

Source: SA WG3 (Security)

Title: CRs to 33.203: Correcting the text on sending an authentication response (Rel-5 / Rel-6)

Document for: Approval

Agenda Item: 7.3.3

SA Doc number	Spec	CR	Rev	Phase	Subject	Cat	Version-Current	SA WG3 Doc number	Workitem
SP-030596	33.203	047	1	Rel-5	Correcting the text on sending an authentication response	F	5.7.0	S3-030799	IMS-ASEC
SP-030596	33.203	048	1	Rel-6	Correcting the text on sending an authentication response	A	6.0.0	S3-030800	IMS-ASEC

CHANGE REQUEST

⌘ **TS 33.203 CR 047** ⌘ rev **1** ⌘ Current version: **5.7.0** ⌘

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Proposed change affects: UICC apps ME Radio Access Network Core Network

Title:	⌘ Correcting the text on sending an authentication response		
Source:	⌘ SA WG3		
Work item code:	⌘ IMS-ASEC	Date:	⌘ 20/11/2003
Category:	⌘ F	Release:	⌘ Rel-5
	<i>Use one of the following categories:</i> 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 .		<i>Use one of the following releases:</i> 2 (GSM Phase 2) R96 (Release 1996) R97 (Release 1997) R98 (Release 1998) R99 (Release 1999) Rel-4 (Release 4) Rel-5 (Release 5) Rel-6 (Release 6)

Reason for change:	⌘ Parts of the text states that RES is sent from the UE to the S-CSCF rather than a response calculated from RES and other parameters. There are CN1 CRs pending the approval of the text in this CR.		
Summary of change:	⌘ It is clarified that an authentication response calculated from RES and other parameters is sent for the UE to the S-CSCF to provide authentication as opposed to sending RES in the clear.		
Consequences if not approved:	⌘ Incompatible implementations are possible without change. Specification will not follow RFC 3310 as claimed.		

Clauses affected:	⌘ 5.1.1, 6.1.1, 6.1.3										
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Y	N										
X											
	X										
	X										
Other comments:	⌘										

5.1.1 Authentication of the subscriber and the network

Authentication between the subscriber and the network shall be performed as specified in section 6.1.

An IM-subscriber will have its subscriber profile located in the HSS in the Home Network. The subscriber profile will contain information on the subscriber that may not be revealed to an external partner, cf. [3]. At registration an S-CSCF is assigned to the subscriber by the I-CSCF. The subscriber profile will be downloaded to the S-CSCF over the Cx-reference point from the HSS (Cx-Pull). When a subscriber requests access to the IP Multimedia Core Network Subsystem this S-CSCF will check, by matching the request with the subscriber profile, if the subscriber is allowed to continue with the request or not i.e. Home Control (Authorization of IM-services).

All SIP-signaling will take place over the PS-domain in the user plane i.e. IP Multimedia Core Network Subsystem is essentially an overlay to the PS-domain. Hence the Visited Network will have control of all the subscribers in the PS-domain i.e. Visited Control (Authorization of bearer resources) since the Visited Network provides the subscriber with a transport service and its associated QoS.

For IM-services a new security association is required between the mobile and the IMS before access is granted to IM-services.

The mechanism for mutual authentication in UMTS is called UMTS AKA. It is a challenge response protocol and the AuC in the Home Stratum derives the challenge. A Quintet containing the challenge is sent from the Home Stratum to the Serving Network. The Quintet contains the expected response XRES and also a message authentication code MAC. The Serving Network compares the response from the UE with the XRES and if they match the UE has been authenticated. The UE calculates an expected MAC, XMAC, and compares this with the received MAC and if they match the UE has authenticated the Serving Network.

The AKA-protocol is a secure protocol developed for UMTS and the same concept/principles will be reused for the IP Multimedia Core Network Subsystem, where it is called IMS AKA.

Note: Although the method of calculating the parameters in UMTS AKA and IMS AKA are identical, the parameters are transported in slightly different ways. In UMTS, the UE's response RES is sent in the clear, while in IMS RES is not sent in the clear but combined with other parameters to form an authentication response and the authentication response is sent to the network (as described in [17]).

The Home Network authenticates the subscriber at anytime via the registration or re-registration procedures.

6.1.1 Authentication of an IM-subscriber

Before a user can get access to the IM services at least one IMPU needs to be registered and the IMPI authenticated in the IMS at application level. In order to get registered the UE sends a SIP REGISTER message towards the SIP registrar server i.e. the S-CSCF, cf. Figure 1, which will perform the authentication of the user. The message flows are the same regardless of whether the user has an IMPU already registered or not.

