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

Document **S3-000613**

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.

33.105 **CR** **xxx** Current Version: 3.4.0

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

For submission to:	SA #10	for approval	☒	strategic	□	*(for SMG*
list expected approval meeting # here ↑		for information	□	non-strategic	□	*use only)*

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 □ UTRAN / Radio □ Core Network ☒
(at least one should be marked with an X)

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

Subject: Anonymity key computation during re-synchronisation

Work item: Security

Category:	F	Correction	□	**Release:**	Phase 2	□
	A	Corresponds to a correction in an earlier release	□		Release 96	□
(only one category	B	Addition of feature	□		Release 97	□
shall be marked	C	Functional modification of feature	☒		Release 98	□
with an X)	D	Editorial modification	□		Release 99	☒
					Release 00	□

Reason for change: ETSI SAGE (developing the example set of functions for AKA) signalled that computing the anonymity key this way would allow for faster processing – and SA-3 did no see security issues related to the change.

Clauses affected: 3.2, 5.1.1, 5.1.1.3, 5.1.1.4, 5.1.2, 5.1.3, 5.1.4, 5.1.6.7, 5.1.6.8 (new)

Other specs affected:	Other 3G core specifications	☒	→ List of CRs:	33.102 CR xxx, 33.103 CR xxx
	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

3.2 Symbols

For the purposes of the present document, the following symbols apply:

||	Concatenation
⊕	Exclusive or
f0	random challenge generating function
f1	network authentication function
f1*	the re-synchronisation message authentication function;
f2	user authentication function
f3	cipher key derivation function
f4	integrity key derivation function
f5	anonymity key derivation function for normal operation
f5*	anonymity key derivation function for re-synchronisation
f6	user identity encryption function
f7	user identity decryption function
f8	UMTS encryption algorithm
f9	UMTS integrity algorithm

5.1.1 Overview

The mechanism for authentication and key agreement described in clause 6.3 of [1] requires the following cryptographic functions:

f0	the random challenge generating function;
f1	the network authentication function;
f1*	the re-synchronisation message authentication function;
f2	the user authentication function;
f3	the cipher key derivation function;
f4	the integrity key derivation function;
f5	the anonymity key derivation function for normal operation;
f5*	the anonymity key derivation function for re-synchronisation.

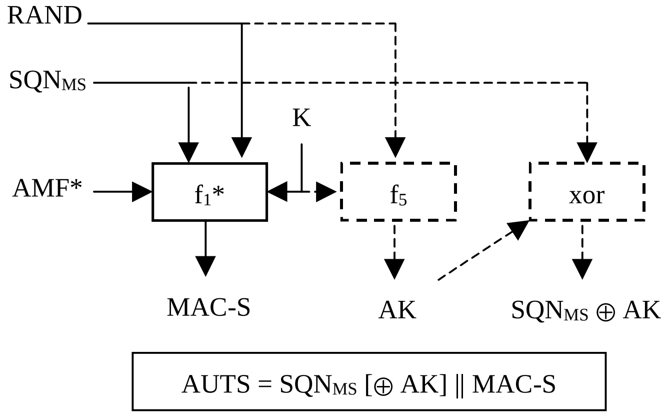
5.1.1.3 Generation of re-synchronisation token in the USIM

Upon the assertion of a synchronisation failure, the USIM generates a re-synchronisation token as follows:

a) The USIM computes MAC-S = $f1*_K(SQN_{MS} \| RAND \| AMF*)$, whereby AMF* is a default value for AMF used in re-synchronisation.

b) If SQN_{MS} is to be concealed with an anonymity key AK, the USIM computes AK = $f5*_K(RAND)$ and the concealed counter value is then computed as $SQN_{MS} \oplus AK$.

c) The re-synchronisation token is constructed as AUTS = SQN_{MS} [$\oplus$ AK] || MAC-S.



EMBED

Figure 3: Generation of re-synchronisation token in the USIM

5.1.1.4 Re-synchronisation in the HLR/AuC

Upon receipt of an indication of synchronisation failure and a (AUTS, RAND) pair, the HLR/AuC may perform the following cryptographic functions:

EMBED

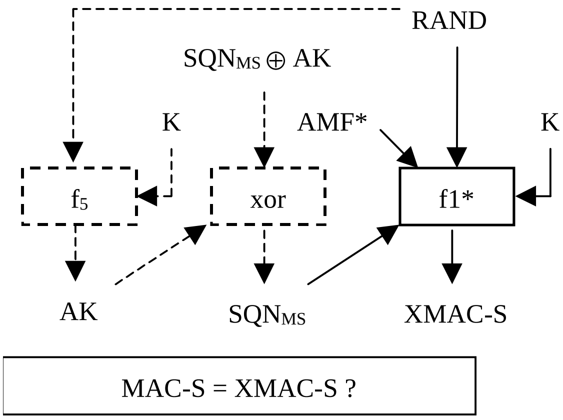


Figure 4: Re-synchronisation in the HLR/AuC

a) If SQN_{MS} is concealed with an anonymity key AK, the HLR/AuC computes AK = $f5*_K$(RAND) and retrieves the unconcealed counter value as SQN_{MS} = (SQN_{MS} ⊕ AK) xor AK.

b) If SQN generated from SQN_{HE} would not be acceptable, then the HLR/AuC computes XMAC-S = $f1*_K$(SQN_{MS} || RAND || AMF*), whereby AMF* is a default value for AMF used in re-synchronisation.

5.1.2 Use

The functions f0—f5 shall only be used to provide mutual entity authentication between USIM and AuC, derive keys to protect user and signalling data transmitted over the radio access link and conceal the sequence number to protect user identity confidentiality. The function f1* shall only be used to provide data origin authentication for the synchronisation failure information sent by the USIM to the AuC. The function f5* shall only be used to provide user identity confidentiality during re-synchronisation.

5.1.3 Allocation

The functions f1—f5, f1*and f5* are allocated to the Authentication Centre (AuC) and the USIM. The function f0 is allocated to the AuC.

5.1.4 Extent of standardisation

The functions f0—f5, f1*and f5* are proprietary to the home environment. Examples of the functions f1, f1* and f2 are CBC-MACs or H-MACs [3].

5.1.5 Implementation and operational considerations

The functions f1—f5, f1* and f5* shall be designed so that they can be implemented on an IC card equipped with a 8-bit microprocessor running at 3.25 MHz with 8 kbyte ROM and 300byte RAM and produce AK, XMAC-A, RES, CK and IK in less than 500 ms execution time.

5.1.6.7 f5

f5: the anonymity key derivation function for normal operation

f5: (K; RAND) → AK

f5 should be a key derivation function. In particular, it shall be computationally infeasible to derive K from knowledge of RAND and AK.

The use of f5 is optional.

5.1.6.8 f5*

f5*: the anonymity key derivation function for re-synchronisation

f5*: (K; RAND) → AK

f5* should be a key derivation function. In particular, it shall be computationally infeasible to derive K from knowledge of RAND and AK.

The use of f5* is optional.