3GPP TSG SA WG3 Security — SA3#36 **S3-040905**
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CR-Form-v7

CHANGE REQUEST

⌘ **33.203** **CR** **076** ⌘ **rev** **-** ⌘ Current version: **6.4.0** ⌘

*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 **X**

Title:	⌘	Corrections to Section 7.1 & 7.2
Source:	⌘	Lucent Technologies
Work item code:	⌘	IMS-ASEC
Date:	⌘	13/08/2004
Category:	⌘	**F**
Release:	⌘	Rel-6

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:	⌘	Correct the description in section 7.1&7.2.
Summary of change:	⌘	Correct the section 7.1 to avoid the repeat description as appropriate. 1. Section 7.1 “Both encryption algorithms shall be supported by both, the UE and the P-CSCF” in section 7.1 was removed since the sentences are repeated. 2. Section 7.2 Page 23 “SPI_U is the symbolic name of a pair of SPI values (cf. clause 7.1) (spi_us, 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_us and spi_us are defined in Annex H.” **Change the spi-us to spi-uc**..
Consequences if not approved:	⌘	Confusion with the specification description.

Clauses affected:	⌘	7.1, 7.2			
Other specs affected:	⌘	**Y**	**N**		⌘
			X	Other core specifications	
			X	Test specifications	
			X	O&M Specifications	
Other comments:	⌘				

****** First Change ******

7.1 Security association parameters

For protecting IMS signalling 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 and confidentiality, in accordance with the provisions in clauses 5.1.3 and 6.2.

The SA parameters that shall be negotiated between UE and P-CSCF in the security mode set-up procedure are:

- **Encryption algorithm**

  The encryption algorithm is either DES-EDE3-CBC as specified in RFC 2451 [20] or AES-CBC as specified in RFC 3602 [22] with 128 bit key.

  Both encryption algorithms shall be supported by both, the UE and the P-CSCF. ~~Both encryption algorithms shall be supported by both, the UE and the P-CSCF.~~

- **Integrity algorithm**

NOTE: What is called "authentication algorithm" in RFC 2406 [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 RFC 2406 [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. clause 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.

- Key length: the length of the encryption key depends on the encryption algorithm. The entropy of the key shall at least be 128 bits.

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 assocations 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").

     TCP case: 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; but it is not mandatory.

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 section 18 of RFC 3261 [6].

  2. The UE associates two ports, called *port_us* and *port_uc*, with each pair of security assocations 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").

TCP case: 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.

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, but it is not mandatory.

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 section 18 of RFC 3261 [6]

3. The P-CSCF is allowed to receive only REGISTER messages and error messages on unprotected ports. All other messages not arriving on a protected port shall be either discarded or rejected by the P-CSCF.

4. 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 rejected or silently discarded by the UE.

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 PI 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.

7.2 Set-up of security associations (successful case)

The set-up of security associations is based on RFC 3329 [21]. Annex H of this specification shows how to use RFC 3329 [21] for the set-up of security associations.

In this clause 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.

