

41. **Notify (P-CSCF to S-CSCF) – see example in table 10.5.3-41**

P-CSCF adds a Route header, with the saved value corresponding to the session. P-CSCF#1 forwards the Notify request to S-CSCF#1.

Table 10.5.3-41: Notify (P-CSCF to S-CSCF)

```
NOTIFY sip:[5555::eee:fff:aaa:bbb]scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 69
Route: sip:scscf1.home1.net;lr, sip:764z87.1@scscf2.home2.net;lr,
sip:876t12.1@pcscf2.home2.net;lr, sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Event:
Content-Type:
Content-Length:

SIP/2.0 200 OK
```

~~**Request-URI:** The first component of the saved Route header.~~

Route: Saved from the 200-OK response to the initial INVITE ~~(with first element moved to Request-URI).~~

42. **Notify (S-CSCF to S-CSCF) – see example in table 10.5.3-42**

S-CSCF#1 forwards the Notify request to S-CSCF#2.

Table 10.5.3-42: Notify (S-CSCF to S-CSCF)

```
NOTIFY sip:[5555::eee:fff:aaa:bbb]scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 68
Route: sip:scscf2.home2.net;lr, sip:876t12.1@pcscf2.home2.net;lr,
sip:[5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
Cseq:
Event:
Content-Type:
Content-Length:

SIP/2.0 200 OK
```

43. **Notify (S-CSCF to P-CSCF) – see example in table 10.5.3-43**

S-CSCF#2 forwards the Notify request to P-CSCF#2.

Table 10.5.3-43: Notify (S-CSCF to P-CSCF)

```
NOTIFY sip:[5555::eee:fff:aaa:bbb]~~pcscf2.home2.net~~ SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP
    scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
Max-Forwards: 67
Route: sip:pcscf2.home2.net;lr~~[5555::eee:fff:aaa:bbb]~~
From:
To:
Call-ID:
Cseq:
Event:
Content-Type:
Content-Length:

SIP/2.0 200 OK
```

44. **Notify (P-CSCF to UE) – see example in table 10.5.3-44**

    P-CSCF#2 forwards the Notify request to UE#2.

Table 10.5.3-44: Notify (P-CSCF to UE)

```
NOTIFY sip:[5555::eee:fff:aaa:bbb] SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1;branch=token1
Max-Forwards: 66
From:
To:
Call-ID:
Cseq:
Event:
Content-Type:
Content-Length:

SIP/2.0 200 OK
```

Via: P-CSCF removes the Via headers, and generates a locally unique token to identify the saved values. It inserts this as a branch value on its Via header.

45. **200-OK (UE to P-CSCF) – see example in table 10.5.3-45**

    UE#2 acknowledges receipt of the Notify request (34) with a 200-OK final response, sent to P-CSCF#2.

Table 10.5.3-45: 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1;branch=token1
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

46. **200-OK (P-CSCF to S-CSCF) – see example in table 10.5.3-46**

    P-CSCF#2 forwards the 200 OK final response to S-CSCF#2.

Table 10.5.3-46: 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
```

```
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP
    scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1,
    SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

P-CSCF restores the Via headers from the branch value in its Via.

47. **200-OK (S-CSCF to S-CSCF) – see example in table 10.5.3-47**

S-CSCF#2 forwards the 200 OK final response to S-CSCF#1.

Table 10.5.3-47: 200 OK (S-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

48. **200-OK (S-CSCF to P-CSCF) – see example in table 10.5.3-48**

S-CSCF#1 forwards the 200 OK final response to P-CSCF#1.

Table 10.5.3-48: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1, SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

49. **200-OK (P-CSCF to UE) – see example in table 10.5.3-49**

P-CSCF#1 forwards the 200 OK final response to UE#1.

Table 10.5.3-49: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

50. **SIP BYE (UE to P-CSCF) – see example in table 10.5.3-50**

Upon receiving the notification of successful refer operation (34), UE#2 terminates the session with UE#1.

