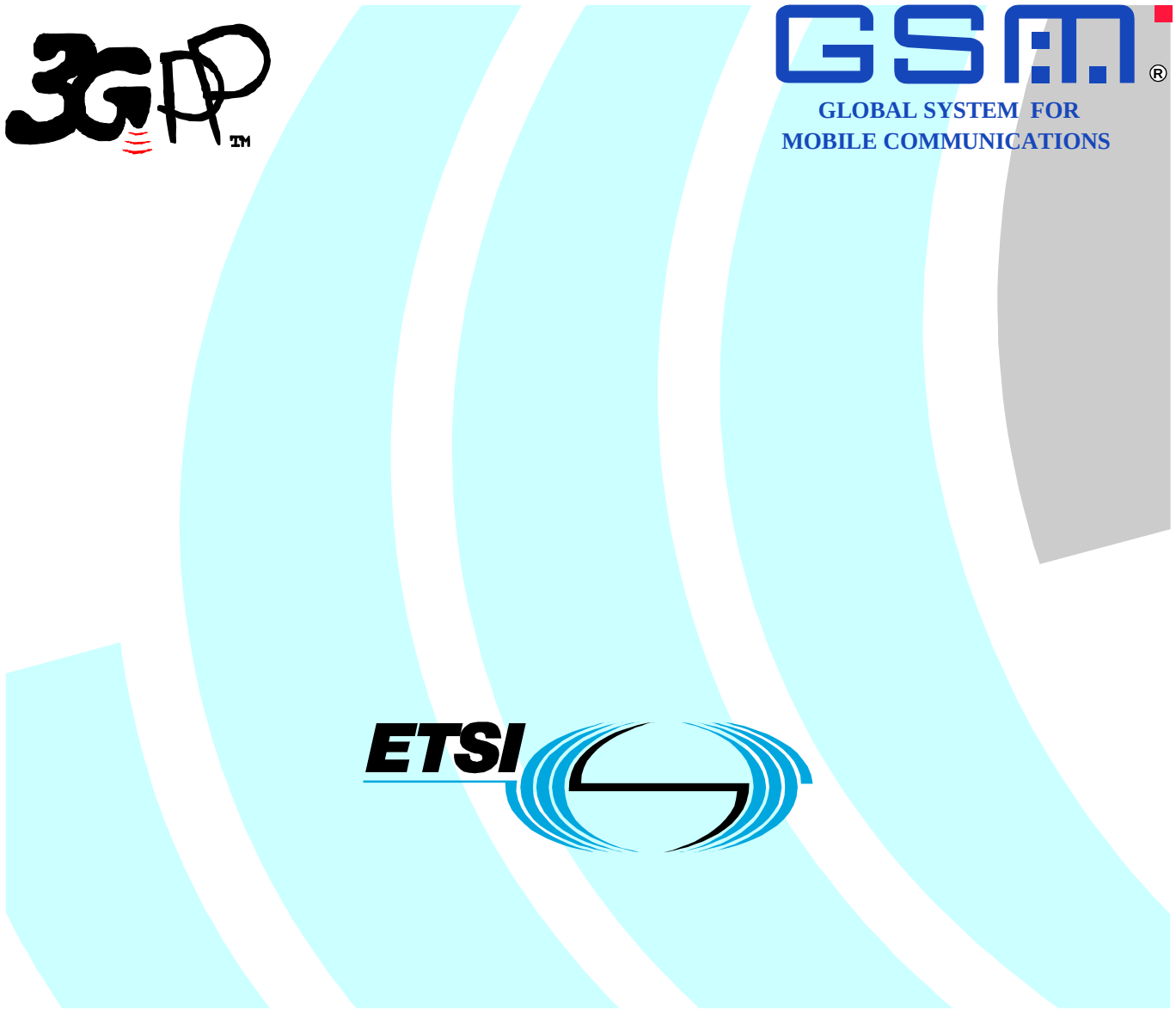
ETSI TS 143 318 V6.9.0 (2007-03)

Technical Specification

Digital cellular telecommunications system (Phase 2+);
Generic access to the A/Gb interface;
Stage 2
(3GPP TS 43.318 version 6.9.0 Release 6)



Reference
RTS/TSGG-0143318v690

Keywords
GSM

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (http://webapp.etsi.org/IPR/home.asp).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

This Technical Specification (TS) has been produced by ETSI 3rd Generation Partnership Project (3GPP).

