CR-Form-v7

CHANGE REQUEST

⌘ 33.203 CR CRNum ⌘rev - ⌘ Current version: 5.6.0 ⌘

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

Proposed change affects: UICC apps⌘ ☐ ME ☒ Radio Access Network ☐ Core Network ☒

Title:	⌘	Removal of SA lifetime
Source:	⌘	Nokia
Work item code:	⌘	IMS security
Date:	⌘	10/07/2003
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)*
Rel-6	*(Release 6)*

Reason for change:	⌘	It is to be compliant with SIP behavior during SA handling, and optimize network resource by using existing mechanism in CN1 stage 3 specification.
Summary of change:	⌘	Removes each individual 'established' SA lifetime. (The temporary lifetime of SA remains.)
Consequences if not approved:	⌘	Lack of alignment with SIP RFC 3261, section 18.

Clauses affected:	⌘	6.1.4, 7.1, 7.3

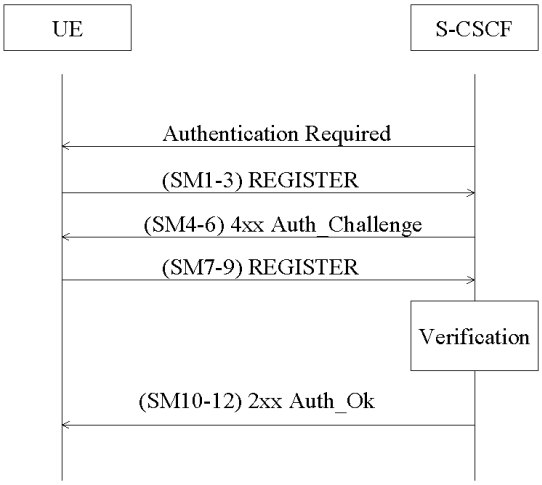
	Y	N			
Other specs affected:		**N**	Other core specifications	⌘	24.228, 24.229
		N	Test specifications		
		N	O&M Specifications		

Other comments: ⌘

***** Next change ****

6.1.4 Network Initiated authentications

In order to authenticate an already registered user, the S-CSCF shall send a request to the UE to initiate a re-registration procedure. When received at the S-CSCF, the re-registration shall trigger a new IMS AKA procedure that will allow the S-CSCF to re-authenticate the user.



~~Both the UE and the P-CSCF shall shorten the lifetime of the old SA pair generated from the last successful authentication, so as to guarantee that the new SA pair shall be used~~.
The UE shall initiate the re-registration on the reception of the Authentication Required indication. Once after a successful authentication, the UE shall immediately start using the new SA. In P-CSCF, after a successful authentication and receive a subsequent message from UE protected by new SA, the P-CSCF shall delete all the old SAs active to the UE. In the event that the UE does not initiate the re-registration procedure after the request from the S-CSCF, the S-CSCF may decide to de-register the subscriber or re-issue an Authentication-Required.

********* NEXT CHANGE**********

7 Security association set-up procedure

The security association set-up procedure is necessary in order to decide what security services to apply and when the security services start. In the IMS authentication of users is performed during registration as specified in clause 6.1. Subsequent signaling communications in this session will be integrity protected based on the keys derived during the authentication process.

7.1 Security association parameters

For protecting IMS signaling between the UE and the P-CSCF it is necessary to agree on shared keys that are provided by IMS AKA, and a set of parameters specific to a protection method. The security mode setup (cf. clause 7.2) is used to negotiate the SA parameters required for IPsec ESP with authentication, but without confidentiality.
The SA parameters that shall be negotiated between UE and P-CSCF in the security mode set-up procedure, are:

- **Integrity algorithm**

NOTE: What is called "authentication algorithm" in [13] is called "integrity algorithm" in this specification in order to be in line with the terminology used in other 3GPP specifications and, in particular, to avoid confusion with the authentication algorithms used in the AKA protocol.

