

## CHANGE REQUEST

⌘ **33.203 CR** ⌘ rev - ⌘ Current version: **5.7.0** ⌘

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

<b>Title:</b>	⌘ SA parameters and management.		
<b>Source:</b>	⌘ Nokia		
<b>Work item code:</b>	⌘ IMS-ASEC	<b>Date:</b>	⌘ 25/09/2003
<b>Category:</b>	⌘ <b>F</b>	<b>Release:</b>	⌘ Rel-5
	Use <u>one</u> of the following categories:		Use <u>one</u> of the following releases:
	<b>F</b> (correction)	<b>2</b> (GSM Phase 2)	
	<b>A</b> (corresponds to a correction in an earlier release)	<b>R96</b> (Release 1996)	
	<b>B</b> (addition of feature),	<b>R97</b> (Release 1997)	
	<b>C</b> (functional modification of feature)	<b>R98</b> (Release 1998)	
	<b>D</b> (editorial modification)	<b>R99</b> (Release 1999)	
	Detailed explanations of the above categories can be found in 3GPP <a href="#">TR 21.900</a> .		<b>Rel-4</b> (Release 4)
			<b>Rel-5</b> (Release 5)
			<b>Rel-6</b> (Release 6)

<b>Reason for change:</b>	⌘ There are too detailed (stage3) descriptions on the usage of the UDP/TCP connections by the SIP application in the UE and the P-CSCF. The usage of the transport layer with SIP is already specified in the SIP RFC. The text does not allow the setup of the TCP connections on demand, and the reuse of the already existing TCP connection by either party. When there are two pair of valid SAs between the UE and the P-CSCF, the SIP layer shall not care which SA the request was received on and which SA the response was received on. Transport layer handles it, SIP layer should not care about these.
<b>Summary of change:</b>	⌘ The text on how to use the transport layer with SIP has been removed. TCP connection setup on demand has been allowed. TCP connection reuse has been allowed.
<b>Consequences if not approved:</b>	⌘ Too restrictive procedures will stay in the specification, TCP connection setup on demand will not be allowed, TCP connection reuse will not be allowed. Very poor performance output for the system.

<b>Clauses affected:</b>	⌘ 7.1, 7.2										
<b>Other specs affected:</b>	<table border="1" style="display: inline-table; border-collapse: collapse; text-align: center;"> <tr> <td style="width: 20px;">Y</td> <td style="width: 20px;">N</td> </tr> <tr> <td>X</td> <td></td> </tr> <tr> <td></td> <td>X</td> </tr> <tr> <td></td> <td>X</td> </tr> </table>	Y	N	X			X		X	Other core specifications	⌘ 24.229
Y	N										
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		Test specifications									
		O&M Specifications									
<b>Other comments:</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/specs/CR.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.

## 7.1 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. In an authenticated registration, the UE and the P-CSCF each select two SPIs, not yet associated with existing inbound SAs, for the new inbound security associations at the UE and the P-CSCF respectively.

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 two pairs 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 associates two ports, called *port\_ps* and *port\_pc*, with each pair of security associations established in an authenticated registration. The ports *port\_ps* and *port\_pc* are different from the standard SIP ports 5060 and 5061. No unprotected messages shall be sent from or received on the ports *port\_ps* and *port\_pc*. From a security point of view, unprotected messages may be received on any port which is different from the ports *port\_ps* and *port\_pc*. The number of the ports *port\_ps* and *port\_pc* are communicated to the UE during the security mode set-up procedure, cf. clause 7.2. These ports are used with both, UDP and TCP. The use of these ports may differ for TCP and UDP, as follows:

**UDP case:** ~~the P-CSCF receives requests and responses protected with ESP from any UE on the port *port\_ps* (the "protected server port"). The P-CSCF sends requests and responses protected with ESP to a UE on the port *port\_pc* (the "protected client port").~~ The messages shall be sent to the port *port\_us* of the UE. For every protected request towards the UE, the P-CSCF shall insert the protected server port *port\_ps* into the Via header. The protected responses from the UE are then sent to *port\_ps* at the P-CSCF.

**TCP case:** ~~the P-CSCF receives requests and sends responses protected with ESP from and to a UE on the port *port\_ps*. The P-CSCF sends requests and receives responses protected with ESP to and from a UE on the port *port\_pc* (the "protected client port").~~ The P-CSCF, if it does not have a TCP connection towards the UE yet, shall set up a TCP connection from its *port\_pc* to the port *port\_us* of the UE before sending a request to it.

NOTE: Both the UE and the P-CSCF may set up a TCP connection from their client port to the other end's server port on demand. An already existing TCP connection may be reused by both the P-CSCF or the UE.

