Technical Specification Group Services and System Aspects **TSGS#10(00)0626**
Meeting #10, Bangkok, Tailand, 11-14 December 2000

Source: **SA WG3**

Title: **CRs to TS 33.102**

Document for: **Approval**

Agenda Item: **7.3.3**

The following CRs were agreed at SA WG3 meeting #16 and are presented to TSG SA #10 for approval.

Spec	CR	Rev	Phase	Subject	Cat	Ver	WG	Meeting	S3 doc
33.102	129		R99	Corrections on ciphering and integrity protection	F	3.6.0	S3	S3-16	S3-000666
33.102	130		R99	Re-transmission of authentication request using the same quintet	F	3.6.0	S3	S3-16	S3-000725
33.102	131		R99	Corrections to Counter Check procedure	F	3.6.0	S3	S3-16	S3-000726
33.102	132		R99	Intersystem handover for CS Services – from GSM BSS to UTRAN	F	3.6.0	S3	S3-16	S3-000727
33.102	133		R99	Correction on use of GSM MS classmark in UMTS	F	3.6.0	S3	S3-16	S3-000729
33.102	134		R99	START value handling for MS with a GSM SIM inserted	F	3.6.0	S3	S3-16	S3-000739

3GPP TSG SA WG 3 (Security) meeting #16 **S3-000666**
Sophia Antipolis, France, 28-30 November, 2000

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CHANGE REQUEST

⌘ **33.102** CR **129** ⌘	rev **-** ⌘	Current version: **3.6.0** ⌘		

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

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [X] Radio Access Network [X] Core Network [ ]

Title: ⌘	Corrections on ciphering and integrity protection		
Source: ⌘	SA WG3		
Work item code: ⌘		***Date:*** ⌘	2000-11-21
Category: ⌘	**F**	***Release:*** ⌘	R99
	Use one of the following categories: ***F*** *(essential 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)*

Reason for change: ⌘	Integrity protection: - The list of RRC messages that can not be integrity protected is updated. - Integrity protection is used on signalling radio bearers (RB 0-4), and it should be clarified that RRC messages on signalling radio bearer using RLC TM (RB 0 in uplink) can also be integrity protected. Ciphering: For radio bearers using RLC TM there is one up-link COUNT-C value and one down-link COUNT-C value for all radio bearers that are connected to the same CN domain. - Since the definition of the plaintext block can be found in TS 33.105, the duplicated description has been removed from this specification.
Summary of change: ⌘	Removal of duplicated text for plaintext block
Consequences if not approved: ⌘	List of RRC messages incomplete causing ambiguity between SA WG3 and RAN documentation.

Clauses affected: ⌘	6.5.1, 6.5.4.1, 6.6.4.1	
Other specs affected: ⌘	[ ] Other core specifications [ ] Test specifications [ ] O&M Specifications	⌘
Other comments: ⌘		

6.5 Access link data integrity

6.5.1 General

Most control signalling information elements that are sent between the MS and the network are considered sensitive and must be integrity protected. A message authentication function shall be applied on these signalling information elements transmitted between the ME and the RNC.

After the RRC connection establishment and execution of the security mode set-up procedure, all dedicated MS <–> network control signalling messages (e.g. RRC, MM, CC, GMM, and SM messages) shall be integrity protected. The Mobility Management layer in the MS supervises that the integrity protection is started (see section 6.4.5).

All signalling messages except the following ones shall then be integrity protected:

HANDOVER TO UTRAN COMPLETE

PAGING TYPE 1

PUSCH CAPACITY REQUEST

PHYSICAL SHARED CHANNEL ALLOCATION

RRC CONNECTION REQUEST

RRC CONNECTION SETUP

RRC CONNECTION SETUP COMPLETE

RRC CONNECTION REJECT

RRC CONNECTION RELEASE (CCCH only)

SYSTEM INFORMATION (BROADCAST INFORMATION)

SYSTEM INFORMATION CHANGE INDICATION

TRANSPORT FORMAT COMBINATION CONTROL (TM DCCH only)

~~- Paging Type 1~~

~~- RRC Connection Request~~

~~- RRC Connection Setup~~

~~- RRC Connection Setup Complete~~

~~- RRC Connection Reject~~

~~- System Information (broadcasted information)~~

~~- Handover to UTRAN complete~~.

6.5.2 Layer of integrity protection

The UIA shall be implemented in the ME and in the RNC.

Integrity protection shall be applied at the RRC layer.

6.5.3 Data integrity protection method

Figure 16 illustrates the use of the integrity algorithm f9 to authenticate the data integrity of a signalling message.

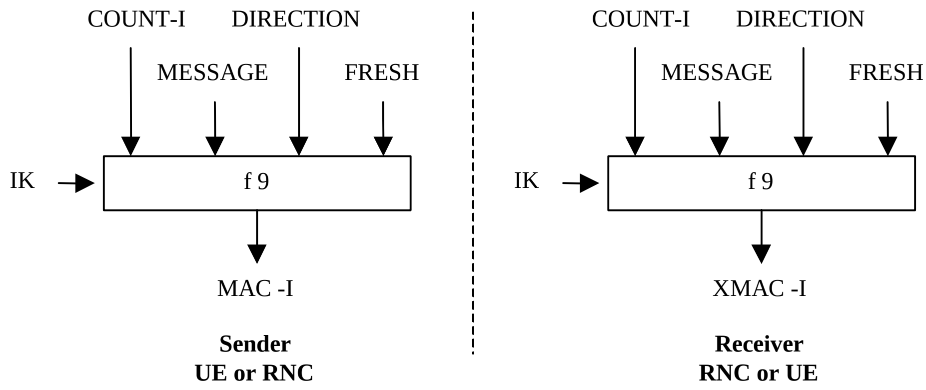

Figure 16: Derivation of MAC-I (or XMAC-I) on a signalling message

The input parameters to the algorithm are the Integrity Key (IK), the integrity sequence number (COUNT-I), a random value generated by the network side (FRESH), the direction bit DIRECTION and the signalling data MESSAGE. Based on these input parameters the user computes message authentication code for data integrity MAC-I using the integrity algorithm f9. The MAC-I is then appended to the message when sent over the radio access link. The receiver computes XMAC-I on the message received in the same way as the sender computed MAC-I on the message sent and verifies the data integrity of the message by comparing it to the received MAC-I.

6.5.4 Input parameters to the integrity algorithm

6.5.4.1 COUNT-I

The integrity sequence number COUNT-I is 32 bits long.