The present document may refer to technical specifications or reports using their 3GPP identities, UMTS identities or GSM identities. These should be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between GSM, UMTS, 3GPP and ETSI identities can be found under http://webapp.etsi.org/key/queryform.asp.

Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document describes the overall architecture for Generic Access (GA) to the A/Gb interfaces. It describes the system concepts, documents the reference architecture, functional entities, network interfaces, and high-level procedures of GA service.

Generic Access to the A/Gb interfaces, or GA, is an extension of GSM/GPRS mobile services that is achieved by tunnelling Non Access Stratum (NAS) protocols between the MS and the Core Network over an IP network. GA is a complement to traditional GSM/GPRS/UTRAN radio coverage.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TS 23.002: "Network architecture".

[2] 3GPP TS 23.009: "Handover procedures".

[3] 3GPP TS 23.271: "Location Services (LCS); Functional description; Stage 2".

[4] 3GPP TS 23.122: "Non-Access-Stratum functions related to Mobile Station (MS) in idle mode".

[5] 3GPP TS 23.236: "Intra-domain connection of Radio Access Network (RAN) nodes to multiple Core Network (CN) nodes".

[6] 3GPP TS 24.008: "Mobile radio interface layer 3 specification; Core network protocols; Stage 3".

[7] 3GPP TS 26.071: "AMR speech codec; General description".

[8] 3GPP TS 29.234: "3GPP system to Wireless Local Area Network (WLAN) interworking, Stage 3".

[9] 3GPP TS 33.234: "3G security; Wireless Local Area Network (WLAN) interworking security".

[10] 3GPP TS 43.020: "Security related network functions".

[11] 3GPP TS 48.004: "Base Station System - Mobile-services Switching Centre (BSS-MSC) interface; Layer 1 specification".

[12] 3GPP TS 48.006: "Signalling transport mechanism specification for the Base Station System - Mobile-services Switching Centre (BSS-MSC) interface".

[13] 3GPP TS 48.008: "Mobile Switching Centre - Base Station System (MSC-BSS) interface; Layer 3 specification".

[14] 3GPP TS 48.014: "General Packet Radio Service (GPRS); Base Station System (BSS) - Serving GPRS Support Node (SGSN) interface; Gb interface Layer 1".

[15] 3GPP TS 48.016: "General Packet Radio Service (GPRS); Base Station System (BSS) - Serving GPRS Support Node (SGSN) interface; Network Service".

[16] 3GPP TS 48.018: "General Packet Radio Service (GPRS); Base Station System (BSS) - Serving GPRS Support Node (SGSN) interface; BSS GPRS protocol".

[17] 3GPP TS 43.059: "Functional stage 2 description of Location Services (LCS) in GERAN".

[18] 3GPP TS 45.008: "Radio subsystem link control".

[19] IETF RFC 793: "Transmission Control Protocol".

[20] IETF RFC 3550: "RTP: A Transport Protocol for Real-Time Applications".

[21] IETF RFC 2451: "The ESP CBC-Mode Cipher Algorithms".

[22] IETF RFC 3602: "The AES-CBC Cipher Algorithm and Its Use with IPsec".

[23] IETF RFC 2104: "HMAC: Keyed-Hashing for Message Authentication".

[24] IETF RFC 2315: "PKCS #7: Cryptographic Message Syntax Version 1.5".

[25] IETF RFC 2404: "The Use of HMAC-SHA-1-96 within ESP and AH".

[26] IETF RFC 2406: "IP Encapsulating Security Payload (ESP)".

[27] IETF RFC 3566: "The AES-XCBC-MAC-96 Algorithm and Its Use With IPsec".

[28] IETF RFC 4434, February 2006: "The AES-XCBC-PRF-128 Algorithm for the Internet Key Exchange Protocol (IKE)".

[29] IETF RFC 3280: "Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile".

[30] IETF draft-haverinen-pppext-eap-sim-16 (December 2004): "Extensible Authentication Protocol Method for GSM Subscriber Identity Modules (EAP-SIM)".

[31] IETF draft-ietf-pki4ipsec-ikecert-profile-03 (October 2004): "The Internet IP Security PKI Profile of IKEv1/ISAKMP, IKEv2, and PKIX".

[32] IETF draft-ietf-ipsec-ikev2-17 (October 2004): "Internet Key Exchange (IKEv2) Protocol".

[33] IETF draft-ietf-ipsec-ikev2-algorithms-05 (April 2004): "Cryptographic Algorithms for use in the Internet Key Exchange Version 2".