The integrity algorithm is either HMAC-MD5-96 [15] or HMAC-SHA-1-96 [16].

Both integrity algorithms shall be supported by both, the UE and the P-CSCF as mandated by [13]. In the unlikely event that one of the integrity algorithms is compromised during the lifetime of this specification, this algorithm shall no longer be supported.

NOTE: If only one of the two integrity algorithms is compromised then it suffices for the IMS to remain secure that the algorithm is no longer supported by any P-CSCF. The security mode set-up procedure (cf. clause 7.2) will then ensure that the other integrity algorithm is selected.

- **SPI (Security Parameter Index)**

  The SPI is allocated locally for inbound SAs. The triple (SPI, destination IP address, security protocol) uniquely identifies an SA at the IP layer. The UE shall select the SPIs uniquely, and different from any SPIs that might be used in any existing SAs (i.e. inbound and outbound SAs). The SPIs selected by the P-CSCF shall be different than the SPIs sent by the UE, cf. section 7.2.

NOTE: This allocation of SPIs ensures that protected messages in the uplink always differ from protected messages in the downlink in, at least, the SPI field. This thwarts reflection attacks. When several applications use IPsec on the same physical interface the SIP application should be allocated a separate range of SPIs.

The following SA parameters are not negotiated:

- Life type: the life type is always seconds;
- SA duration: the SA duration has a fixed length of 2^{32}-1;

NOTE: The SA duration is a network layer concept. From a practical point of view, the value chosen for "SA duration" does not impose any limit on the lifetime of an SA at the network layer. ~~The SA lifetime is controlled by the SIP application as specified in clause 7.4.~~

- Mode: transport mode;
- Key length: the length of the integrity key IK_{ESP} depends on the integrity algorithm. It is 128 bits for HMAC-MD5-96 and 160 bits for HMAC-SHA-1-96.

Selectors:

The security associations (SA) have to be bound to specific parameters (selectors) of the SIP flows between UE and P-CSCF, i.e. source and destination IP addresses, transport protocols that share the SA, and source and destination ports.

- IP addresses are bound to a pair of SAs, as in clause 6.3, as follows:
  - inbound SA at the P-CSCF:
    The source and destination IP addresses associated with the SA are identical to those in the header of the IP packet in which the initial SIP REGISTER message was received by the P-CSCF.
  - outbound SA at the P-CSCF:
    the source IP address bound to the outbound SA equals the destination IP address bound to the inbound SA;
    the destination IP address bound to the outbound SA equals the source IP address bound to the inbound SA.

NOTE: This implies that the source and destination IP addresses in the header of the IP packet in which the protected SIP REGISTER message was received by the P-CSCF need to be the same as those in the header of the IP packet in which the initial SIP REGISTER message was received by the P-CSCF.

- The transport protocol selector shall allow UDP and TCP.
- Ports:

1. The P-CSCF receives messages protected with ESP from any UE on one fixed port (the"protected port") different from the standard SIP port 5060. The number of the protected port is communicated to the UE during the security mode set-up procedure, cf. clause 7.2. For every protected request towards UE, the P-CSCF shall insert the protected port into Via header. No unprotected messages shall be sent from or received on this port. From a security point of view, the P-CSCF may receive unprotected messages from any UE on any port which is different from the protected port.

NOTE: The protected port is fixed for a particular P-CSCF, but may be different for different P-CSCFs.

2. For protected or unprotected outbound messages from the P-CSCF (inbound for the UE) any source port number may be used at the P-CSCF from a security point of view.

3. For each security association, the UE assigns a local port to send or receive protected messages to and from the P-CSCF ("protected port"). No unprotected messages shall be sent to or received on this port. The UE shall use a single protected port number for both TCP and UDP connections. The port number is communicated to the P-CSCF

during the security mode set-up procedure, cf. clause 7.2. When the UE sends a re-REGISTER request, it shall always pick up a new port number and send it to the network. If the UE is not challenged by the network, the port number shall be obsolete. Annex H of this specification gives detail how the port number is populated in SIP message. From a security point of view, the UE may send or receive unprotected messages to or from the P-CSCF on any ports which are not the protected ports.