NOTE: The protected server port *port\_ps* stays fixed for a UE until all IMPUs from this UE are de-registered. It may be fixed for a particular P-CSCF over all UEs, but there is no need to fix the same protected server port for different P-CSCFs.

NOTE: The distinction between the UDP and the TCP case reflects the different behaviour of SIP over UDP and TCP, as specified in RFC 3261, section 18.

2. The UE associates two ports, called *port\_us* and *port\_uc*, with each pair of security associations established in an authenticated registration. The ports *port\_us* and *port\_uc* are different from the standard SIP ports 5060 and 5061. No unprotected messages shall be sent from or received on the ports *port\_us* and *port\_uc*. From a security point of view, unprotected messages may be received on any port which is different from the ports *port\_us* and *port\_uc*. The number of the ports *port\_us* and *port\_uc* are communicated to the P-CSCF during the security mode set-up procedure, cf. clause 7.2. These ports are used with both, UDP and TCP. The use of these ports may differ for TCP and UDP, as follows:

**UDP case:** ~~the UE receives requests and responses protected with ESP on the port *port\_us* (the "protected server port"). The UE sends requests and responses protected with ESP on the port *port\_uc* (the "protected client port").~~ For every protected request towards the P-CSCF, the UE shall insert the protected server port *port\_us* into the Via header. The protected responses from the P-CSCF are then sent to *port\_us* at the UE. The messages shall be sent to the port *port\_ps* of the P-CSCF.

**TCP case:** ~~the UE receives requests and sends responses protected with ESP on the port *port\_us*. The UE sends requests and receives responses protected with ESP on the port *port\_uc* (the "protected client port").~~ The UE, if it does not have a TCP connection towards the P-CSCF yet, shall set up a TCP connection to the port *port\_ps* of the P-CSCF before sending a request to it. The UE shall put its port *port\_us* into the Via header.

NOTE: Both the UE and the P-CSCF may set up a TCP connection from their client port to the other end's server port on demand. An already existing TCP connection may be reused by both the P-CSCF or the UE.

NOTE: The protected server port *port\_us* stays fixed for a UE until all IMPUs from this UE are de-registered.

NOTE: The distinction between the UDP and the TCP case reflects the different behaviour of SIP over UDP and TCP, as specified in RFC 3261, section 18.

The following rules apply:

1. For each unidirectional 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, P-CSCF\_protected\_port, SPI, IMPI, IMPU1, ... , IMPUn, lifetime) in an "SA\_table". The pair (UE\_protected\_port, P-CSCF\_protected\_port) equals either (*port\_uc*, *port\_ps*) or (*port\_us*, *port\_pc*).

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 source IP address in the packet headers coincide with the UE's IP address inserted in the Via header of the protected REGISTER message. If the Via header does not explicitly contain the UE's IP address, but rather a symbolic name then the P-CSCF shall first resolve the symbolic name by suitable means to obtain an IP address.
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\_client\_port), where the UE\_IP\_address is the source IP address in the packet header and the protected client 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 six 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 six 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 triple (UE\_IP\_address, UE\_protected\_port, P-CSCF\_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 unidirectional SA which has been established and has not expired, the SIP application at the UE stores at least the following data: (UE\_protected\_port, P-CSCF\_protected\_port, SPI, lifetime) in an "SA\_table". The pair (UE\_protected\_port, P-CSCF\_protected\_port) equals either (*port\_uc*, *port\_ps*) or (*port\_us*, *port\_pc*).

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 numbers for the protected ports 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 the pair (UE\_protected\_port, P-CSCF\_protected\_port) in the "SA table".