[34] IETF draft-ietf-ipsec-ui-suites-06 (April 2004): "Cryptographic Suites for IPsec".

[35] IETF RFC 3948: "UDP Encapsulation of IPsec ESP Packets".

[36] IETF RFC 2486: "The Network Access Identifier".

[37] IETF RFC 768: "User Datagram Protocol".

[38] IETF draft-arkko-pppext-eap-aka-15 (December 2004): "Extensible Authentication Protocol Method for 3rd Generation Authentication and Key Agreement (EAP-AKA)".

[39] IETF RFC 791: "Internet Protocol".

[40] 3GPP TS 25.331: "Radio Resource Control (RRC) protocol specification".

[41] 3GPP TS 23.032: "Universal Geographical Area Description (GAD)".

[42] IETF RFC 2409: "The Internet Key Exchange (IKE)".

[43] 3GPP TS 23.003: "Numbering, addressing and identification".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

AP-ID: The AP-ID (Access Point-ID) is the physical identity (e.g. MAC address) of the generic IP access network point through which the MS is accessing GAN service. This identifier is provided by the MS (obtained via broadcast from the AP) to the GANC via the Up interface, when it requests GAN service. The AP-ID may be used by the GANC to support location services. The AP-ID may also be used by the service provider to restrict GAN service access via only authorized APs.

GERAN/UTRAN Mode: MS mode of operation where the NAS layers communicate through either the GERAN RR or the UTRAN RRC entities

GAN Mode: MS mode of operation where the NAS layers communicate through the GA-CSR entity

Generic Access Network: access network providing access to A/Gb interfaces via an IP network

Generic Access Network Controller: network node that connects to the MSC and SGSN via the A-interface and Gb interface and enables access via a generic IP network.
Three different logical roles for the GANC are defined in this specification: Provisioning GANC, Default GANC and Serving GANC.

default GANC: logical role of a GANC in the HPLMN, which redirects an MS performing the GAN Registration Procedure to a preferred Serving GANC within the HPLMN or VPLMN. The Serving GANC and Default GANC may be the same entity, in which case no redirection is required.

discovery procedure: process by which the MS discovers the Default GANC in the HPLMN

handover: mobile station engaged in a call moves between 3GPP access networks and GAN

handover in: mobile station moves from 3GPP access networks to GAN

handover out: mobile station moves from GAN to 3GPP access networks

provisioning GANC: logical role of a GANC in the HPLMN of an MS
When an MS performs the Discovery Procedure to this GANC, the MS is provided the address of the Default GANC in the HPLMN.

redirection: process by which a Default or Serving GANC redirects an MS to an alternative Serving GANC
This alternative GANC is likely to become the Serving GANC for the MS.

registration procedure: process by which an MS requests the Generic Access Service from a GANC

rove in: mobile station reselects from 3GPP access networks to GAN

rove out: mobile station reselects from GAN to 3GPP access networks

roving: action of re-selection between 3GPP access technology and GAN for a mobile station in idle mode

seamless: free from noticeable transitions (i.e. no end-user action is required; speech interruptions are short; service interruptions are short; incoming calls are not missed; packet sessions are maintained; services work identically)

serving GANC: logical role of the GANC in a PLMN which provides an MS with the Generic Access service

suitable cell: this is a cell on which an MS may camp. It must satisfy criteria which are defined for A/Gb mode in 3GPP TS 43.022 and for Iu mode in 3GPP TS 25.304