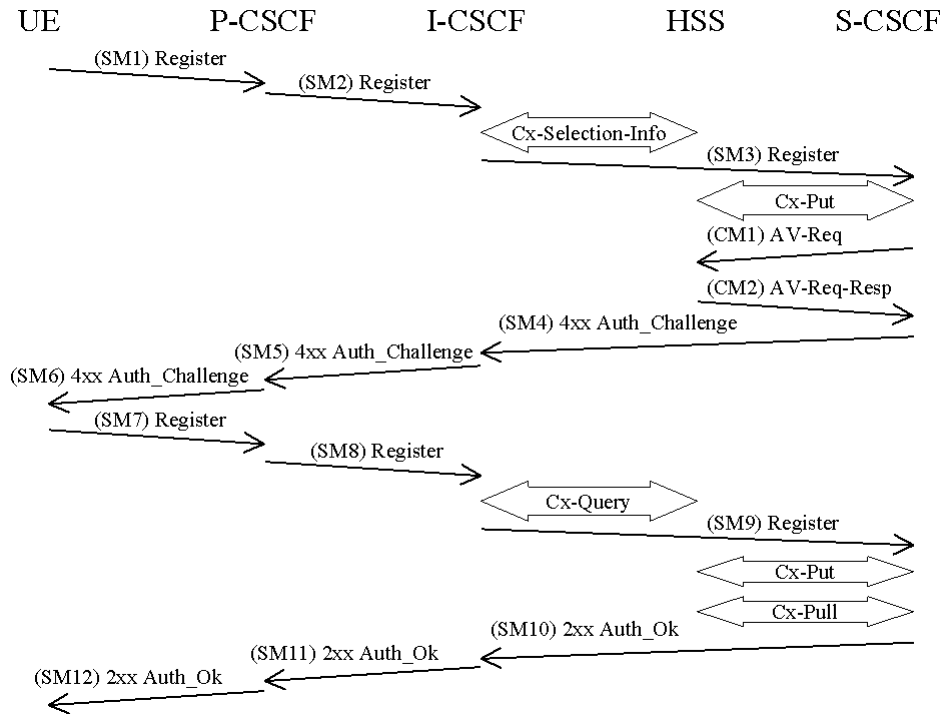


Figure 4: The IMS Authentication and Key Agreement for an unregistered IM subscriber and successful mutual authentication with no synchronization error

The detailed requirements and complete registration flows are defined in [8] and [11].

SMn stands for SIP Message n and CMm stands for Cx message m which has a relation to the authentication process:

SM1:
REGISTER(IMPI, IMPU)

In SM2 and SM3 the P-CSCF and the I-CSCF respectively forwards the SIP REGISTER towards the S-CSCF.

After receiving SM3, if the IMPU is not currently registered at the S-CSCF, the S-CSCF needs to set the registration flag at the HSS to initial registration pending. This is done in order to handle mobile terminated calls while the initial registration is in progress and not successfully completed. The registration flag is stored in the HSS together with the S-CSCF name and user identity, and is used to indicate whether a particular IMPU of the user is unregistered or registered at a particular S-CSCF or if the initial registration at a particular S-CSCF is pending. The registration flag is set by the S-CSCF sending a Cx-Put to the HSS. If the IMPU is currently registered, the S-CSCF shall leave the registration flag set to *registered*. At this stage the HSS has performed a check that the IMPI and the IMPU belong to the same user.

Upon receiving the SIP REGISTER the S-CSCF shall use an Authentication Vector (AV) for authenticating and agreeing a key with the user. If the S-CSCF has no valid AV then the S-CSCF shall send a request for AV(s) to the HSS in CM1 together with the number m of AVs wanted where m is at least one.

CM1:
Cx-AV-Req(IMPI, m)

Upon receipt of a request from the S-CSCF, the HSS sends an ordered array of n authentication vectors to the S-CSCF using CM2. The authentication vectors are ordered based on sequence number. Each authentication vector consists of the following components: a random number RAND, an expected response XRES, a cipher key CK, an integrity key IK and an authentication token AUTN. Each authentication vector is good for one authentication and key agreement between the S-CSCF and the IMS user.