For signalling radio bearers (RB 0-4) ~~There~~there is one COUNT-I value per up-link signalling radio bearer and one COUNT-I value per down-link signalling radio bearer~~ using RLC AM or RLC UM~~.

COUNT-I is composed of two parts: a "short" sequence number and a "long" sequence number. The "short" sequence number forms the least significant bits of COUNT-I while the "long" sequence number forms the most significant bits of COUNT-I. The "short" sequence number is the 4-bit RRC sequence number (RRC SN) that is available in each RRC PDU. The "long" sequence number is the 28-bit RRC hyper frame number (RRC HFN) which is incremented at each RRC SN cycle.

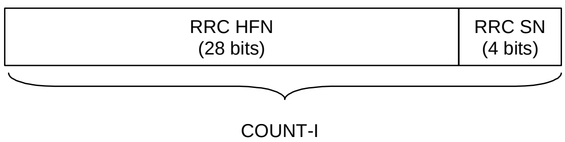

Figure 16a: The structure of COUNT-I

The RRC HFN is initialised by means of the parameter START, which is described in subclause 6.4.8. The ME and the RNC then initialise the 20 most significant bits of the RRC HFN to START; the remaining bits of the RRC HFN are initialised to 0.

6.5.4.2 IK

The integrity key IK is 128 bits long.

There may be one IK for CS connections (IK_{CS}), established between the CS service domain and the user and one IK for PS connections (IK_{PS}) established between the PS service domain and the user. Which integrity key to use for a particular connection is described in 6.5.5.

For UMTS subscribers IK is established during UMTS AKA as the output of the integrity key derivation function f4, that is available in the USIM and in the HLR/AuC. For GSM subscribers, that access the UTRAN, IK is established following GSM AKA and is derived from the GSM cipher key Kc, as described in 6.8.2.

IK is stored in the USIM and a copy is stored in the ME. IK is sent from the USIM to the ME upon request of the ME. The USIM shall send IK under the condition that a valid IK is available. The ME shall trigger a new authentication procedure if the current value of $START_{CS}$ or $START_{PS}$ in the USIM are not up-to-date or $START_{CS}$ or $START_{PS}$ have reached THRESHOLD. The ME shall delete IK from memory after power-off as well as after removal of the USIM.

IK is sent from the HLR/AuC to the VLR/SGSN and stored in the VLR/SGSNas part of a quintet. It is sent from the VLR/SGSN to the RNC in the (RANAP) *security mode command*.

At handover, the IK is transmitted within the network infrastructure from the old RNC to the new RNC, to enable the communication to proceed, and the synchronisation procedure is resumed. The IK remains unchanged at handover.

6.5.4.3 FRESH

The network-side nonce FRESH is 32 bits long.

There is one FRESH parameter value per user. The input parameter FRESH protects the network against replay of signalling messages by the user. At connection set-up the RNC generates a random value FRESH and sends it to the user in the (RRC) *security mode command*. The value FRESH is subsequently used by both the network and the user throughout the duration of a single connection. This mechanism assures the network that the user is not replaying any old MAC-Is.

At handover with relocation of the S-RNC, the new S-RNC generates its own value for the FRESH parameter and sends it to the ME in the RRC message that indicates a new UTRAN Radio Network Temporary Identity due to a SRNC relocation (see TS 25.331 [17]).

6.5.4.4 DIRECTION

The direction identifier DIRECTION is 1 bit long.

The direction identifier is input to avoid that the integrity algorithm used to compute the message authentication codes would use an identical set of input parameter values for the up-link and for the down-link messages. The value of the DIRECTION is 0 for messages from UE to RNC and 1 for messages from RNC to UE.

6.5.4.5 MESSAGE

The signalling message itself with the radio bearer identity. The latter is appended in front of the message. Note that the radio bearer identity is not transmitted with the message but it is needed to avoid that for different instances of message authentication codes the same set of input parameters is used.

6.5.5 Integrity key selection

There may be one IK for CS connections (IK_{CS}), established between the CS service domain and the user and one IK for PS connections (IK_{PS}) established between the PS service domain and the user.

The data integrity of radio bearers for user data is not protected.

The signalling radio bearers are used for transfer of signalling data for services delivered by both CS and PS service domains. These signalling radio bearers are data integrity protected by the IK of the service domain for which the most recent security mode negotiation took place. This may require that the integrity key of an (already integrity protected) ongoing signalling connection has to be changed, when a new connection is established with another service domain, or when a security mode negotiation follow a re-authentication during an ongoing connection. This change should be completed within five seconds after the security mode negotiation.

6.5.6 UIA identification

Each UMTS Integrity Algorithm (UIA) will be assigned a 4-bit identifier. Currently, the following values have been defined:

"0001_2" : UIA1, Kasumi.

The remaining values are not defined.

The use of Kasumi for the integrity protection function f9 is specified in TS 35.201 [11] and TS 35.202 [12]. Implementers' test data and design conformance data is provided in TS 35.203 [13] and TS 35.202 [14].

6.6 Access link data confidentiality

6.6.1 General

User data and some signalling information elements are considered sensitive and must be confidentiality protected. To ensure identity confidentiality (see section 6.1), the temporary user indentity (P-)TMSI must be transferred in a protected mode at allocation time and at other times when the signalling procedures permit it.

These needs for a protected mode of transmission are fulfilled by a confidentiality function which is applied on dedicated channels between the ME and the RNC.

6.6.2 Layer of ciphering

The ciphering function is performed either in the RLC sub-layer or in the MAC sub-layer, according to the following rules:

- If a radio bearer is using a non-transparent RLC mode (AM or UM), ciphering is performed in the RLC sub-layer.
- If a radio bearer is using the transparent RLC mode, ciphering is performed in the MAC sub-layer (MAC-d entity).

Ciphering when applied is performed in the S-RNC and the ME and the context needed for ciphering (CK, HFN, etc.) is only known in S-RNC and the ME.

6.6.3 Ciphering method

Figure 16b illustrates the use of the ciphering algorithm f8 to encrypt plaintext by applying a keystream using a bit per bit binary addition of the plaintext and the keystream. The plaintext may be recovered by generating the same keystream using the same input parameters and applying a bit per bit binary addition with the ciphertext.