3.2 Symbols

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

Up	Interface between MS and GANC

3.3 Abbreviations

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

AAA	Authentication, Authorization and Accounting
AKA	Authentication and Key Agreement
AP	Access Point
AS	Access Stratum
BSC	Base Station Controller
BSS	Base Station Subsystem
BSSGP	Base Station System GPRS Protocol
BSSMAP	Base Station System Management Application Part
CC	Call Control
CGI	Cell Global Identification
CM	Connection Management
CN	Core Network
CS	Circuit Switched
CTM	Cellular Text Telephone Modem
DNS	Domain Name System
DTM	Dual Transfer Mode
EAP	Extensible Authentication Protocol
ETSI	European Telecommunications Standards Institute
FCC	US Federal Communications Commission
FQDN	Fully Qualified Domain Name
GA-CSR	Generic Access - Circuit Switched Resources
GAD	Geographical Area Description
GAN	Generic Access Network
GANC	Generic Access Network Controller
GA-PSR	Generic Access - Packet Switched Resources
GA-RC	Generic Access - Resource Control
GERAN	GSM EDGE Radio Access Network
GGSN	Gateway GPRS Support Node
GMM/SM	GPRS Mobility Management and Session Management
GPRS	General Packet Radio Service
GSM	Global System for Mobile communications
GSN	GPRS Support Node
HLR	Home Location Register
HPLMN	Home PLMN
IETF	Internet Engineering Task Force
IKE	Internet Key Exchange
IMEISV	International Mobile station Equipment Identity and Software Version number
IMSI	International Mobile Subscriber Identity
IP	Internet Protocol
LA	Location Area
LAI	Location Area Identity
LLC	Logical Link Control
MAC	Medium Access Control
MAC	Message Authentication Code
MM	Mobility Management
MS	Mobile Station
MSC	Mobile Switching Center
MTP1	Message Transfer Part layer 1
MTP2	Message Transfer Part layer 2
MTP3	Message Transfer Part layer 3
NAS	Non-Access Stratum

PDP	Packet Data Protocol
PDU	Protocol Data Unit
PLMN	Public Land Mobile Network
PSAP	Public Safety Answering Point

NOTE: A PSAP is an emergency services network element that is responsible for answering emergency calls.

PSTN	Public Switched Telephone Network
P-TMSI	Packet - TMSI
QoS	Quality of Service
RA	Routing Area
RAC	Routing Area Code
RAI	Routing Area Identity
RAT	Radio Access Technology
RLC	Radio Link Control
RTCP	Real Time Control Protocol
RTP	Real Time Protocol
SCCP	Signalling Connection Control Part
SEGW	SEcurity GateWay
SGSN	Serving GPRS Support Node
SIM	Subscriber Identity Module
SMLC	Serving Mobile Location Center
SMS	Short Message Service
SNDCP	Sub-Network Dependent Convergence Protocol
TBF	Temporary Block Flow
TC	Transport Channel
TCP	Transmission Control Protocol
TFO	Tandem Free Operation
TMSI	Temporary Mobile Subscriber Identity
TrFO	Transcoder Free Operation
TTY	Text Telephone or TeletYpewriter
UDP	User Datagram Protocol
UMTS	Universal Mobile Telecommunication System
VLR	Visited Location Register
VPLMN	Visited Public Land Mobile Network

4 Architecture

The Generic Access Network functional architecture is illustrated in figure 1.