CM2:

Cx-AV-Req-Resp(IMPI, RAND1||AUTN1||XRES1||CK1||IK1, ..., RANDn||AUTNn||XRESn||CKn||IKn)

When the S-CSCF needs to send an authentication challenge to the user, it selects the next authentication vector from the ordered array, i.e. authentication vectors in a particular S-CSCF are used on a first-in / first-out basis.

The S-CSCF sends a SIP 4xx Auth_Challenge i.e. an authentication challenge towards the UE including the challenge RAND, the authentication token AUTN in SM4. It also includes the integrity key IK and the cipher key CK for the P-CSCF. ~~Draft-ietf-sip-digest-aka-01~~ RFC 3310 [17] specifies ~~how the fields~~ to populate ~~the corresponding~~ parameters of ~~an authentication~~ challenge.

The verification of the SQN by the USIM and ISIM will cause the UE to reject an attempt by the S-CSCF to re-use a AV. Therefore no AV shall be sent more than once.

NOTE: This does not preclude the use of the normal SIP transaction layer re-transmission procedures.

SM4:

4xx Auth_Challenge(IMPI, RAND, AUTN, IK, CK)

When the P-CSCF receives SM5 it shall store the key(s) and remove that information and forward the rest of the message to the UE i.e.

SM6:

4xx Auth_Challenge(IMPI, RAND, AUTN)

Upon receiving the challenge, SM6, the UE takes the AUTN, which includes a MAC and the SQN. The UE calculates the XMAC and checks that XMAC=MAC and that the SQN is in the correct range as in [1]. If both these checks are successful the UE ~~uses~~ ~~calculates the response~~, RES, ~~and some other parameters to calculate an authentication response~~. ~~This response is~~ puts it into the Authorization header and ~~sends it~~ back to the registrar in SM7. RFC 3310 ~~Draft-ietf-sip-digest-aka-01~~ [17] specifies ~~how the fields~~ to populate ~~the corresponding~~ parameters of the response. It should be noted that the UE at this stage also computes the session keys CK and IK.

SM7:

REGISTER(IMPI, ~~Authentication response~~RES)

The P-CSCF forwards the ~~authentication response~~RES in SM8 to the I-CSCF, which queries the HSS to find the address of the S-CSCF. In SM9 the I-CSCF forwards the ~~authentication response~~RES to the S-CSCF.

Upon receiving SM9 containing the response, the S-CSCF retrieves the active XRES for that user and uses this to check the ~~authentication~~ response sent by the UE as described in RFC 3310 ~~Draft-ietf-sip-digest-aka-01~~ [17]. If the check is successful then the user has been authenticated and the IMPU is registered in the S-CSCF. If the IMPU was not currently registered, the S-CSCF shall send a Cx-Put to update the registration-flag to *registered*. If the IMPU was currently registered the registration-flag is not altered.

It shall be possible to implicitly register IMPU(s). The implicitly registered IMPU(s) all belong to the same Service Profile. All the IMPU(s) being implicitly registered shall be delivered by the HSS to the S-CSCF and subsequently to the P-CSCF. The S-CSCF shall regard all implicitly registered IMPU(s) as registered IMPU(s).

When an IMPU has been registered this registration will be valid for some period of time. Both the UE and the S-CSCF will keep track on a timer for this purpose but the expiration time in the UE is smaller than the one in the S-CSCF in order to make it possible for the UE to be registered and reachable without interruptions. A successful registration of a

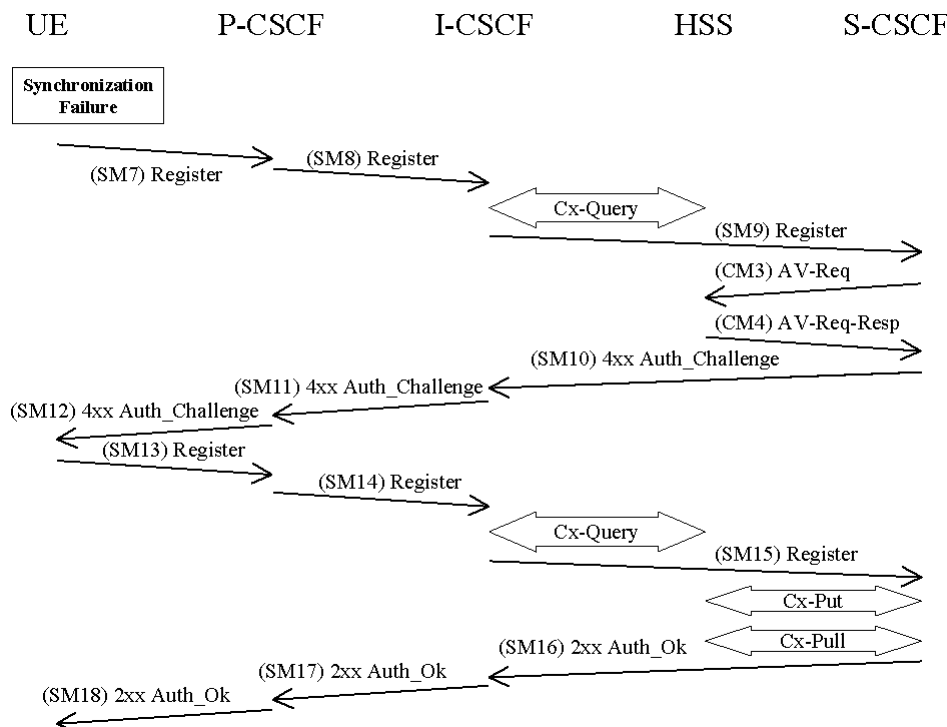
previously registered IMPU (including implicitly registered IMPUs) means the expiry time of the registration is refreshed.