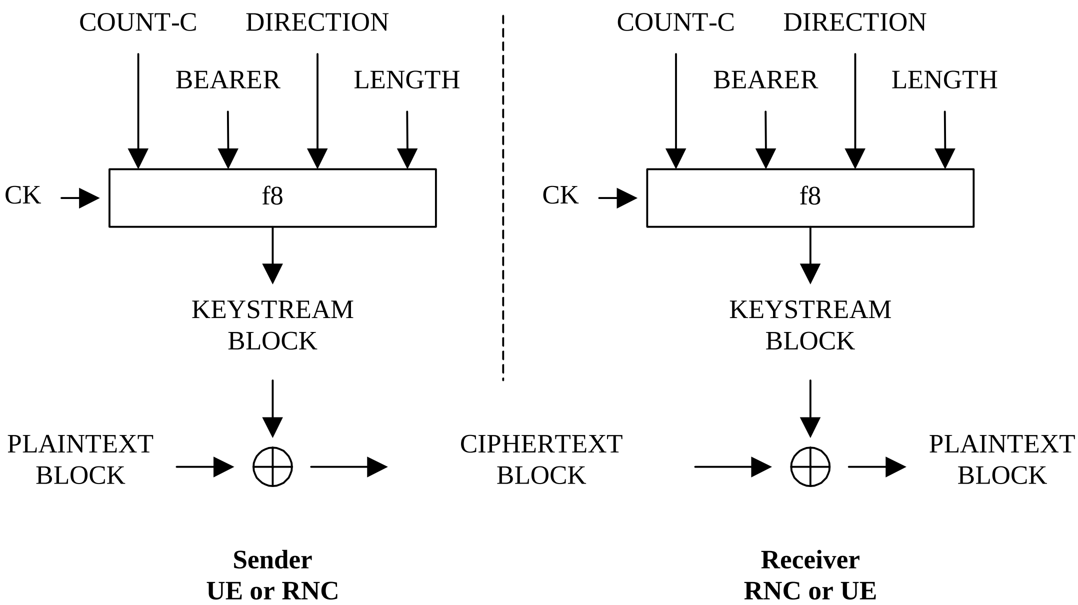

Figure 16b: Ciphering of user and signalling data transmitted over the radio access link

The input parameters to the algorithm are the cipher key CK, a time dependent input COUNT-C, the bearer identity BEARER, the direction of transmission DIRECTION and the length of the keystream required LENGTH. Based on these input parameters the algorithm generates the output keystream block KEYSTREAM which is used to encrypt the input plaintext block PLAINTEXT to produce the output ciphertext block CIPHERTEXT.

The input parameter LENGTH shall affect only the length of the KEYSTREAM BLOCK, not the actual bits in it.

6.6.4 Input parameters to the cipher algorithm

6.6.4.1 COUNT-C

The ciphering sequence number COUNT-C is 32 bits long.

There is~~are~~ one COUNT-C value per up-link radio bearer and one COUNT-C value per down-link radio bearer using RLC AM or RLC UM. There is~~are~~ one up-link COUNT-C value and one down-link COUNT-C value for all radio bearers using the transparent RLC mode that are connected to the same CN domain (and mapped onto DCH).

COUNT-C is composed of two parts: a "short" sequence number and a "long" sequence number. The "short" sequence number forms the least significant bits of COUNT-C while the "long" sequence number forms the most significant bits of COUNT-C. The update of COUNT-C depends on the transmission mode as described below (see figure 16c).

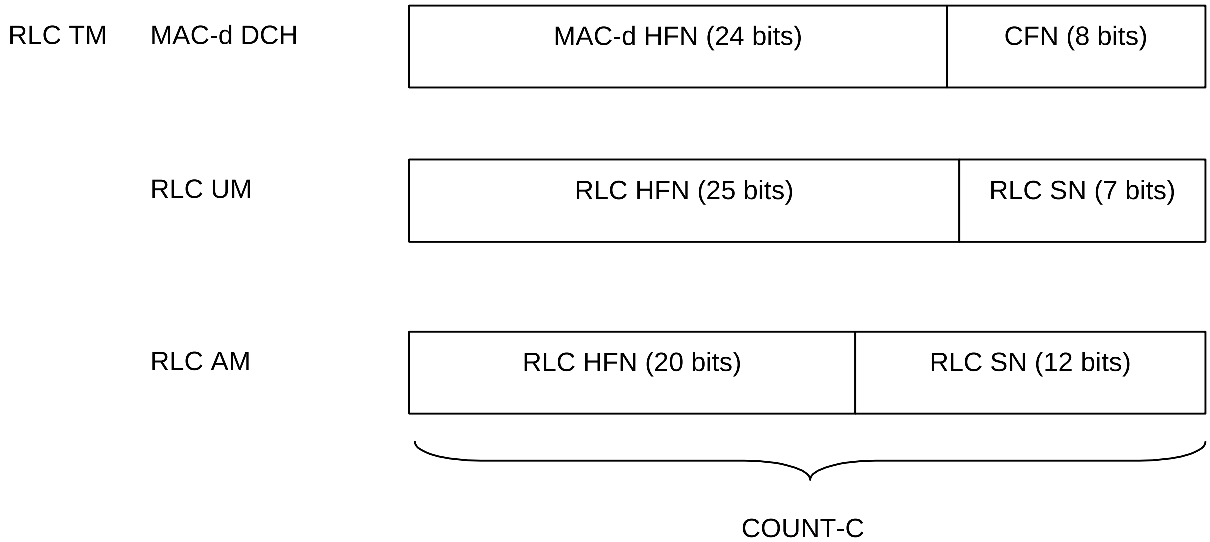

Figure 16c: The structure of COUNT-C for all transmission modes

- For RLC TM on DCH, the "short" sequence number is the 8-bit connection frame number CFN of COUNT-C. It is independently maintained in the ME MAC-d entity and the SRNC MAC-d entity. The "long" sequence number is the 24-bit MAC-d HFN, which is incremented at each CFN cycle.

- For RLC UM mode, the "short" sequence number is the 7-bit RLC sequence number (RLC SN) and this is part of the RLC UM PDU header. The "long" sequence number is the 25-bit RLC UM HFN which is incremented at each RLC SN cycle.

- For RLC AM mode, the "short" sequence number is the 12-bit RLC sequence number (RLC SN) and this is part of the RLC AM PDU header. The "long" sequence number is the 20-bit RLC AM HFN which is incremented at each RLC SN cycle.

The hyperframe number HFN is initialised by means of the parameter START, which is described in subclause 6.4.8. The ME and the RNC then initialise the 20 most significant bits of the RLC AM HFN, RLC UM HFN and MAC-d HFN to START. The remaining bits of the RLC AM HFN, RLC UM HFN and MAC-d HFN are initialised to zero.

When a new radio bearer is created during a RRC connection in ciphered mode, the HFN is initialised by the current START value (see subclause 6.4.8).