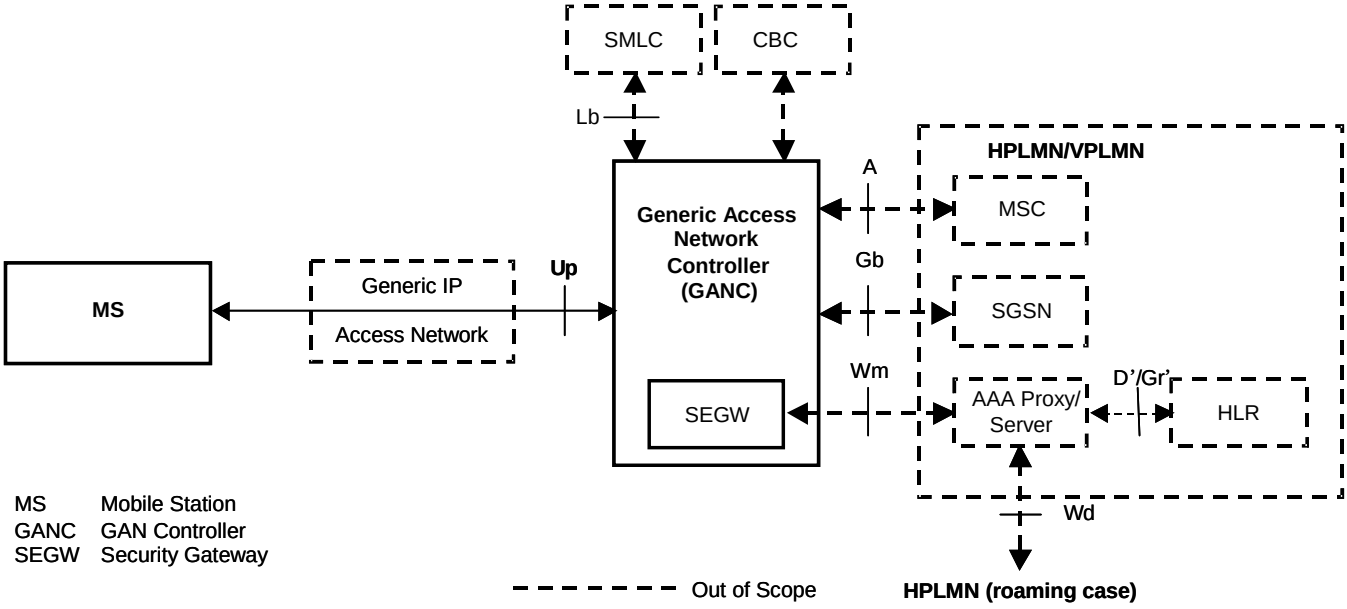


Figure 1: GAN functional architecture

The main features of the GAN architecture are:

- New entities, and entities with enhanced functionality:
  - Mobile Station (MS).
  - Generic Access Network Controller (GANC). The GANC appears to the core network as a GERAN Base Station Subsystem (BSS). It includes a Security Gateway (SEGW) that terminates secure remote access tunnels from the MS, providing mutual authentication, encryption and data integrity for signalling, voice and data traffic.
- A Generic IP Access network provides connectivity between the MS and the GANC. The IP transport connection extends from the GANC to the MS. A single interface, the Up interface, is defined between the GANC and the MS.
- Co-existence with the GSM/GPRS Radio Access Network (GERAN) and interconnection with the Core Network (CN) via the standardized interfaces defined for GERAN A/Gb mode:
  - A-interface for circuit switched services as defined in 3GPP TS 48.008 [13].
  - Gb-interface for packet switched services as defined in 3GPP TS 48.018 [16].
  - Lb-interface for supporting location services as defined in 3GPP TS 43.059 [17].
  - CBC-BSC interface for supporting cell broadcast services as defined in 3GPP TS 23.041
- Transaction control (e.g. CC, SM) and user services are provided by the core network (e.g. MSC/VLR and the SGSN/GGSN).
- Use of AAA server over the Wm interface as defined by 3GPP TS 29.234 [8]. The AAA server is used to authenticate the MS when it sets up a secure tunnel. Note that only a subset of the Wm functionalities is required for the GAN application. As a minimum the GANC-SEGW shall support the Wm authentication procedures.

Indication of support for PS Services and of support for DTM is provided through appropriate signalling to the MS.

5 Functional entities

5.1 Mobile Station (MS)

The MS contains a new functional block to access a Generic Access Network (GAN).

5.2 Generic Access Network Controller (GANC)

The core network interacts with the Generic Access Network Controller (GANC) as though it was an A/Gb mode BSS. The generic IP access network provides connectivity between the GANC and the MS. The GANC entity inter-works between the A/Gb interfaces and a generic IP access network, using the following functionality:

- User plane circuit switched services:
  - Reframing of AMR/RTP to AMR/(A-interface framing).
  - If non-TrFO, transcoding voice to/from the MS to PCM voice from/to the MSC.
  - If TrFO, transcoding maybe required if a common codec cannot be negotiated.
- User plane packet switched services:
  - Inter-working data transport channels over Up interface to packet flows over Gb interface.
- Control plane functionality:
  - Security Gateway (SEGW) for the set-up of a secure tunnel to MS for mutual authentication, encryption and data integrity. The SEGW provides a subset of the Wm functions, specifically the authentication procedures.
  - Registration for GAN access and providing system information.
  - Management of GAN bearer paths for CS and PS services, including the establishment, administration, and release of control and user plane bearers between the MS and the GANC.
  - Functionality providing support for paging and handover procedures.
  - Transparent transfer of L3 messages (i.e. NAS protocols) between the MS and core network.

6 Control and User Plane Architecture

6.1 CS Domain

6.1.1 CS Domain - Control Plane

6.1.1.1 CS Domain - Control Plane - GAN Architecture

The GAN architecture in support of CS Domain control plane is illustrated in figure 2.