Table 10.5.3-40: SIP BYE (UE to P-CSCF)

```
BYE sip:[5555::aaa:bbb:ccc:ddd]SIP/2.0
Via: SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
Max-Forwards: 70
From: sip:B36(SHA-1(+1-212-555-2222; time=36123E5B; seq=73))@localhost;tag=314159
To: "Alien Blaster" <sip:B36(SHA-1(+1-212-555-1111; time=36123E5B;
seq=72))@localhost>;tag=171828
Call-ID: cb03a0s09a2sdfglkj490333
Cseq: 131 BYE
Content-Length: 0
```

~~**Request-URI:** Contains the value of the Contact header from the initial INVITE.~~

Via: Contains the IP address or FQDN of the originating UE.

From:/To:/Call-ID: Contain the values previously used to establish the session, including the tag value from the response. Since this request is being initiated by the destination, the From and To are reversed.

Cseq: Next higher sequential value.

51. **SIP BYE (P-CSCF to S-CSCF) – see example in table 10.5.3-51**

P-CSCF adds a Route header, with the saved value corresponding to the session. P-CSCF#2 forwards the Notify request to S-CSCF#2.

Table 10.5.3-51: SIP BYE (P-CSCF to S-CSCF)

```
BYE sip:[5555::aaa:bbb:ccc:ddd]scscf2.home2.net SIP/2.0
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1, SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
Max-Forwards: 70
Route: sip:scscf2.home2.net;lr, sip:332b23.1@scscf1.home1.net;lr,
sip:pcscf1.home1.net;lr, sip:[5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Cseq:
Content-Length:
```

~~**Request-URI:** The first component of the saved Route header.~~

Route: Saved from the 200-OK response to the initial INVITE ~~(with first element moved to Request-URI~~).

52. **SIP BYE (S-CSCF to S-CSCF) – see example in table 10.5.3-52**

S-CSCF#2 forwards the SIP BYE request to S-CSCF#1.

Table 10.5.3-52: SIP BYE (S-CSCF to S-CSCF)

```
BYE sip:[5555::aaa:bbb:ccc:ddd]scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP
    pcscf2.home2.net;branch=876t12.1, SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
Max-Forwards: 68
Route: sip:scscf1.home1.net;lr, sip:pcscf1.home1.net;lr, sip:[5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Cseq:
Content-Length:
```

53. **SIP BYE (S-CSCF to P-CSCF) – see example in table 10.5.3-53**

S-CSCF#1 forwards the SIP BYE request to P-CSCF#1.

Table 10.5.3-53: SIP BYE (S-CSCF to P-CSCF)

```
BYE sip:[5555::aaa:bbb:ccc:ddd]pcscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1,
    SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
Max-Forwards: 67
Route: sip:pcscf1.home1.net;lr[5555::aaa:bbb:ccc:ddd]
From:
To:
Call-ID:
Cseq:
Content-Length:
```

54. **SIP BYE (P-CSCF to UE) – see example in table 10.5.3-54**

P-CSCF#2 forwards the SIP BYE request to UE#2.

Table 10.5.3-54: SIP BYE (P-CSCF to UE)

```
BYE sip:[5555::aaa:bbb:ccc:ddd] SIP/2.0
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1;branch=token1
Max-Forwards: 66
From:
To:
Call-ID:
Cseq:
Content-Length:
```

Via: P-CSCF removes the Via headers, and generates a locally unique token to identify the saved values. It inserts this as a branch value on its Via header.

55. **200-OK (UE to P-CSCF) – see example in table 10.5.3-55**

UE#2 acknowledges receipt of the SIP BYE request (44) with a 200-OK final response, sent to P-CSCF#1.

Table 10.5.3-55: 200 OK (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.home1.net;branch=431h23.1;branch=token1
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

56. **200-OK (P-CSCF to S-CSCF) – see example in table 10.5.3-56**

P-CSCF#1 forwards the 200 OK final response to S-CSCF#1.

