3GPP TSG SA WG 3 (Security) meeting #15
Washington (USA), 12—14 September, 2000

Document **S3-000598**
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.

33.102	**CR**	**xxx**	Current Version:	3.5.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to:	SA #9	for approval	X	strategic		(for SMG use only)
list expected approval meeting # here ↑		for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

Proposed change affects: (U)SIM [ ] ME [X] UTRAN / Radio [ ] Core Network [X]
(at least one should be marked with an X)

Source: Siemens **Date:** 13 Sept. 2000

Subject: Optional support for USIM-ME interface for GSM-only R99 ME

Work item: Security

Category: *(only one category shall be marked with an X)*

F	Correction	
A	Corresponds to a correction in an earlier release	
B	Addition of feature	
C	Functional modification of feature	X
D	Editorial modification	

Release:

Phase 2	
Release 96	
Release 97	
Release 98	
Release 99	X
Release 00	

Reason for change: Support for the USIM-ME interface is optional for GSM-only R99 ME.

Clauses affected: 6.8.1

Other specs affected:

Other 3G core specifications		→ List of CRs:
Other GSM core specifications		→ List of CRs:
MS test specifications		→ List of CRs:
BSS test specifications		→ List of CRs:
O&M specifications		→ List of CRs:

Other comments:

help.doc

<--------- double-click here for help and instructions on how to create a CR

6.8.1 Authentication and key agreement of UMTS subscribers

6.8.1.1 General

For UMTS subscribers, authentication and key agreement will be performed as follows:

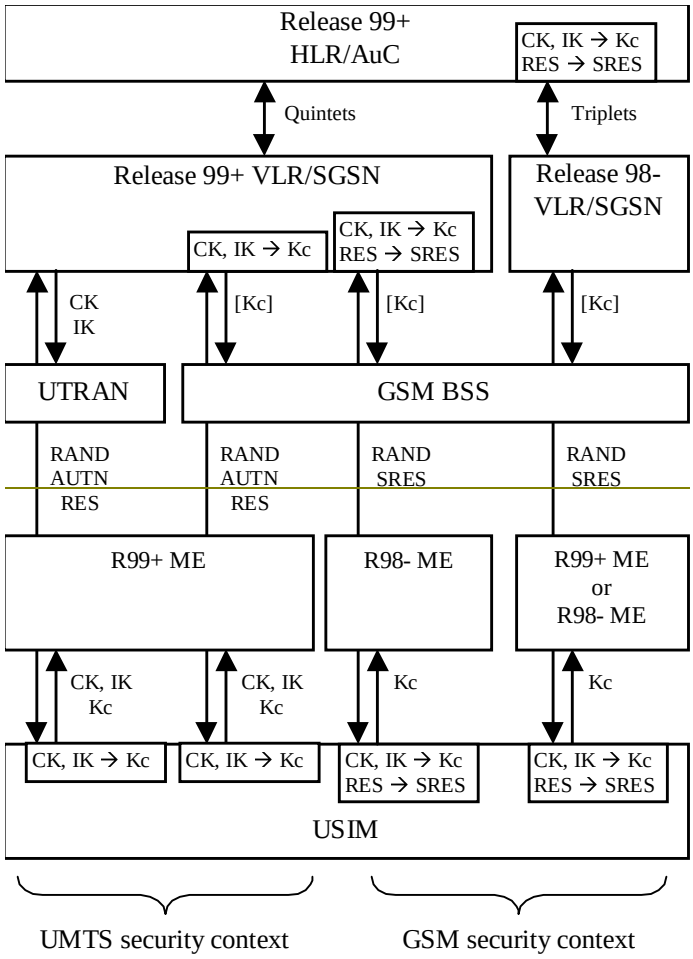
- UMTS AKA shall be applied when the user is attached to a UTRAN.
- UMTS AKA shall be applied when the user is attached to a GSM BSS, in case the user has ~~R99+~~ ME capable of UMTS AKA and also the VLR/SGSN is R99+. In this case, the GSM cipher key Kc is derived from the UMTS cipher/integrity keys CK and IK, by the VLR/SGSN on the network side and by the USIM on the user side.
- GSM AKA shall be applied when the user is attached to a GSM BSS, in case the user has ~~R98-~~ ME not capable of UMTS AKA. In this case, the GSM user response SRES and the GSM cipher key Kc are derived from the UMTS user response RES and the UMTS cipher/integrity keys CK and IK. A R98- VLR/SGSN uses the stored Kc and RES and a R99+ VLR/SGSN derives the SRES from RES and Kc from CK, IK.