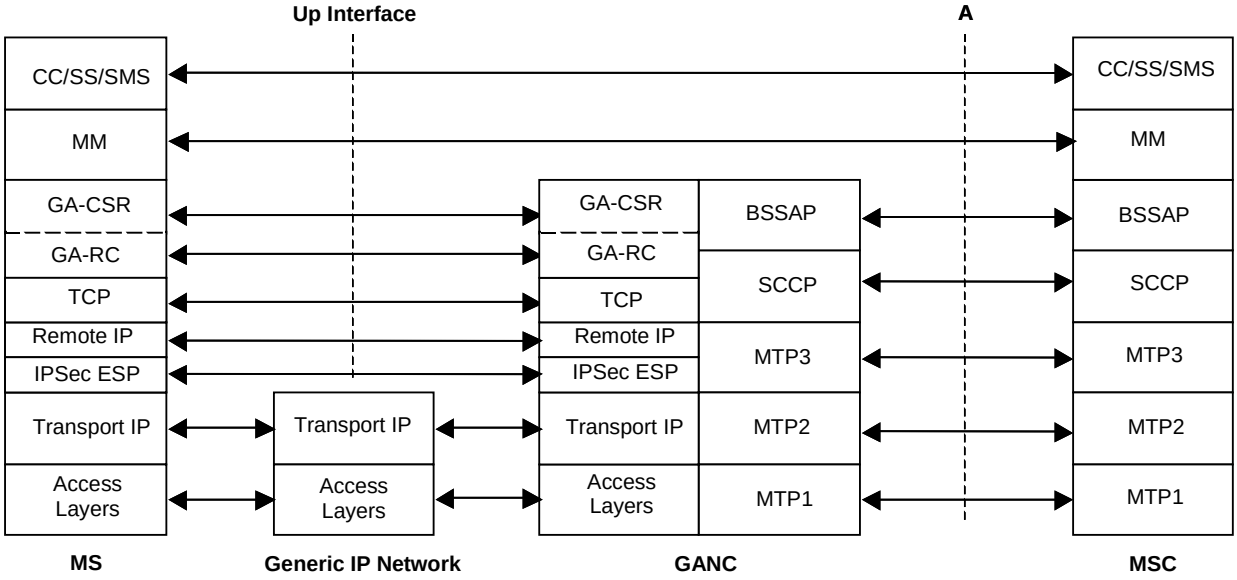


Figure 2: Up CS Domain Control Plane Architecture

The main features of the Up interface for the CS domain control plane are as follows:

- The underlying Access Layers and Transport IP layer provides the generic connectivity between the MS and the GANC.
- The IPsec layer provides encryption and data integrity.
- TCP provides reliable transport for the GA-RC between MS and GANC and is transported using the Remote IP layer.
- The GA-RC manages the IP connection, including the GAN registration procedures.
- The GA-CSR protocol performs functionality equivalent to the GSM-RR protocol, using the underlying connection managed by the GA-RC.
- Protocols, such as MM and above, are carried transparently between the MS and MSC.
- The GANC terminates the GA-CSR protocol and inter-works it to the A-interface using BSSAP messaging.
- The Remote IP layer is the "inner" IP layer for IPsec tunnel mode and is used by the MS to be addressed by the GANC. Remote IP layer is configured during the IPsec connection establishment.

6.1.1.2 CS Domain - Control Plane - MS Architecture

The MS architecture for the CS domain control plane in the MS is illustrated in figure 3.

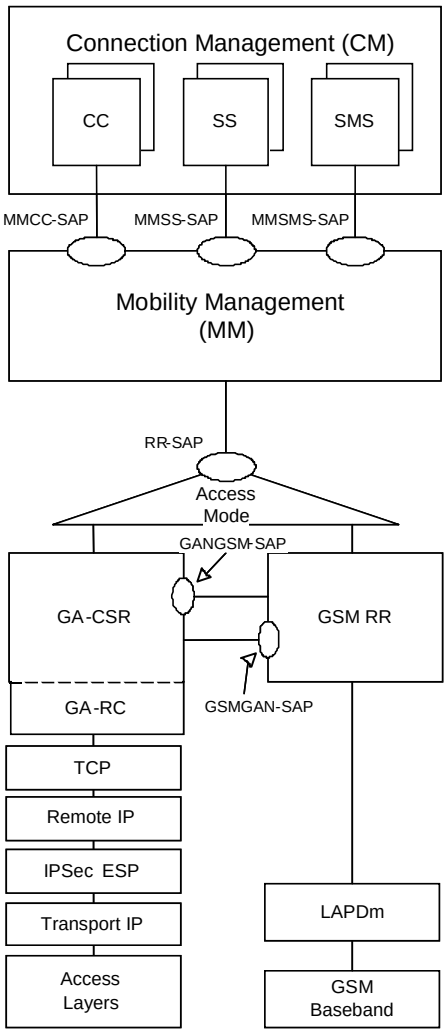


Figure 3: MS CS Domain Control plane Architecture

Figure 3 illustrates the main features of the MS CS Domain Control Plane architecture, which are as follows:

- The RR-SAP interface to the GSM-MM layer is preserved identically for both GSM and GAN access.
- An access mode switch is provided to switch between GERAN/UTRAN and GAN modes.
- GA-CSR peers with GSM-RR to provide coordination for roving and handover.