4. The P-CSCF is allowed to receive only REGISTER messages on unprotected ports. All other messages not arriving on the protected port shall be discarded by the P-CSCF.

5. For every protected request, the UE shall insert the protected port of the corresponding SA into Via header. The UE is allowed to receive only the following messages on an unprotected port:

   - responses to unprotected REGISTER messages;

   - error messages.

   All other messages not arriving on a protected port shall be discarded by the UE.

The following rules apply:

1. For each SA which has been established ~~and has not expired~~, the SIP application at the P-CSCF stores at least the following data: (UE_IP_address, UE_protected_port, SPI, IMPI, IMPU1, ... , IMPUn~~, lifetime~~) in an "SA_table".

NOTE: The SPI is only required when initiating and deleting SAs in the P-CSCF. The SPI is not exchanged between IPsec and the SIP layer for incoming or outgoing SIP messages.

2. The SIP application at the P-CSCF shall check upon receipt of a protected REGISTER message that the pair (source IP address, source port) in the packet headers coincide with the UE's address pair (IP address, source port) inserted in the Via header of the protected REGISTER message. If the Via header does not explicitly contain the UE's address pair, but rather a symbolic name then the P-CSCF shall first resolve the symbolic name by suitable means to obtain an address pair.

3. The SIP application at the P-CSCF shall check upon receipt of an initial REGISTER message that the pair (UE_IP_address, UE_protected_port), where the UE_IP_address is the source IP address in the packet header and the protected port is sent as part of the security mode set-up procedure (cf. clause 7.2), has not yet been associated with entries in the "SA_table". Furthermore, the P-CSCF shall check that, for any one IMPI, no more than three SAs per direction are stored at any one time. If these checks are unsuccessful the registration is aborted and a suitable error message is sent to the UE.

NOTE: According to clause 7.4 on SA handling, at most three SAs per direction may exist at a P-CSCF for one user at any one time.

4. For each incoming protected message the SIP application at the P-CSCF shall verify that the correct inbound SA according to clause 7.4 on SA handling has been used. The SA is identified by the pair (UE_IP_address, UE_protected_port) in the "SA_table". The SIP application at the P-CSCF shall further check that the IMPU associated with the SA in the "SA_table" and the IMPU in the received SIP message coincide. If this is not the case the message shall be discarded.

5. For each SA which has been established and has not expired, the SIP application at the UE stores at least the following data: (UE_protected_port, SPI, lifetime) in an "SA_table".

NOTE: The SPI is only required to initiate and delete SAs in the UE. The SPI is not exchanged between IPsec and the SIP layer for incoming or outgoing SIP messages.

6. When establishing a new pair of SAs (cf. clause 6.3) the SIP application at the UE shall ensure that the selected number for the protected port, as well as SPI number, do not correspond to an entry in the "SA_table".

NOTE: Regarding the selection of the number of the protected port at the UE it is generally recommended that the UE randomly selects the number of the protected port from a sufficiently large set of numbers not yet allocated at the UE. This is to thwart a limited form of a Denial of Service attack. UMTS PS access link security also helps to thwart this attack.