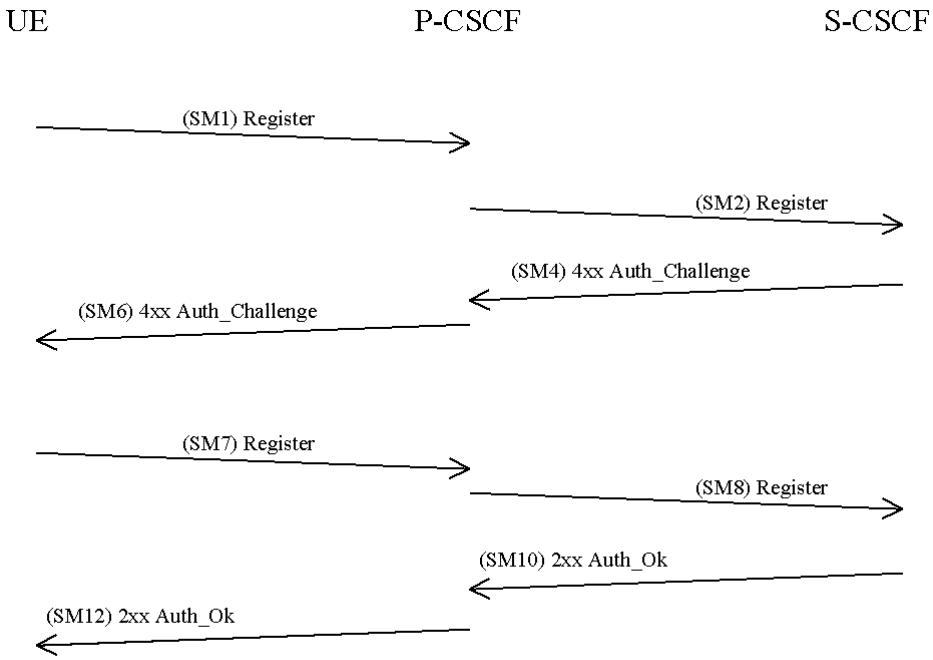

Figure 8

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 and encryption algorithms, which the UE supports.

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

SPI_U is the symbolic name of a pair of SPI values (cf. clause 7.1) (spi_ucs, 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_ucs and spi_us are defined in Annex H.

Port_U is the symbolic name of a pair of port numbers (*port_uc*, *port_us*) as defined in clause 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 keys IK_{IM} and CK_{IM} received from the S-CSCF to the temporarily stored parameters.

A Release 6 P-CSCF shall propose SA alternatives for Release 5 and Release 6 UE's since the UE may or may not support confidentiality protection. The P-CSCF selects the SPI for the inbound SA. The P-CSCF then selects the SPIs for the inbound SAs. The same SPI number shall be used for Release 5 and Release 6 options. 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 and encryption algorithm the P-CSCF proceeds as follows: the P-CSCF has a list of integrity and encryption algorithms it supports, ordered by priority. Release 6 algorithms shall have higher priority than Release 5 algorithms.The P-CSCF selects the first algorithm combination 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 and encryption algorithms, which the P-CSCF supports.

NOTE: P-CSCF may be configured to trust on the encryption provided by the underlying access network. In this case, the P-CSCF acts according to Release 5 specificatons, and does not include encryption algorithms to the *Security-setup*-line in SM6.

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

SPI_P is the symbolic name of the pair of SPI values (cf. clause 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 clause 7.1. The syntax of Port_P is defined in Annex H.

Upon receipt of SM6, the UE determines the integrity and encryption algorithms as follows: the UE selects the first integrity and encryption algorithm combination on the list received from the P-CSCF in SM 6 which is also supported by the UE.

NOTE: Release 5 UE will not support any encryption algorithms, and will choose the first Release 5 integrity algorithm on the list received from the P-CSCF in SM6.

The UE then proceeds to establish two new pairs of SAs in the local SAD.

The UE shall integrity and confidentiality 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 and encryption 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 thecorresponding 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 and confidentiality check in the P-CSCF.

SM8:
REGISTER(Integrity-Protection = *Successful, Confidentiality-Protection = Seccessful,* 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.

An example of how to make use of 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.

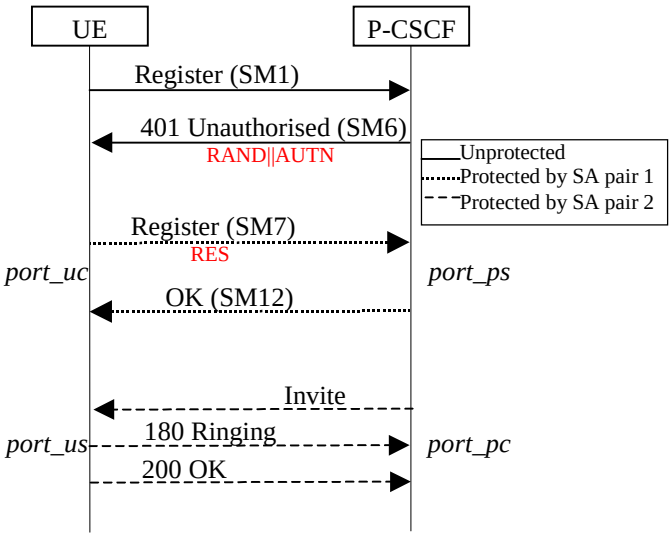

Figure 9