Table 10.5.3-56: 200 OK (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=332b23.1, SIP/2.0/UDP
    scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1,
    SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
From:
To:
```

```
Call-ID:
CSeq:
Content-Length:
```

P-CSCF restores the Via headers from the branch value in its Via.

57. **200-OK (S-CSCF to S-CSCF) – see example in table 10.5.3-57**

S-CSCF#1 forwards the 200 OK final response to S-CSCF#2.

Table 10.5.3-57: 200 OK (S-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf2.home2.net;branch=764z87.1, SIP/2.0/UDP
    pcscf2.home2.net;branch=876t12.1, SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

58. **200-OK (S-CSCF to P-CSCF) – see example in table 10.5.3-58**

S-CSCF#2 forwards the 200 OK final response to P-CSCF#2.

Table 10.5.3-58: 200 OK (S-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf2.home2.net;branch=876t12.1, SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

59. **200-OK (P-CSCF to UE) – see example in table 10.5.3-59**

P-CSCF#2 forwards the 200 OK final response to UE#2.

Table 10.5.3-59: 200 OK (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::eee:fff:aaa:bbb]
From:
To:
Call-ID:
CSeq:
Content-Length:
```

3GPP TSG-CN1 Meeting #SIPadhoc0204
Madrid, Spain, 23. – 25. April 2002

Tdoc N1-~~021037~~021087

CR-Form-v5

CHANGE REQUEST

⌘ **24.228**	**CR 022**	⌘ **rev**	**1** ⌘	Current version:	**5.0.0** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [X] Radio Access Network [ ] Core Network [X]

Title: ⌘	Addition of the DHCPv6 related IETF documents		
Source: ⌘	Ericsson		
Work item code: ⌘	IMS-CCR	***Date:*** ⌘	24-Apr-02
Category: ⌘	**F**	***Release:*** ⌘	REL-5
	Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change: ⌘	There are no references to the DHCPv6 procedures in 24.228
Summary of change: ⌘	Addition of the references to DHCPv6 and DHCPv6 options for SIP servers
Consequences if not approved: ⌘	Missunderstanding about the standard to implement

Clauses affected: ⌘	2, 5.2	
Other specs affected: ⌘	[X] Other core specifications ⌘	24.229
	[ ] Test specifications	
	[ ] O&M Specifications	
Other comments: ⌘		

How to create CRs using this form:
Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

************ First proposed change ****************

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 23.228: "IP multimedia subsystem; Stage 2".

[3] IETF 2543bis: “SIP: Session Initiation Protocol” (ietf-sip-rfc2543bis-05.txt)

[4] IETF RFC 2782: "A DNS RR for specifying the location of services (DNS SRV)".

[5] IETF RFC 2806: "URLs for Telephone Calls".

[6] IETF RFC 2916: "E.164 number and DNS".

[7] 3GPP TS 33.203: "Access security for IP based services".

[8] 3GPP TS 23.060: "General Packet Radio Service (GPRS) Service description; Stage 2".

[9] 3GPP TS 29.207: "End to end Quality of Service (QoS); stage 3".

[10] 3GPP TS 29.060: "General Packet Radio Service (GPRS); GPRS Tunnelling Protocol (GTP) across the Gn and Gp Interface".

[11] 3GPP TS 29.228: "IP Multimedia (IM) Subsystem Cx Interface; Signalling flows and message contents".

[12] 3GPP TS 24.008: "Mobile radio interface layer 3 specification; Core Network Protocols; Stage 3".

Editors Note: This reference to 2543 will need to be updated to reference the assigned RFC number, once the draft achieves RFC status within the IETF.

[12A] draft-ietf-dhc-dhcpv6-23 (February 2002): "Dynamic Host Configuration Protocol for IPv6 (DHCPv6)"

Editor's note: The above document cannot be formally referenced until it is published as an RFC.

[12B] draft-ietf-sip-dhcpv6-00 (April 2002): "DHCPv6 options for SIP servers"

Editor's note: The above document cannot be formally referenced until it is published as an RFC.