NOTE: To operate within ~~a R98-~~ ME not capable of UMTS AKA the USIM may support the SIM-ME interface as defined in GSM 11.11, and support GSM AKA which provides the corresponding GSM functionality for calculating SRES and Kc based on the ~~3G~~ subscriber authentication key K and the 3G authentication algorithm implemented in the USIM. Due to the fact that the 3G authentication algorithm only computes CK/IK and RES, conversion of CK/IK to Kc shall be achieved by using the conversion function c3, and conversion of RES to SRES by c2.

- GSM AKA shall be applied when the user is attached to a GSM BSS, in case the VLR/SGSN is R98-. In this case, the USIM derives the GSM user response SRES and the GSM cipher key Kc from the UMTS user response RES and the UMTS cipher/integrity keys CK, IK.

The execution of the UMTS (resp. GSM) AKA results in the establishment of a UMTS (resp. GSM) security context between the user and the serving network domain to which the VLR/SGSN belongs. The user needs to separately establish a security context with each serving network domain.

Figure 18 shows the different scenarios that can occur with UMTS subscribers using either R98- or R99+ ME in a mixed network architecture.


Release 99+
HLR/AuC
CK, IK → Kc
RES → SRES
Quintets
Triplets
Release 99+ VLR/SGSN
Release 98-
VLR/SGSN
CK, IK → Kc
CK, IK → Kc
RES → SRES
CK
IK
[Kc]
[Kc]
[Kc]
UTRAN
GSM BSS
RAND
AUTN
RES
RAND
AUTN
RES
RAND
SRES
RAND
SRES
R99+ ME
R98- ME
R99+ ME
or
R98- ME
CK, IK
Kc
CK, IK
Kc
Kc
Kc
CK, IK → Kc
CK, IK → Kc
CK, IK → Kc
RES → SRES
CK, IK → Kc
RES → SRES
USIM
UMTS security context
GSM security context

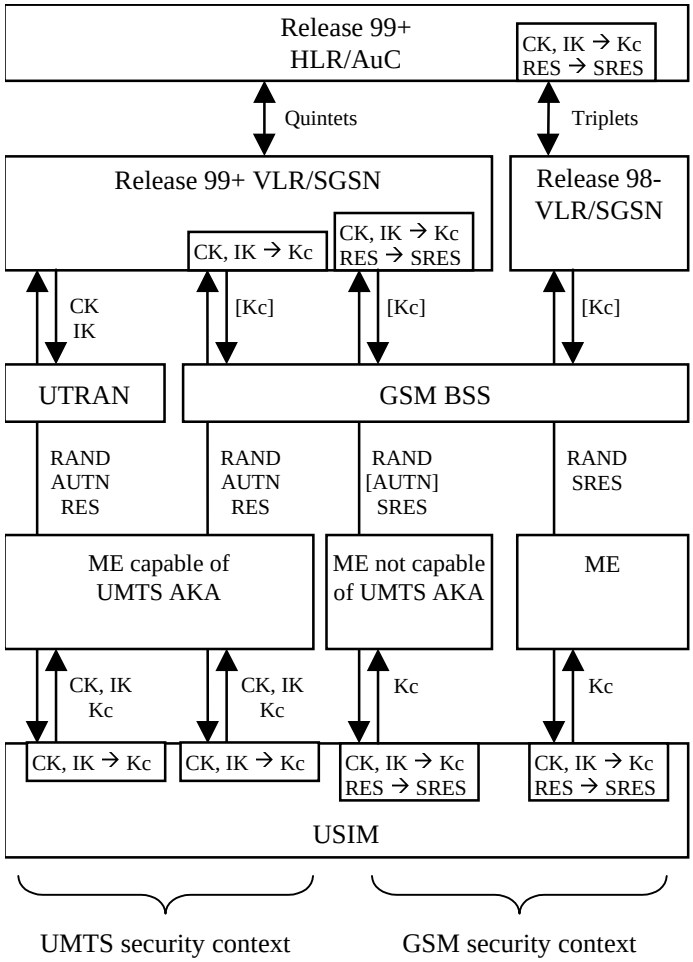


Figure 18: Authentication and key agreement of UMTS subscribers

Note that the UMTS parameters RAND, AUTN and RES are sent transparently through the UTRAN or GSM BSS and that the GSM parameters RAND and SRES are sent transparently through the GSM BSS.