~~The plaintext block, i.e. the data unit that is ciphered, depends on the transmission mode as described below.~~

- ~~For RLC UM mode, the plaintext block is the UMD PDU excluding the first octet, i.e. excluding the RLC UM PDU header (see TS 25.322 [19]).~~
- ~~For RLC AM mode, the plaintext block is the AMD PDU excluding the two first octets, i.e. excluding the RLC AM PDU header (see TS 25.322 [19]).~~
- ~~For RLC TM on DCH, the plaintext block is the MAC SDU (see TS 25.321 [18]).~~

6.6.4.2 CK

The cipher key CK is 128 bits long.

There may be one CK for CS connections (CK_{CS}), established between the CS service domain and the user and one CK for PS connections (CK_{PS}) established between the PS service domain and the user. The CK to use for a particular radio bearer is described in 6.6.5. For UMTS subscribers, CK is established during UMTS AKA, as the output of the cipher key derivation function f3, available in the USIM and in HLR/AuC. For GSM subscribers that access the UTRAN, CK is established following GSM AKA and is derived from the GSM cipher key Kc, as described in 8.2.

CK is stored in the USIM and a copy is stored in the ME. CK is sent from the USIM to the ME upon request of the ME. The USIM shall send CK under the condition that a valid CK is available. The ME shall trigger a new authentication procedure if the current value of $START_{CS}$ or $START_{PS}$ in the USIM have reached THRESHOLD. The ME shall delete CK from memory after power-off as well as after removal of the USIM.

CK is sent from the HLR/AuC to the VLR/SGSN and stored in the VLR/SGSN as part of the quintet. It is sent from the VLR/SGSN to the RNC in the (RANAP) security mode command.

At handover, the CK is transmitted within the network infrastructure from the old RNC to the new RNC, to enable the communication to proceed. The cipher CK remains unchanged at handover.

6.6.4.3 BEARER

The radio bearer identifier BEARER is 5 bits long.

There is one BEARER parameter per radio bearer associated with the same user and multiplexed on a single 10ms physical layer frame. The radio bearer identifier is input to avoid that for different keystream an identical set of input parameter values is used.

6.6.4.4 DIRECTION

The direction identifier DIRECTION is 1 bit long.

The direction identifier is input to avoid that for the keystreams for the up-link and for the down-link would use the an identical set of input parameter values. The value of the DIRECTION is 0 for messages from UE to RNC and 1 for messages from RNC to UE.

6.6.4.5 LENGTH

The length indicator LENGTH is 16 bits long.

The length indicator determines the length of the required keystream block. LENGTH shall affect only the length of the KEYSTREAM BLOCK, not the actual bits in it.

3GPP TSG-SA3 Meeting #16 **Tdoc S3-000725**
Sophia Antipolis, France, 28-30 Nov.

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CHANGE REQUEST

⌘ **33.102**	**CR 130**	⌘ rev	**-**	⌘ Current version:	**3.6.0**	⌘

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

Proposed change affects: ⌘	(U)SIM [X]	ME/UE [X]	Radio Access Network [ ]	Core Network [ ]

Title: ⌘	Re-transmission of authentication request using the same quintet		
Source: ⌘	SA WG3		
Work item code: ⌘	Security	***Date:*** ⌘	28 Nov. 2000
Category: ⌘	**F**	***Release:*** ⌘	R99
	Use one of the following categories: ***F*** *(essential 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)*

Reason for change: ⌘	The implementation of the retransmission mechanism on USIM is considered inefficient.
Summary of change: ⌘	The retransmission-mechanism is moved from USIM to ME.
Consequences if not approved: ⌘	Inefficient implementation

Clauses affected: ⌘		
Other specs affected: ⌘	[ ] Other core specifications ⌘ [ ] Test specifications [ ] O&M Specifications	
Other comments: ⌘		

6.3.3 Authentication and key agreement

The purpose of this procedure is to authenticate the user and establish a new pair of cipher and integrity keys between the VLR/SGSN and the USIM. During the authentication, the USIM verifies the freshness of the authentication vector that is used.

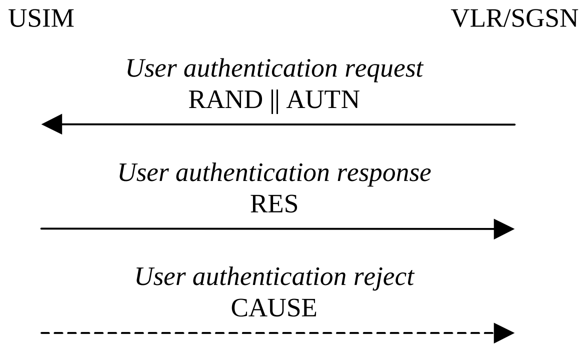

Figure 8: Authentication and key establishment

The VLR/SGSN invokes the procedure by selecting the next unused authentication vector from the ordered array of authentication vectors in the VLR/SGSN database. Authentication vectors in a particular node are used on a first-in / first-out basis. The VLR/SGSN sends to the USIM the random challenge RAND and an authentication token for network authentication AUTN from the selected authentication vector.

Upon receipt the user proceeds as shown in Figure 9.