************ Next proposed change ****************

5.2 PDP context activation and P-CSCF discovery procedures

5.2.1 Introduction

The Proxy-CSCF discovery shall be performed after GPRS attach and after or as part of a successful activation of a PDP context using one of the following mechanisms:

- Employ Dynamic Host Configuration Protocol for IPv6 (DHCPv6) ~~DHCP~~ [12A], the DHCPv6 options for SIP servers [12B] and if needed DNS to obtain the P-CSCF address as described in subclause 5.2.2.

- Obtain the Proxy-CSCF address from the PDP Context Activation signalling as described in subclause 5.2.3.The UE can freely decide which of the described mechanisms it will use to acquire the P-CSCF address. In case several P-CSCF addresses are provided to the UE without sufficient priority indication, the selection of which P-CSCF address to use by the UE is implementation specific.

5.2.2 DHCP procedure for P-CSCF discovery

In DHCP procedures for P-CSCF discovery, the UE employs Dynamic Host Configuration Protocol for IPv6 (DHCPv6) [12B]~~DHCP~~, the DCHPv6 option for SIP servers [12B] and if needed DNS to obtain the P-CSCF address.

Editor's Note: This approach needs further study on the interactions with the restrictions on the Signalling PDP Context, TS 23.228 subclause 4.2.6.

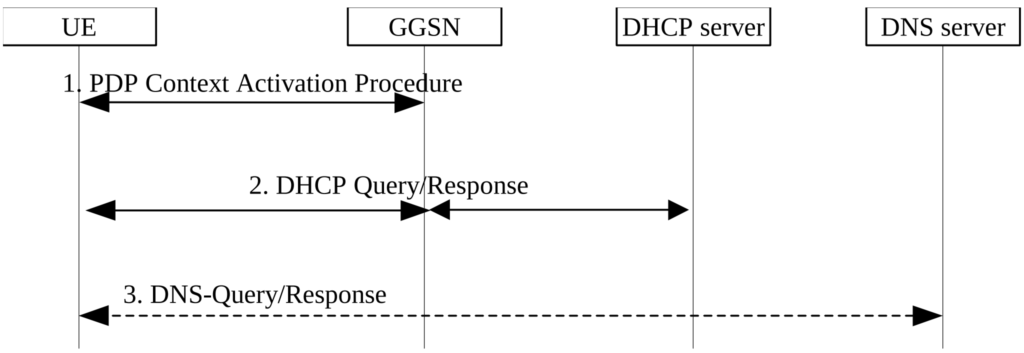


Figure 5.2.2-1: P-CSCF discovery using DHCP and DNS

1. **PDP Context Establishment Procedure (UE to GPRS)**

   Establishment of appropriate PDP context bearer by using the PDP Context Establishment procedure as specified in 3GPP TS 24.008.

2. **DHCP Query/Response (UE to DHCP)**

   The UE sends a request to a DHCP server. It may requesta list of fully qualified domain names of P-CSCF(s) and the IP addresses of the DNS servers, or it may request a list of P-CSCF(s) IP address(es) as described in clause 4 of the DHCPv6 options for SIP servers [12B]. Multiple DHCP Query/Response message exchange may be required to retrieve the requested information.

3. **DNS Query/Response (UE to DNS)**

   If P-CSCF address(es) are not received in the DHCP Query/Response, the UE performs a DNS query to retrieve a list of P-CSCF(s) IP addresses from which one is selected. If the response does not contain the IP addresses an additional DNS query is needed to resolve a Fully Qualified Domain Name (FQDN) to an IP address.

Table 5.2.2-3a DNS: DNS Query (UE to DNS)

```
OPCODE=SQUERY
QNAME=_sip._udp.pcscf.visited1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 5.2.2-3b DNS Query Response (DNS to UE)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=_sip._udp.pcscf.visited1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.pcscf.visited1.net          0 IN SRV 1 10 5060 pcscf1.visited1.net
                                         0 IN SRV 1  0 5060 pcscf7.visited1.net

pcscf1.visited1.net                  0 IN AAAA     5555::aba:dab:aaa:daa
pcscf7.visited1.net                  0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each P-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the P-CSCF (i.e. the pcscf1.visited1.net). Since the Additional Data field of the query-response also contains the IP address of the selected P-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.