In case of a GSM BSS, ciphering is applied in the GSM BSS for services delivered via the MSC/VLR, and by the SGSN for services delivered via the SGSN. In the latter case the GSM cipher key Kc is not sent to the GSM BSS.

In case of a UTRAN, ciphering and integrity are always applied in the RNC, and the UMTS cipher/integrity keys CK an IK are always sent to the RNC.

6.8.1.2 R99+ HLR/AuC

Upon receipt of an *authentication data request* from a R99+ VLR/SGSN for a UMTS subscriber, a R99+ HLR/AuC shall send quintuplets, generated as specified in 6.3.

Upon receipt of an *authentication data request* from a R98- VLR/SGSN for a UMTS subscriber, a R99+ HLR/AuC shall send triplets, derived from quintuplets using the following conversion functions:

a) c1: $RAND_{[GSM]} = RAND$

b) c2: $SRES_{[GSM]} = XRES_1$ [xor $XRES_2$ [xor $XRES_3$ [xor $XRES_4$]]]

c) c3: $Kc_{[GSM]} = CK_1$ xor CK_2 xor IK_1 xor IK_2

whereby $XRES_i$ are all 32 bit long and XRES = $XRES_1$ [|| $XRES_2$ [|| $XRES_3$ [|| $XRES_4$]]] dependent on the length of XRES, and CK_i and IK_i are both 64 bits long and CK = CK_1 || CK_2 and IK = IK_1 || IK_2.

6.8.1.3 R99+ VLR/SGSN

The AKA procedure will depend on the terminal capabilities, as follows:

- **UMTS subscriber with R99+ ME**

When the user has R99+ ME, the VLR/SGSN shall send the UE a UMTS authentication challenge (i.e., RAND and AUTN) ~~UMTS AKA shall be performed~~ using a quintuplet that is either:

a) retrieved from the local database,

b) provided by the HLR/AuC, or

c) provided by the previously visited R99+ VLR/SGSN.

Note: Originally all quintuplets are provided by the HLR/AuC.

When the ME is capable of the USIM-ME interface UMTS AKA is performed and the VLR/SGSN receives the UMTS response RES.

UMTS AKA results in the establishment of a UMTS security context; the UMTS cipher/integrity keys CK and IK and the key set identifier KSI are stored in theVLR/SGSN.

When the user is attached to a UTRAN, the UMTS cipher/integrity keys are sent to the RNC, where the cipher/integrity algorithms are allocated.

When the user is attached to a GSM BSS, UMTS AKA is followed by the derivation of the GSM cipher key from the UMTS cipher/integrity keys. When the user receives service from an MSC/VLR, the derived cipher key Kc is then sent to the BSC (and forwarded to the BTS). When the user receives service from an SGSN, the derived cipher key Kc is applied in the SGSN itself.

~~UMTS authentication and key freshness is always provided to UMTS subscribers with R99+ **ME** independently of the radio access network.~~

When the ME is not capable of the USIM-ME interface GSM AKA is performed and the VLR/SGSN receives the GSM response SRES. This can only occur when the user is attached via the GSM BSS.

The VLR/SGSN shall accept both the UMTS response RES (max. 128 bits) and the GSM response SRES (32 bits).

NOTE: When the ME is Release 99 and not capable of UMTS AKA a UMTS security context is established in the VLR/SGSN while a GSM security context is established in the UE. This can only occur when GSM-only ME is used.