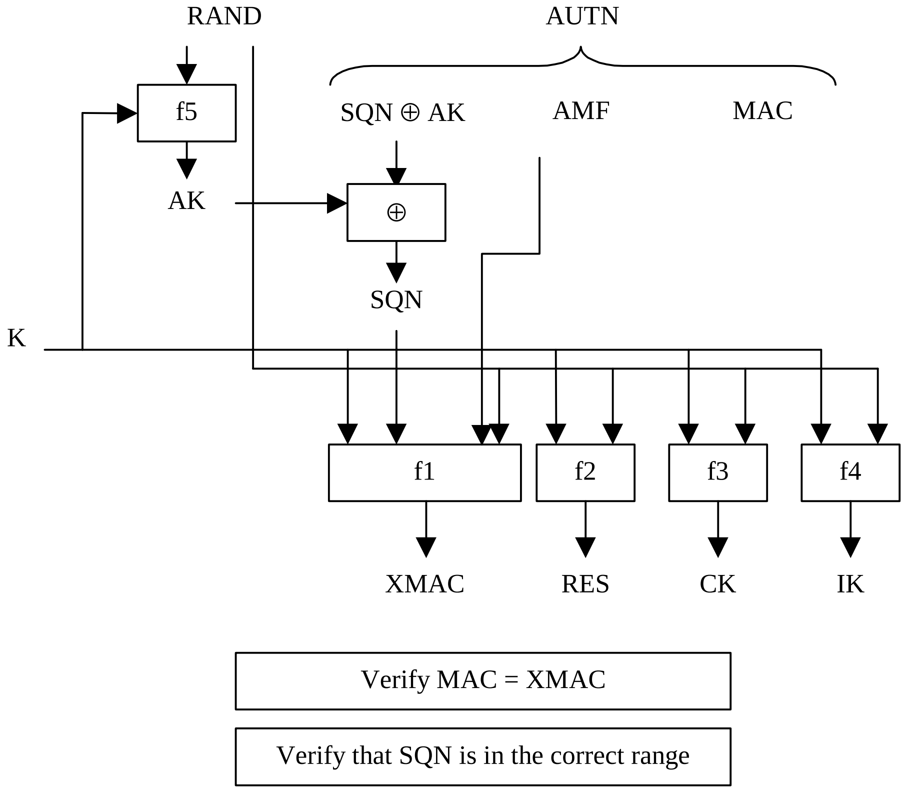

Figure 9: User authentication function in the USIM

Upon receipt of RAND and AUTN the USIM first computes the anonymity key AK = $f5_K$ (RAND) and retrieves the sequence number SQN = (SQN ⊕ AK) ⊕ AK.

Next the USIM computes XMAC = $f1_K$ (SQN || RAND || AMF) and compares this with MAC which is included in AUTN. If they are different, the user sends *user authentication reject* back to the VLR/SGSN with an indication of the cause and the user abandons the procedure. In this case, VLR/SGSN shall initiate an Authentication Failure Report procedure towards the HLR as specified in section 6.3.6. VLR/SGSN may also decide to initiate a new identification and authentication procedure towards the user.

Next the USIM verifies that the received sequence number SQN is in the correct range.

If the USIM considers the sequence number to be not in the correct range, it sends *synchronisation failure* back to the VLR/SGSN including an appropriate parameter, and abandons the procedure.

The synchronisation failure message contains the parameter AUTS. It is AUTS = Conc(SQN_{MS}) || MAC-S. Conc(SQN_{MS}) = $SQN_{MS} \oplus$ $f5^*_K$(RAND) is the concealed value of the counter SQN_{MS} in the MS, and MAC-S = $f1^*_K$(SQN_{MS} || RAND || AMF) where RAND is the random value received in the current user authentication request. f1* is a message authentication code (MAC) function with the property that no valuable information can be inferred from the function values of f1* about those of f1, ... , f5, f5* and vice versa. f5* is the key generating function used to compute AK in re-synchronisation procedures with the property that no valuable information can be inferred from the function values of f5* about those of f1, f1*, f2, ... , f5 and vice versa.

The AMF used to calculate MAC-S assumes a dummy value of all zeros so that it does not need to be transmitted in the clear in the re-synch message.

The construction of the parameter AUTS in shown in the following Figure 10:

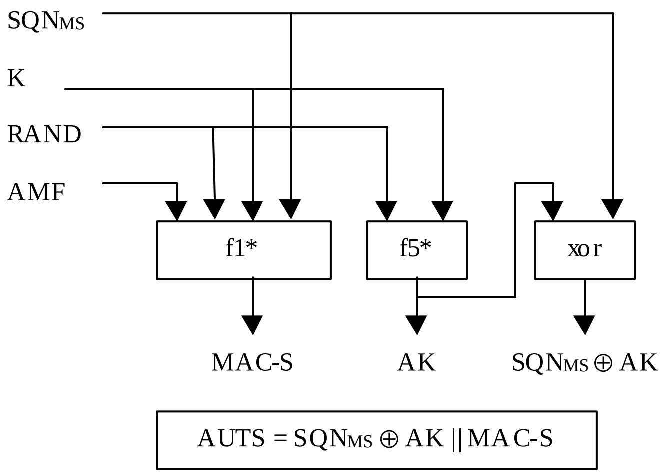

Figure 10: Construction of the parameter AUTS

If the sequence number is considered to be in the correct range however, the USIM computes RES = $f2_K$ (RAND) and includes this parameter in a *user authentication response* back to the VLR/SGSN. Finally the USIM computes the cipher key CK = $f3_K$ (RAND) and the integrity key IK = $f4_K$ (RAND). Note that if this is more efficient, RES, CK and IK could also be computed earlier at any time after receiving RAND. If the USIM also supports conversion function c3, it shall derive the GSM cipher key Kc from the UMTS cipher/integrity keys CK and IK. UMTS keys are sent to the MS along with the derived GSM key for UMTS-GSM interoperability purposes. USIM shall store original CK, IK until the next successful execution of AKA.

Upon receipt of *user authentication response* the VLR/SGSN compares RES with the expected response XRES from the selected authentication vector. If XRES equals RES then the authentication of the user has passed. The VLR/SGSN also selects the appropriate cipher key CK and integrity key IK from the selected authentication vector. If XRES and RES are different, VLR/SGSN shall initiate an Authentication Failure Report procedure towards the HLR as specified in section 6.3.6. VLR/SGSN may also decide to initiate a new identification and authentication procedure towards the user.

Re-use and re-transmission of (RAND, AUTN)

The verification of the SQN by the USIM will cause the MS to reject an attempt by the VLR/SGSN to re-use a quintet to establish a particular UMTS security context more than once. In general therefore the VLR/SGSN shall use a quintet only once.

There is one exception however: in the event that the VLR/SGSN has sent out an *authentication request* using a particular quintet and does not receive a response message (*authentication response* or *authentication reject*) from the MS, it may re-transmit the *authentication request* using the same quintet. However, as soon as a response message arrives no further re-transmissions are allowed. If after the initial transmission or after a series of re-transmissions no response arrives, retransmissions may be abandoned. If retransmissions are abandoned then the VLR/SGSN shall delete the quintet. At the MS side, in order to allow this re-transmission without causing additional re-synchronisation procedures, the USIM ME shall store the last received (RAND, AUTN) pair as well as the corresponding RES, CK and IK. If the USIM returned SRES and Kc (for GSM access), the ME shall store these values. When the USIM ME receives an *authentication request* and discovers that a (RAND, AUTN) pair is repeated and the associated START parameter is 0, it shall re-transmit the response. The USIM ME shall delete the stored values (RAND, AUTN) pair, RES and SRES (if existed) and the corresponding RES as soon as the security mode command is received by the ME or the connection is aborted. the START parameter is updated by the ME (see subclause 6.4.8). The ME shall be able to handle the retransmission for both PS and CS domain simultaneously.