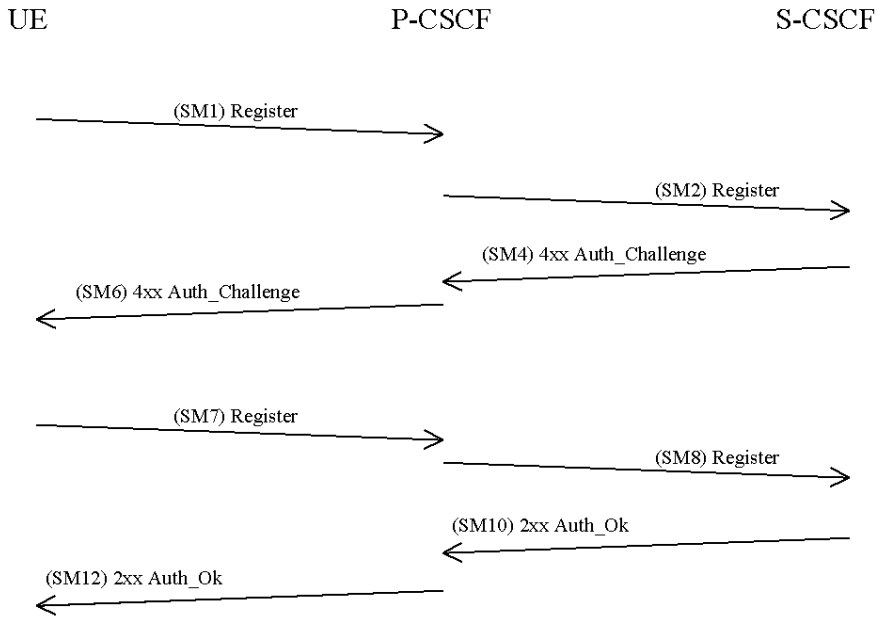
7. For each incoming protected message the SIP application at the UE shall verify that the correct inbound SA according to clause 7.4 on SA handling has been used. The SA is identified by UE_protected_port in the "SA table". The source port selector is set to be a wildcard in the UE's IPsec database.

NOTE: If the integrity check of a received packet fails then IPsec will automatically discard the packet.

8. ~~The lifetime of an SA at the application layer between the UE and the P-CSCF shall equal the registration period.~~

7.2 Set-up of security associations (successful case)

The set-up of security associations is based on [21]. Annex H of this specification shows how to use [21] for the set-up of security associations.
In this section the normal case is specified i.e. when no failures occurs. Note that for simplicity some of the nodes and messages have been omitted. Hence there are gaps in the numbering of messages, as the I-CSCF is omitted.



The UE sends a Register message towards the S-CSCF to register the location of the UE and to set-up the security mode, cf. clause 6.1. In order to start the security mode set-up procedure, the UE shall include a *Security-setup*-line in this message.
The *Security-setup-line* in SM1 contains the Security Parameter Index value and the protected port selected by the UE. It also contains a list of identifiers for the integrity algorithms which the UE supports.

SM1:
REGISTER(Security-setup = *SPI_U, Port_U, UE integrity algorithms list)*

SPI_U is the symbolic name of the SPI value (cf. section 7.1) spi that the UE selects. The syntax of spi is defined in Annex H.
Port_U is the symbolic name of a pair of port numbers (port1, port2) where port1 defines the destination port number for inbound messages at the UE that are protected, and port2 defines the source port number for outbound messages at the UE that are protected. The syntax of port1 and port2 is defined in Annex H.
Upon receipt of SM1, the P-CSCF temporarily stores the parameters received in the *Security-setup-line* together with the UE's IP address from the source IP address of the IP packet header, the IMPI and IMPU. Upon receipt of SM4, the P-CSCF adds the key IK_{IM} received from the S-CSCF to the temporarily stored parameters. The P-CSCF then selects the SPI for the inbound SA. The P-CSCF shall define the SPIs such that they are unique and different from any SPIs as received in the *Security-setup-line* from the UE.

NOTE: This rule is needed since the UE and the P-CSCF use the same key for inbound and outbound traffic.

In order to determine the integrity algorithm the P-CSCF proceeds as follows: the P-CSCF has a list of integrity algorithms it supports, ordered by priority. The P-CSCF selects the first integrity algorithm on its own list which is also supported by the UE.

The P-CSCF then establishes another pair of SAs in the local security association database.