It should be noted that the UE initiated re-registration opens up a potential denial-of-service attack. That is, an attacker could try to register an already registered IMPU and respond with [an incorrect](#)~~the wrong~~ RES authentication [response](#)~~and~~ in order to make the HN de-register the IMPU. For this reason a subscriber should not be de-registered if it fails an authentication. It shall be defined by the policy of the operator when successfully registered IMPU(s) are to be de-registered.

The lengths of the IMS AKA parameters are specified in chapter 6.3.7 in [1].

6.1.3 Synchronization failure

In this section the case of an authenticated registration with synchronization failure is described. After re-synchronization, authentication may be successfully completed, but it may also happen that in subsequent attempts other failure conditions (i.e. user authentication failure, network authentication failure) occur. In below only the case of synchronization failure with subsequent successful authentication is shown. The other cases can be derived by combination with the flows for the other failure conditions.



The flow equals the flow in 6.1.1 up to SM6. When the UE receives SM6 it detects that the SQN is out of range and sends a synchronization failure back to the S-CSCF in SM7. [RFC 3310](#) ~~Draft-ietf-sip-digest-aka-01~~ [17] describes the fields to populate corresponding parameters of synchronization failure.

SM7:
REGISTER(Failure = *Synchronization Failure*, AUTS, IMPI)

Upon receiving the *Synchronization Failure* and the AUTS the S-CSCF sends an Av-Req to the HSS in CM3 including the required number of Avs, m.

CM3:
Cx-AV-Req(IMPI, RAND,AUTS, m)

The HSS checks the AUTS as in section 6.3.5 in [1]. After potentially updating the SQN, the HSS sends new AVs to the S-CSCF in CM4.

CM4:
Cx-AV-Req-Resp(IMPI, n,RAND₁||AUTN₁||XRES₁||CK₁||IK₁,...,RAND_n||AUTN_n||XRES_n||CK_n||IK_n)

The rest of the messages i.e. SM10-SM18 including the Cx messages are exactly the same as SM4-SM12 and the corresponding Cx messages in 6.1.1.