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CHANGE REQUEST

⌘	**33.102**	**CR**	**131**	⌘	rev	**-**	⌘	Current version:	**3.6.0** ⌘

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

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [X] Radio Access Network [X] Core Network [ ]

Title: ⌘	Corrections to Counter Check procedure		
Source: ⌘	SA WG3		
Work item code: ⌘		***Date:*** ⌘	2000-11-21
Category: ⌘	**F**	***Release:*** ⌘	R99
	Use one of the following categories: ***F*** *(essential 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)*

Reason for change: ⌘	The description of Counter Check procedure has been aligned with the one in TS 25.331.
Summary of change: ⌘	Alignment of Counter Check procedure desciption with TS 25.331
Consequences if not approved: ⌘	Misalignment of descriptions

Clauses affected: ⌘	6.4.7	
Other specs affected: ⌘	[ ] Other core specifications ⌘ [ ] Test specifications [ ] O&M Specifications	
Other comments: ⌘		

6.4.7 Signalling procedure for periodic local authentication

The following procedure is used by the RNC to periodically perform a local authentication. At the same time, the amount of data sent during the RRC connection is periodically checked by the RNC and the UEME. The RNC is monitoring the COUNT-C and COUNT-I value associated to each radio bearer. The procedure is triggered whenever any of these values reaches a critical checking value. The granularity of these checking values and the values themselves are defined by the visited network. All messages in the procedure are integrity protected.

CR-Form-v3

CHANGE REQUEST

⌘	**33.102**	**CR**	**132**	⌘ rev	**-**	⌘ Current version:	**3.6.0**	⌘

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Proposed change affects: ⌘ (U)SIM [ ] ME/UE [ ] Radio Access Network [ ] Core Network [X]

Title:	⌘	Intersystem handover for CS Services – from GSM BSS to UTRAN
Source:	⌘	SA WG3
Work item code:	⌘	
Date:	⌘	2000-11-21
Category:	⌘	**F**
Release:	⌘	R99

Use one of the following categories:
F *(essential 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)

Reason for change:	⌘	Cases where a GSM security context has been established for a UMTS subscriber and a handover to a UTRAN is performed have not been taken into account.
Summary of change:	⌘	Takes a handover scenario into account.
Consequences if not approved:	⌘	No Security Context description of the procedure for GSM handover to UTRAN

Clauses affected:	⌘	6.8.5
Other specs affected:	⌘	[ ] Other core specifications ⌘ [ ] Test specifications [ ] O&M Specifications
Other comments:	⌘	

6.8.5 Intersystem handover for CS Services – from GSM BSS to UTRAN

If ciphering has been started when an intersystem handover occurs from GSM BSS to UTRAN, the necessary information (e.g. CK, IK, START value information, supported/allowed UMTS algorithms) is transmitted within the system infrastructure before the actual handover is executed to enable the communication to proceed from the old GSM BSS to the new RNC, and to continue the communication in ciphered mode. The GSM BSS requests the MS to send the UMTS capability information, which includes information on the START values and UMTS security capabilities of the MS. The intersystem handover will imply a change of ciphering algorithm from a GSM A5 to a UEA. The target UMTS RNC includes the selected UMTS ciphering mode in the handover to UTRAN command message sent to the MS via the GSM BSS.

The integrity protection of signalling messages shall be started immediately after that the intersystem handover from GSM BSS to UTRAN is completed. The Serving RNC will do this by initiating the RRC security mode control procedure when the first RRC message (i.e. the Handover to UTRAN complete message) has been received from the MS. The UE security capability information, that has been sent from MS to RNC via the GSM radio access and the system infrastructure before the actual handover execution, will then be included in the RRC Security mode command message sent to MS and then verified by the MS (i.e. verified that it is equal to the UE security capability information stored in the MS)

6.8.5.1 UMTS security context

A UMTS security context in GSM BSS is only established for UMTS subscribers with R99+ ME under GSM BSS controlled by a R99+ VLR/SGSN. At the network side, two cases are distinguished:

a) In case of a handover to a UTRAN controlled by the same MSC/VLR, the stored UMTS cipher/integrity keys CK and IK are sent to the target RNC.

b) In case of a handover to a UTRAN controlled by another MSC/VLR, the initial MSC/VLR sends the stored UMTS cipher/integrity keys CK and IK to the new RNC via the new MSC/VLR that controls the target RNC. The initial MSC/VLR remains the anchor point for throughout the service.

   The anchor MSC/VLR also derives and sends to the non-anchor MSC/VLR the GSM cipher key Kc. The non-anchor MSC/VLR stores all keys. This is done to allow subsequent handovers in a non-anchor R99+ MSC/VLR.

At the user side, in either case, the ME applies the stored UMTS cipher/integrity keys CK and IK.

6.8.5.2 GSM security context

Handover from GSM BSS to UTRAN with a GSM security context is ~~only~~ possible for a GSM subscriber with a R99+ ME or for a UMTS subscriber with a R99+ ME when the initial MSC/VLR is R98-. At the network side, two cases are distinguished:

a) In case of a handover to a UTRAN controlled by the same MSC/VLR, UMTS cipher/integrity keys CK and IK are derived from the stored GSM cipher key Kc (using the conversion functions c4 and c5) and sent to the target RNC.~~ Note that~~ In case of subsequent handover in a non-anchor R99+ MSC/VLR, a GSM cipher key Kc ~~has been~~ is received for a UMTS subscriber if the anchor MSC/VLR is R98-.

b) In case of a handover to a UTRAN controlled by another MSC/VLR, the initial MSC/VLR (R99+ or R98-) sends the stored GSM cipher key Kc to the new MSC/VLR controlling the target RNC. That MSC/VLR derives UMTS cipher/integrity keys CK and IK which are then forwarded to the target RNC. The initial MSC/VLR remains the anchor point for throughout the service.

At the user side, in either case, the ME derives the UMTS cipher/integrity keys CK and IK from the stored GSM cipher key Kc (using the conversion functions c4 and c5) and applies them.