The *Security-setup*-line in SM6 contains the SPI assigned by the P-CSCF and the fixed number of the protected port at the P-CSCF. It also contains a list of identifiers for the integrity algorithms which the P-CSCF supports.

SM6:
4xx Auth_Challenge(Security-setup = *SPI_P, Port_P, P-CSCF integrity algorithms list)*

SPI_P is the symbolic name of the SPI value (cf. section 7.1) spi that the P-CSCF selects. The syntax of spi is defined in Annex H.
Port_P is the symbolic name of the port number port1, where port1 defines the destination port number for inbound messages at the P-CSCF that are protected. The port number port2 of the P-CSCF shall be absent in Port_P. The syntax of port1 is defined in Annex H.
Upon receipt of SM6, the UE determines the integrity algorithm as follows: the UE selects the first integrity algorithm on the list received from the P-CSCF in SM 6 which is also supported by the UE.
The UE then proceeds to establish another pair of SAs in the local SAD.
The UE shall integrity-protect SM7 and all following SIP messages. Furthermore the integrity algorithms list received in SM6 shall be included:

SM7:
REGISTER(Security-setup = *P-CSCF integrity algorithms list)*

After receiving SM7 from the UE, the P-CSCF shall check whether the integrity algorithms list received in SM7 is identical with the integrity algorithms list sent in SM6. If this is not the case the registration procedure is aborted.
The P-CSCF shall include in SM8 information to the S-CSCF that the received message from the UE was integrity protected. The P-CSCF shall add this information to all subsequent REGISTER messages received from the UE that have successfully passed the integrity check in the P-CSCF.
SM8:
REGISTER(Integrity-Protection = *Successful*, IMPI*)*

The P-CSCF finally sends SM12 to the UE. SM12 does not contain information specific to security mode setup (i.e. a Security-setup line), but with sending SM12 not indicating an error the P-CSCF confirms that security mode setup has been successful. After receiving SM12 not indicating an error, the UE can assume the successful completion of the security-mode setup.

7.3 Error cases in the set-up of security associations

7.3.1 Error cases related to IMS AKA

Errors related to IMS AKA failures are specified in section 6.1. However, this section additionally describes how these shall be treated, related to security setup.

7.3.1.1 User authentication failure

In this case, SM7 fails integrity check by IPsec at the P-CSCF if the IK_{IM} derived from RAND at UE is wrong. The SIP application at the P-CSCF never receives SM7. It shall delete the temporarily stored SA parameters associated with this registration after a time-out.
In case IK_{IM} was derived correctly, but the response was wrong the authentication of the user fails at the S-CSCF due to an incorrect response. The S-CSCF will send a 4xx Auth_Failure message to the UE, via the P-CSCF, which may pass through an already established SA. Afterwards, both, the UE and the P-CSCF delete the new SAs.

7.3.1.2 Network authentication failure

If the UE is not able to successfully authenticate the network, the UE shall send a REGISTER message which may pass through an already established SA, indicating a network authentication failure, to the P-CSCF. The P-CSCF deletes the new SAs after receiving this message.

7.3.1.3 Synchronisation failure

In this situation, the UE observes that the AUTN sent by the network in SM6 contains an out-of-range sequence number. The UE shall send a REGISTER message to the P-CSCF, which may pass through an already established SA, indicating the synchronization failure. The P-CSCF deletes the new SAs after receiving this message.

7.3.1.4 Incomplete authentication

If the UE responds to an authentication challenge from a S-CSCF, but does not receive a reply before the request times out, the UE shall start a registration procedure if it still requires any IM services. The first message in this registration should be protected with an SA created by a previous successful authentication if one exists.
If during the incomplete authentication, the ~~P-CSCF deletes a registration SA due to its lifetime being exceeded~~ registration is expired, the S-CSCF shall send a notification message to the P-CSCF indicating ~~should~~ that the P-CSCF shall delete any information relating to that registration procedure.