- **UMTS subscriber with R98- ME**

When the user has R98- ME, the R99+ VLR/SGSN shall send the UE a GSM authentication challenge (i.e., RAND) ~~perform GSM AKA~~ using a triplet that is either

a) derived by means of the conversion functions c2 and c3 in the R99+ VLR/SGSN from a quintuplet that is:

i) retrieved from the local database,

ii) provided by the HLR/AuC, or

iii) provided by the previously visited R99+ VLR/SGSN, or

b) provided as a triplet by the previously visited MSC/VLR or SGSN.

NOTE: R99+ VLR/SGSN will always provide quintuplets for UMTS subscribers.

NOTE: For a UMTS subscriber, all triplets are derived from quintuplets, be it in the HLR/AuC or in an VLR/SGSN.

GSM AKA results in the establishment of a GSM security context; the GSM cipher key Kc and the cipher key sequence number CKSN are stored in the VLR/SGSN.

In this case the user is attached to a GSM BSS. When the user receives service from an MSC/VLR, the GSM cipher key is sent to the BSC (and forwarded to the BTS). When the user receives service from an SGSN, the derived cipher key Kc is applied in the SGSN itself.

UMTS authentication and key freshness cannot be provided to UMTS subscriber with R98- ME.

6.8.1.4 R99+ ME

Release 99+ ME that has UTRAN radio capability shall support the USIM-ME interface as specified in TS 31.102 [n].

Release 99+ ME that has no UTRAN radio capabilities (i.e., GSM-only R99 ME) may support the USIM-ME interface as specified in TS 31.102 [n].

R99+ ME that supports the USIM-ME interface with a USIM inserted and attached to a UTRAN shall only participate in UMTS AKA and shall not participate in GSM AKA.

R99+ ME that supports the USIM-ME interface with a USIM inserted and attached to a GSM BSS shall participate in UMTS AKA and may participate in GSM AKA. Participation in GSM AKA is required to allow registration in a R98- VLR/SGSN.

R99+ ME that does not support the USIM-ME interface with a USIM inserted shall only participate in GSM AKA.

The execution of UMTS AKA results in the establishment of a UMTS security context; the UMTS cipher/integrity keys CK and IK and the key set identifier KSI are passed to the ME. If the USIM supports conversion function c3 and/or GSM AKA, the ME shall also receive a GSM cipher key Kc derived at the USIM.

The execution of GSM AKA results in the establishment of a GSM security context; the GSM cipher key Kc and the cipher key sequence number CKSN are stored in the ME.

6.8.1.5 USIM

The USIM

shall support UMTS AKA and

may support backwards compatibility with the GSM system, which consists of

Feature 1. GSM cipher key derivation (conversion function c3) to access GSM BSS attached to a R99+ VLR/SGSN using a dual-mode R99+ ME

Feature 2. GSM AKA to access the GSM BSS attached to a R98- VLR/SGSN or when using R98- ME;

Feature 3. SIM-ME interface [GSM 11.11] to operate within R98- ME.

When the ME provides the USIM with RAND and AUTN, UMTS AKA shall be executed. If the verification of AUTN is successful, the USIM shall respond with the UMTS user response RES and the UMTS cipher/integrity keys CK and IK. The USIM shall store CK and IK as current security context data. If the USIM supports access to GSM cipher key derivation (feature 1), the USIM shall also derive the GSM cipher key Kc from the UMTS cipher/integrity keys CK and IK using conversion function c3 and send the derived Kc to the R99+ ME. In case the verification of AUTN is not successful, the USIM shall respond with an appropriate error indication to the R99+ ME.

When the ME provides the USIM with only RAND, and the USIM supports GSM AKA (Feature 2), GSM AKA shall be executed. The USIM first computes the UMTS user response RES and the UMTS cipher/integrity keys CK and IK. The USIM then derives the GSM user response SRES and the GSM cipher key Kc using the conversion functions c2 and c3. The USIM then stores the GSM cipher key Kc as the current security context and sends the GSM user response SRES and the GSM cipher key Kc to the ME.

In case the USIM does not support GSM cipher key derivation (Feature 1) or GSM AKA (Feature 2), the R99+ ME shall be informed. A USIM that does not support GSM cipher key derivation (Feature 1) cannot operate in any GSM BSS. A USIM that does not support GSM AKA (Feature 2) cannot operate under a R98- VLR/SGSN or in a R98- ME.