3GPP TSG SA WG 3 (Security) meeting #16
Sophia Antipolis, France, 28-30 November, 2000

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CHANGE REQUEST

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Proposed change affects: ⌘ (U)SIM [ ] ME/UE [X] Radio Access Network [X] Core Network [ ]

Title:	⌘	Correction on use of GSM MS classmark in UMTS		
Source:	⌘	SA WG3		
Work item code:	⌘		***Date:*** ⌘	2000-11-21
Category:	⌘	**F**	***Release:*** ⌘	R99
		Use one of the following categories: ***F*** *(essential 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)*

Reason for change:	⌘	The information about capabilities of UE in GSM security algorithms is transferred to CN already in initial message. This information can directly be used in inter-system handover and there is no need to request it again. This is true provided that the information is checked at the same time as UE's UMTS seurity capability is checked.
Summary of change:	⌘	Enables checking of capability information for protocol efficiency
Consequences if not approved:	⌘	Less efficient protocol as information needs to be retrieved again

Clauses affected:	⌘	6.4.5, 6.8.4		
Other specs affected:	⌘	[ ] Other core specifications [ ] Test specifications [ ] O&M Specifications	⌘	
Other comments:	⌘			

6.4.5 Security mode set-up procedure

This section describes one common procedure for both ciphering and integrity protection set-up. It is mandatory to start integrity protection of signalling messages by use of this procedure at each new signalling connection establishment between MS and VLR/SGSN. The four exceptions when it is not mandatory to start integrity protection are:

- If the only purpose with the signalling connection establishment and the only result is periodic location registration, i.e. no change of any registration information.
- If there is no MS-VLR/SGSNsignalling after the initial L3 signalling message sent from MS to VLR/SGSN, i.e. in the case of deactivation indication sent from the MS followed by connection release.
- If the only MS-VLR/SGSN signalling after the initial L3 signalling message sent from MS to VLR/SGSN, and possible user identity request and authentication (see below), is a reject signalling message followed by a connection release.
- If the call is an emergency call teleservice as defined in TS 22.003, see section 6.4.9.2 below

When the integrity protection shall be started, the only procedures between MS and VLR/SGSN that are allowed after the initial connection request (i.e. the initial Layer 3 message sent to VLR/SGSN) and before the security mode set-up procedure are the following:

- Identification by a permanent identity (i.e. request for IMSI), and
- Authentication and key agreement

The message sequence flow below describes the information transfer at initial connection establishment, possible authentication and start of integrity protection and possible ciphering.

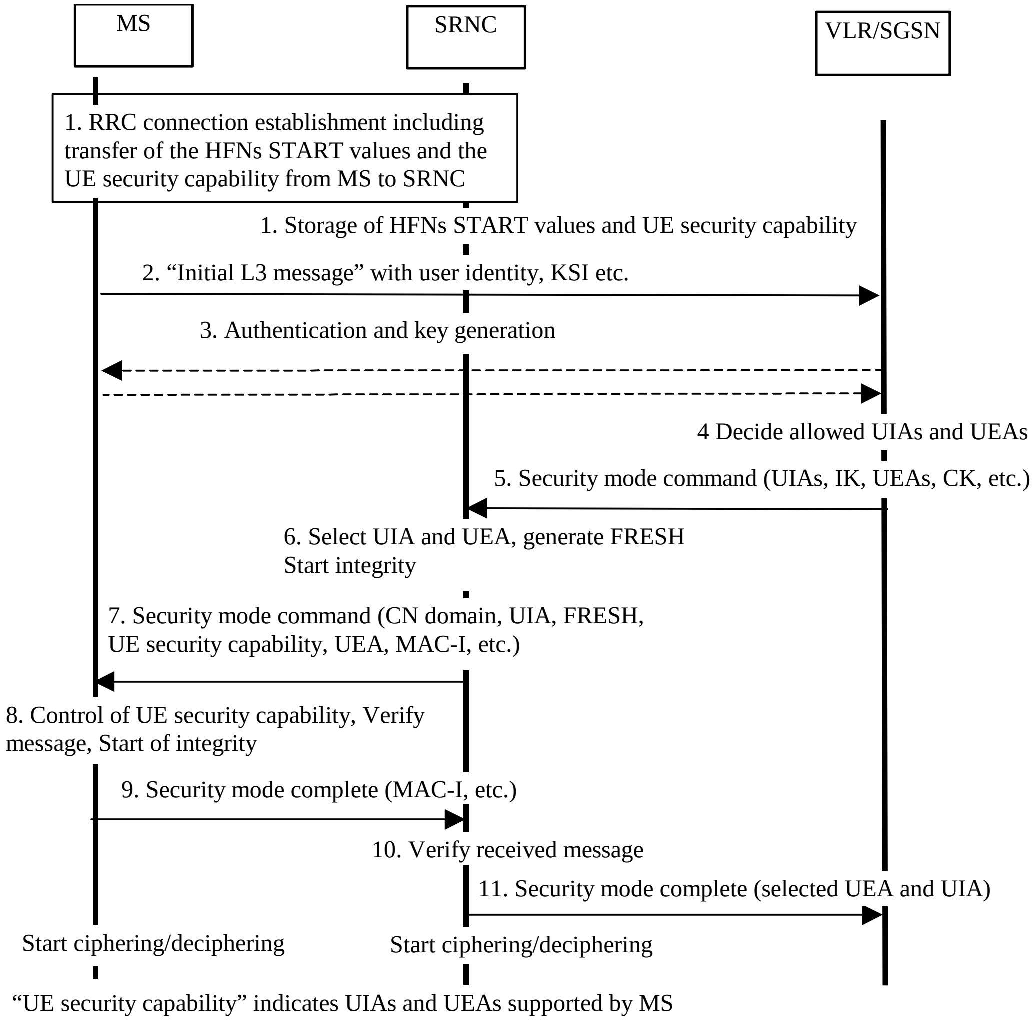

Figure 14: Local authentication and connection set-up

NOTE 1: The network must have the "ME security capability" information before the integrity protection can start, i.e. the "ME security capability" must be sent to the network in an unprotected message. Returning the "ME security capability" later on to the ME in a protected message will give ME the possibility to verify that it was the correct "ME security capability" that reached the network.

Detailed description of the flow above:

1. RRC connection establishment includes the transfer from MS to RNC of the ME security capability and the START values for the CS service domain respective the PS service domain. The UE security capability information includes the ciphering capabilities (UEAs) and the integrity capabilities (UIAs) of the MS. The START values and the UE security capability information are stored in the SRNC.

2. The MS sends the Initial L3 message (Location update request, CM service request, Routing area update request, attach request, paging response etc.) to the VLR/SGSN. This message contains e.g. the user identity and the KSI. The included KSI (Key Set Identifier) is the KSI allocated by the CS service domain or PS service domain at the last authentication for this CN domain.

3. User identity request may be performed (see 6.2). Authentication of the user and generation of new security keys (IK and CK) may be performed (see 6.3.3). A new KSI will then also be allocated.