7.3.2 Error cases related to the Security-Set-up

7.3.2.1 Proposal unacceptable to P-CSCF

In this case the P-CSCF cannot accept the proposal set sent by the UE in the Security-Set-up command of SM1. The P-CSCF shall respond to SM1 indicating a failure, by sending an error response to the UE.

7.3.2.2 Proposal unacceptable to UE

If the P-CSCF sends in the security-setup line of SM6 a proposal that is not acceptable for the UE, the UE shall terminate the registration procedure.

7.3.2.3 Failed consistency check of Security-Set-up lines at the P-CSCF

The P-CSCF shall check whether authentication algorithms list received in SM7 is identical with the authentication algorithms list sent in SM6. If this is not the case the registration procedure is aborted. (Cf. clause 7.2).

7.4 Authenticated re-registration

Every registration that includes a user authentication attempt produces new security associations. If the authentication is successful, then these new security associations shall replace the previous ones. This clause describes how the UE and P-CSCF handle this replacement and which SAs to apply to which message.
If the UE has an already active security association, then it shall use this to protect the REGISTER message. If the S-CSCF is notified by the P-CSCF that the REGISTER message from the UE was integrity-protected it may decide not to authenticate the user by means of the AKA protocol. However, the UE may send unprotected REGISTER messages at any time. In this case, the S-CSCF shall authenticate the user by means of the AKA protocol. In particular, if the UE considers the SA no longer active at the P-CSCF, e.g., after receiving no response to several protected messages, then the UE should send an unprotected REGISTER message.
Security associations may be unidirectional or bi-directional. This clause assumes that security associations are unidirectional, as this is the general case. ~~For IP layer SAs, the lifetime mentioned in the following clauses is the lifetime held at the application layer. Furthermore d~~Deleting an SA means deleting the SA from both the application and IPsec layer. The message numbers, e.g. SM1, used in the following clauses relate to the message flow given in section 6.1.1.

7.4.1 Void

7.4.1a Management of security associations in the UE

The UE shall be involved in only one registration procedure at a time, i.e. the UE shall remove any data relating to any previous incomplete registrations or authentications, including any SAs created by an incomplete authentication.
The UE may start a registration procedure with an existing pair of SAs. This will be referred to as the old SAs. The authentication produces a pair of new SAs. These new SAs shall not by used to protect non-authentication traffic until noted during the authentication flow. In the same way, certain messages in the authentication shall be protected with a particular SA. If the UE receives a message protected with the incorrect SA, it shall discard the message.
A successful authentication proceeds in the following steps:

- The UE sends the SM1 message to register with the IMS. If SM1 was protected, it shall be protected with the old outbound SA.
- The UE receives an authentication challenge in a message (SM6) from the P-CSCF. This message shall be protected with the old inbound SA if SM1 was protected and unprotected otherwise.
- If this message SM6 can be successfully processed by the UE, the UE creates the new SAs, which are derived according to section 7.1. The P-CSCF shall have a timer to control that ~~lifetime of the~~ new SAs are maintained temporarily~~shall be set~~ to allow enough time to complete the registration procedure. The UE then sends its response (SM7) to the P-CSCF, which shall be protected with the new outbound SA. Meanwhile, if SM1 was protected, the UE shall use the old SAs for messages other than those in the authentication, until a successful message of new authentication is received (SM12); if SM1 was unprotected, the UE is not allowed to use IMS service until it receives an authentication successful message (SM12).
- The UE receives an authentication successful message (SM12) from the P-CSCF. It shall be protected with the new inbound SA.

- After the successful processing of this message by the UE, the registration is complete. ~~The UE sets the lifetime of the new SAs using the maximum of registration timer in the message and the lifetime of the old SAs.~~ For further ~~traffic~~ request sent from UE, the new outbound SA is used. The old outbound SA is ~~are~~ now deleted. The old inbound SA is kept for receiving messages from P-CSCF. It shall be deleted when ~~either lifetime is expired, or~~ a further SIP message protected with the new inbound SA is successfully received from the P-CSCF. The new SAs are used to protect all traffic.