6.1.2 CS Domain - User Plane

6.1.2.1 CS Domain - User Plane - GAN Architecture

The GAN protocol architecture in support of CS domain user plane is illustrated figure 4.

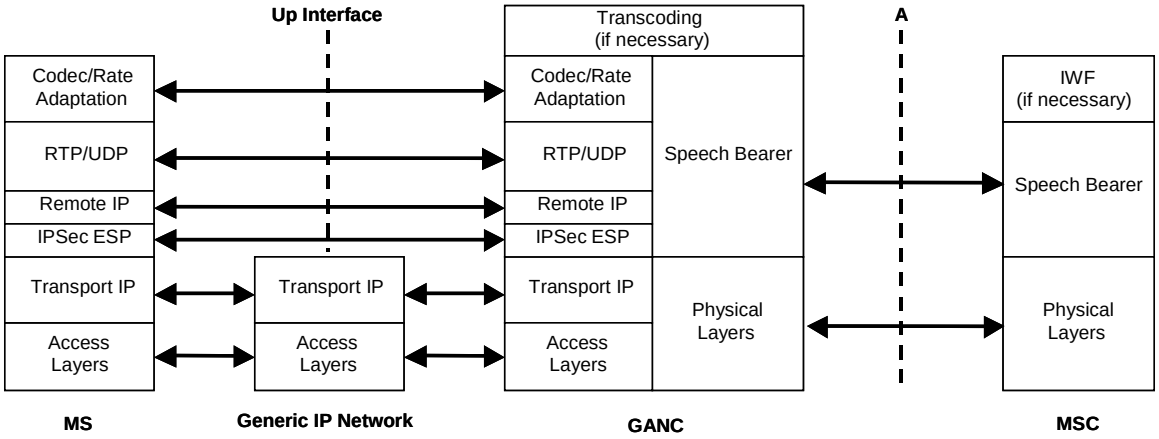


Figure 4: Up CS Domain User Plane Protocol Architecture

The main features of the CS domain user plane of the Up interface are as follows:

- The underlying Access Layers and Transport IP layer provides the generic connectivity between the MS and the GANC.
- The IPsec layer provides encryption and data integrity.
- CS domain user plane is transported over RTP/UDP between MS and GANC.
- Support for AMR FR codec, as specified in 3GPP TS 26.071 [7], is mandatory when operating in GAN mode, with support for other codecs being optional.
- CS-data is transported over RTP/UDP, by defining a new RTP frame format to carry the TAF-TRAU (V.110-like) frames over RTP.
- TTY is transported using CTM over GSM codec over RTP/UDP.
- The GANC re-frames the CS domain user plane between RTP/UDP and the speech bearers over the A-interface.

6.2 PS Domain

6.2.1 PS Domain - GAN Architecture

6.2.1.1 PS Domain - Control Plane - GAN Architecture

The GAN architecture in support of PS Domain Control Plane is illustrated in figure 5.