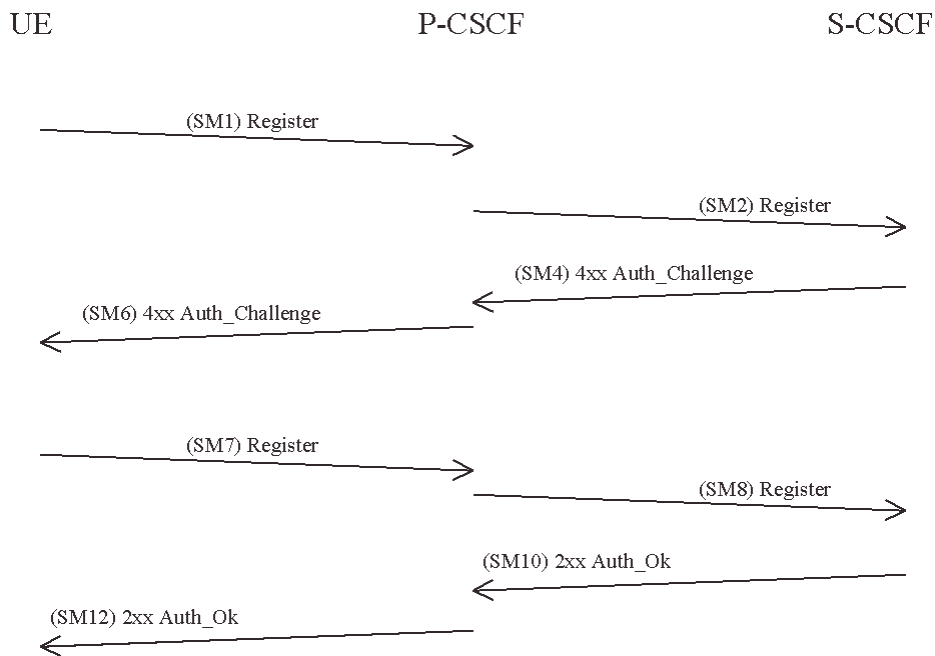
NOTE: If the integrity check of a received packet fails then IPsec will automatically discard the packet.

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 values and the protected ports 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 a pair of SPI values (cf. section 7.1) (*spi\_uc*, *spi\_us*) that the UE selects. *spi\_uc* is the SPI of the inbound SA at UE's the protected client port, and *spi\_us* is the SPI of the inbound SA at the UE's protected server port. The syntax of *spi\_uc* and *spi\_us* is defined in Annex H.

*Port\_U* is the symbolic name of a pair of port numbers (*port\_uc*, *port\_us*) as defined in section 7.1. The syntax of *port\_uc* and *port\_us* 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 SPIs for the inbound SAs. 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 two new pairs of SAs in the local security association database.

The *Security-setup*-line in SM6 contains the SPIs and the ports assigned by 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 pair of SPI values (cf. section 7.1) (*spi\_pc*, *spi\_ps*) that the P-CSCF selects. *spi\_pc* is the SPI of the inbound SA at the P-CSCF's protected client port, and *spi\_ps* is the SPI of the inbound SA at the P-CSCF's protected server port. The syntax of *spi\_pc* and *spi\_ps* is defined in Annex H.

Port\_P is the symbolic name of the port numbers (*port\_pc*, *port\_ps*) as defined in section 7.1. The syntax of Port\_P 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 two new pairs of SAs in the local SAD.

The UE shall integrity-protect SM7 and all following SIP messages. Furthermore the integrity algorithms list, *SPI\_P*, and *Port\_P* received in SM6, and *SPI\_U*, *Port\_U* sent in SM1 shall be included:

SM7:

REGISTER(Security-setup = *SPI\_U*, *Port\_U*, *SPI\_P*, *Port\_P*, *P-CSCF integrity algorithms list*)

After receiving SM7 from the UE, the P-CSCF shall check whether the integrity algorithms list, *SPI\_P*, and *Port\_P* received in SM7 is identical with the corresponding parameters sent in SM6. It further checks whether *SPI\_U* and *Port\_U* received in SM7 are identical with those received in SM1. If these checks are not successful 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 as indicated in clause 6.1.5. 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.

The use of the two pairs of unidirectional SAs is illustrated in the figure below with a set of example message exchanges protected by the respective IPsec SAs where the INVITE and following messages are assumed to be carried over TCP.

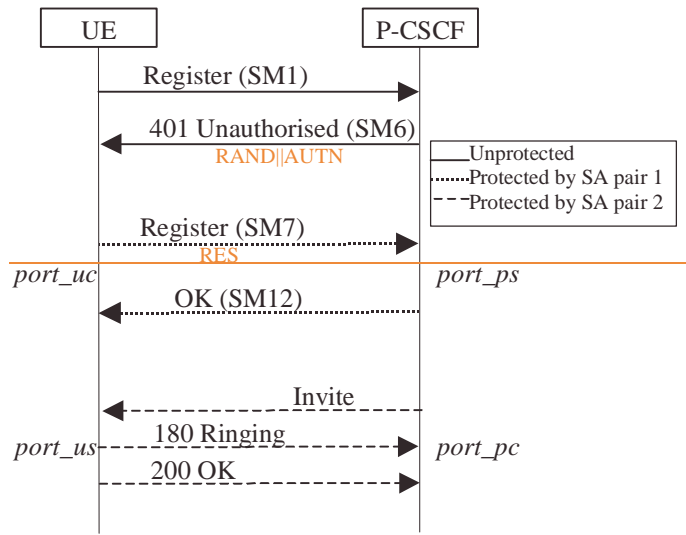


Figure 1

\*\*\*\*\* End of Change \*\*\*\*\*