A failure in the authentication can occur for several reasons. If the SM1 was not protected, then no protection shall be applied to the failure messages, except the user authentication failure message which shall be protected with the new SA. If SM1 was protected, the old SAs shall be used to protect the failure messages. In both cases, after processing the failure message, the UE shall delete the new SAs.

The UE shall monitor the expiry time of registrations without authentication and adjust the lifetime of SAs it holds to ensure that they live longer than the expiry time given in the registration.

The UE shall delete any SA whose lifetime is exceeded. If there is no any registered IMPU, the UE shall delete all SAs.

7.4.2 Void

7.4.2a Management of security associations in the P-CSCF

When the S-CSCF initiates an authentication by sending a challenge to the UE, the P-CSCF may already contain existing SAs from previously completed authentications. It may also contain an existing pair of SAs from an incomplete authentication. These will be referred to as the old and registration SAs respectively. The authentication produces a pair of new SAs. These new SAs shall not be used to protect non-authentication traffic until noted during the authentication flow. Similarly certain messages in the authentication shall be protected with a particular SA. If the P-CSCF receives a message protected with the incorrect SA, it shall discard the message.
The P-CSCF associates the IMPI given in the registration procedure and all the successfully registered IMPUs related to that IMPI to an SA.
A successful authentication proceeds in the following steps:

- The P-CSCF receives the SM1 message. If SM1 is protected, it shall be protected with the old inbound SA.
- The P-CSCF forwards the message containing the challenge (SM6) to the UE. This shall be protected with the old outbound SA, if SM1 was protected and unprotected otherwise.
- The P-CSCF then creates the new SAs, which are derived according to section 7.1. The ~~expiry time of~~timer for the new SAs shall be set to allow enough time to complete the registration procedure. The registration SAs shall be deleted if they exist.
- The P-CSCF receives the message carrying the response (SM7) from the UE. It shall be protected using the new inbound SA. If SM1 was protected, the old SAs are used to protect messages other than those in the authentication.
- The P-CSCF forwards the successful registration message (SM12) to the UE. It shall be protected using the new outbound SA. This completes the registration procedure for the P-CSCF. ~~The P-CSCF sets the expiry time of the new SAs equal to the maximum of registration timer in the message and the lifetime of the old SAs.~~
- After SM12 is sent, the P-CSCF handles the UE related SAs according to following rules:
  - If there are old SAs, but SM1 is received unprotected, the P-CSCF considers error cases happened, and assumes UE does not have those old SAs for use. In this case the P-CSCF shall remove the old SAs.
  - If SM1 is protected with an old valid SA, the P-CSCF keeps this inbound SA and the corresponding outbound SA with the UE active, and continues to use them. Any other old SAs are deleted. The kept old SAs are ~~deleted when either the old SAs lifetime are expired, or~~ a further SIP message protected with the new inbound SA is successfully received from the UE. Then further messages are protected with new SAs. This completes the SA handling procedure for the P-CSCF.

A failure in the authentication can occur for several reasons. If the SM1 was not protected, then no protection shall be applied to the failure messages, except the user authentication failure message which shall be protected with the new SA. If SM1 was protected, the old SAs shall be used to protect the failure messages. In both cases, after processing the failure message, the P-CSCF shall delete the new SAs.

~~The P-CSCF shall monitor the expiry time of registrations without authentication and adjust the lifetime of SAs it holds to ensure that they live longer than the expiry time given in the registration.~~

A Security association shall be deleted from application level when a notification received from S-CSCF indicating there is no registration corresponding to that UE. Then ~~The~~ the P-CSCF shall delete any SA ~~from the IPsec database whose lifetime is exceeded~~.