CHANGE REQUEST

⌘ **TS 33.203 CR 048** ⌘ rev **1** ⌘ Current version: **6.0.0** ⌘

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	Use <u>one</u> of the following categories:		Use <u>one</u> of the following releases:
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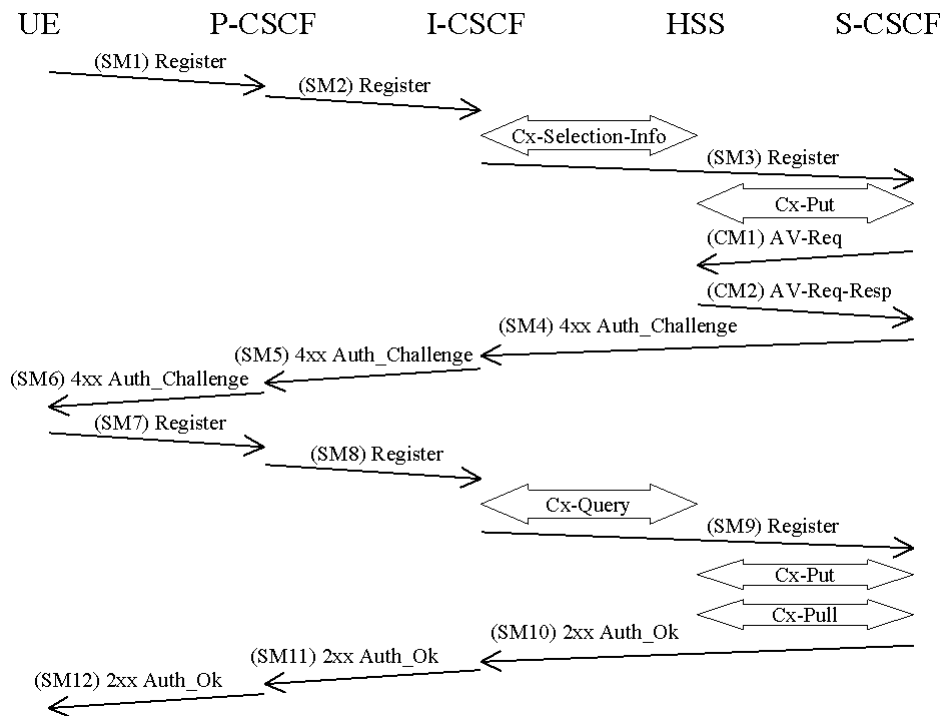


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CM2:

Cx-AV-Req-Resp(IMPI, RAND1||AUTN1||XRES1||CK1||IK1, ..., RANDn||AUTNn||XRESn||CKn||IKn)

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SM4:

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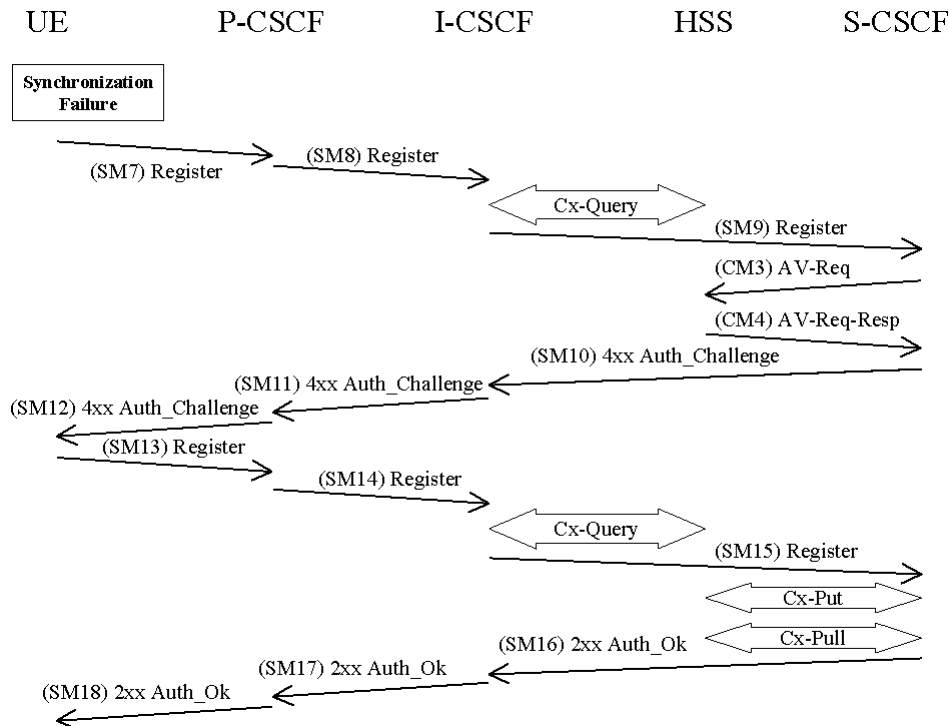
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SM7:
REGISTER(Failure = *Synchronization Failure*, AUTS, IMPI)

Upon receiving the *Synchronization Failure* and the AUTS the S-CSCF sends an Av-Req to the HSS in CM3 including the required number of Avs, m.

CM3:
Cx-AV-Req(IMPI, RAND,AUTS, m)

The HSS checks the AUTS as in section 6.3.5 in [1]. After potentially updating the SQN, the HSS sends new AVs to the S-CSCF in CM4.

CM4:
Cx-AV-Req-Resp(IMPI, n,RAND₁||AUTN₁||XRES₁||CK₁||IK₁,...,RAND_n||AUTN_n||XRES_n||CK_n||IK_n)

The rest of the messages i.e. SM10-SM18 including the Cx messages are exactly the same as SM4-SM12 and the corresponding Cx messages in 6.1.1.