4. The VLR/SGSNdetermines which UIAs and UEAs that are allowed to be used.

5. The VLR/SGSNinitiates integrity and ciphering by sending the RANAP message Security Mode Command to SRNC. This message contains a list of allowed UIAs and the IK to be used. If ciphering shall be started, it contains the allowed UEAs and the CK to be used. It also contains the UE's capability information about GSM ciphering algorithms in the form of GSM MS classmark. If a new authentication and security key generation has been performed (see 3 above), this shall be indicated in the message sent to the SRNC. The indication of new generated keys implies that the START value to be used shall be reset (i.e. set to zero) at start use of the new keys. Otherwise, it is the START value already available in the SRNC that shall be used (see 1. above).
6. The SRNC decides which algorithms to use by selecting from the list of allowed algorithms, and the list of algorithms supported by the MS (see 6.4.2). The SRNC generates a random value FRESH and initiates the downlink integrity protection. If the requirements received in the Security mode command can not be fulfilled, the SRNC sends a SECURITY MODE REJECT message to the requesting VLR/SGSN. The further actions are described in 6.4.2.
7. The SRNC generates the RRC message Security mode command. The message includes the ME security capability, the UIA and FRESH to be used and if ciphering shall be started also the UEA to be used. Additional information (start of ciphering) may also be included. Because of that the MS can have two ciphering and integrity key sets, the network must indicate which key set to use. This is obtained by including a CN type indicator information in the Security mode command message. If the GSM MS classmark exists, then the message shall also contain it.~~s GSM MS classmark.~~ Before sending this message to the MS, the SRNC generates the MAC-I (Message Authentication Code for Integrity) and attaches this information to the message.
8. At reception of the Security mode command message, the MS controls that the ME security capability received is equal to the ME security capability sent in the initial message. The same applies to the GSM MS classmark. The MS computes XMAC-I on the message received by using the indicated UIA, the stored COUNT-I and the received FRESH parameter. The MS verifies the integrity of the message by comparing the received MAC-I with the generated XMAC-I.
9. If all controls are successful, the MS compiles the RRC message Security mode complete and generates the MAC-I for this message. If any control is not successful, the procedure ends in the MS.
10. At reception of the response message, the SRNC computes the XMAC-I on the message. The SRNC verifies the data integrity of the message by comparing the received MAC-I with the generated XMAC-I.
11. The transfer of the RANAP message Security Mode Complete response, including the selected algorithms, from SRNC to the VLR/SGSN ends the procedure.

The Security mode command to MS starts the downlink integrity protection, i.e. this and all following downlink messages sent to the MS are integrity protected using the new integrity configuration. The Security mode complete from MS starts the uplink integrity protection, i.e. this and all following messages sent from the MS are integrity protected using the new integrity configuration. When ciphering shall be started, the Ciphering Activation time information that is exchanged between SRNC and MS during the Security mode set-up procedure sets the RLC Sequence Number/Connection Frame Number when to start ciphering in Downlink respective Uplink using the new ciphering configuration.

**** next modified section***

6.8.4 Intersystem handover for CS Services – from UTRAN to GSM BSS

If ciphering has been started when an intersystem handover occurs from UTRAN to GSM BSS, the necessary information (e.g. Kc, supported/allowed GSM ciphering algorithms) is transmitted within the system infrastructure before the actual handover is executed to enable the communication to proceed from the old RNC to the new GSM BSS, and to continue the communication in ciphered mode. ~~The RNC requests the MS to send the MS Classmark, which includes information on the GSM ciphering algorithm capabilities of the MS~~. The intersystem handover will imply a change of ciphering algorithm from a UEA to a GSM A5. The GSM BSS includes the selected GSM ciphering mode in the handover command message sent to the MS via the RNC.

The integrity protection of signalling messages is stopped at handover to GSM BSS.

The START values (see subclause 6.4.8) shall be stored in the ME/USIM at handover to GSM BSS.

3GPP TSG-SA WG3 Meeting #16 ***S3-000739***
Sophia Antipolis, France, 28-30 November 2000

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Proposed change affects: ⌘ (U)SIM [ ] ME/UE [X] Radio Access Network [ ] Core Network [ ]

Title:	⌘	START value handling for MS with a GSM SIM inserted		
Source:	⌘	Vodafone		
Work item code:	⌘	Security	***Date:*** ⌘	30-Nov-00
Category:	⌘	**F**	***Release:*** ⌘	R99
		Use one of the following categories: ***F*** *(essential 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)*

Reason for change:	⌘	It needs to be specified what START value is used to initialise the hyperframe number which is input to the confidentiality and integrity algorithms when a GSM SIM is inserted into a UMTS terminal (when a USIM is inserted the START value is read from the USIM).
Summary of change:	⌘	Section 6.8.2.4 is modified to specify that START values are stored in the ME when a GSM SIM is inserted.
Consequences if not approved:	⌘	It would not be possible to use a 3G ME with a GSM SIM card inserted on UTRAN.

Clauses affected:	⌘	6.8.2.4			
Other specs affected:	⌘	X	Other core specifications	⌘	TS 25.331
		X	Test specifications		TS 34.123, TS 34.108
			O&M Specifications		
Other comments:	⌘				

6.8.2.3 VLR/SGSN

The R99+ VLR/SGSN shall perform GSM AKA using a triplet that is either:

a) retrieved from the local database,

b) provided by the HLR/AuC, or

c) provided by the previously visited VLR/SGSN.

NOTE: All triplets are originally provided by the HLR/AuC.

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.

When the user is attached to a UTRAN, the R99+ VLR/SGSN derives the UMTS cipher/integrity keys from the GSM cipher key using the following conversion functions:

a) c4: $CK_{[UMTS]} = Kc \| Kc$;

b) c5: $IK_{[UMTS]} = Kc_1 \text{ xor } Kc_2 \| Kc \| Kc_1 \text{ xor } Kc_2$;

whereby in c5, Kc_i are both 32 bits long and $Kc = Kc_1 \| Kc_2$.

The UMTS cipher/integrity keys are then sent to the RNC where the ciphering and integrity algorithms are allocated.

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

6.8.2.4 R99+ ME

R99+ ME with a SIM inserted, shall participate only in GSM AKA.

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.

When the user is attached to a UTRAN, R99+ ME shall derive the UMTS cipher/integrity keys CK and IK from the GSM cipher key Kc using the conversion functions c4 and c5. The ME shall handle the $START_{CS}$ and $START_{PS}$ as described in section 6.4.8 with the exception that the START values are stored on the ME rather than on the GSM SIM. If the ME looses the current START value for a particular domain (e.g. due to power off) it shall delete the corresponding GSM cipher key (Kc), the derived UMTS cipher/integrity keys (CK and IK), and reset the START value to zero. The ME shall then trigger a new authentication and key agreement at the next connection establishment by indicating to the network that no valid keys are available for use using the procedure described in section 6.4.4.