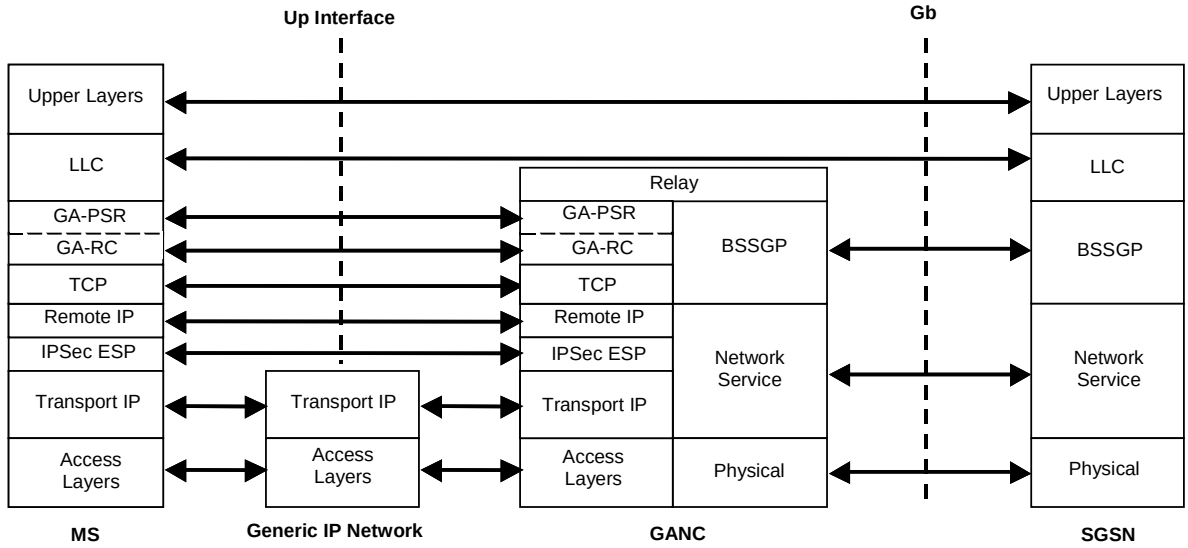


Figure 5: Up PS Domain Control Plane Architecture

The main features of the Up interface for the PS domain control plane are as follows:

- The underlying Access Layers and Transport IP layer provides the generic connectivity between the MS and the GANC.
- The IPsec layer provides encryption and data integrity.
- TCP provides reliable transport for the GA-PSR between MS and GANC.
- The GA-RC manages the IP connection, including the GAN registration procedures.
- The GA-PSR protocol performs functionality equivalent to the GPRS-RLC protocol. The concept of a TBF is replaced by mechanisms to manage an IP connection between MS and GANC.

NOTE: No QoS can be assured when utilizing the GA-PSR transport channel.

- Protocols, such as LLC and above, are carried transparently between the MS and CN.
- The GANC terminates the GA-PSR protocol and inter-works it to the Gb-interface using BSSGP.

6.2.1.2 PS Domain - User Plane - GAN Architecture

The GAN architecture for PS Domain User Plane is illustrated in figure 6.

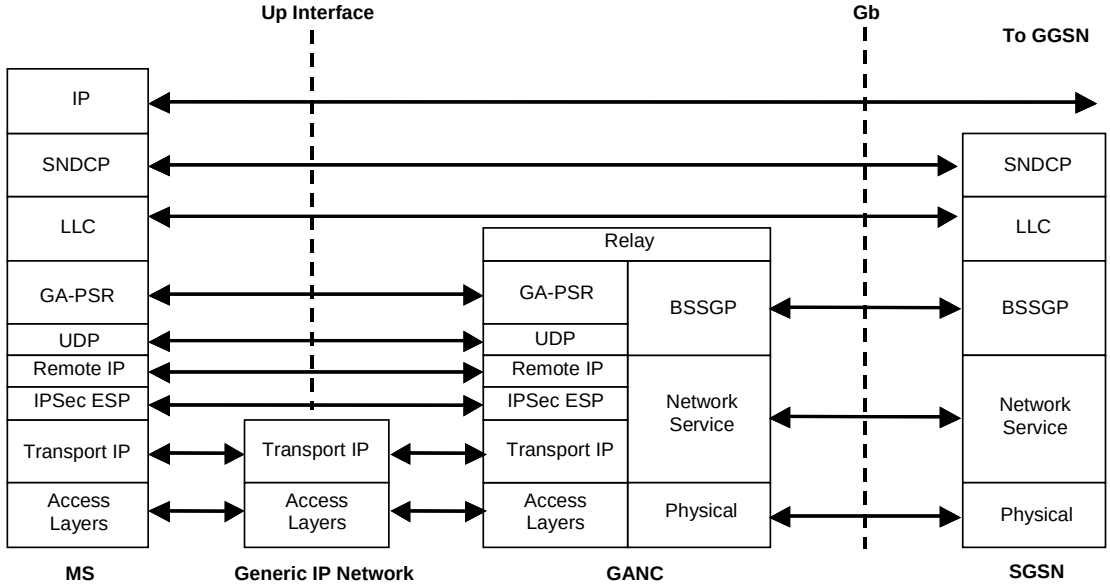


Figure 6: Up PS Domain User Plane Protocol Architecture

The main features of the Up interface for PS domain user plane are as follows:

- The underlying Access Layers and Transport IP layer provides the generic connectivity between the MS and the GANC.
- The IPsec layer provides encryption and data integrity.
- The GA-PSR operates between the MS to the GANC transporting the upper layer payload (i.e. user plane data)across the Up interface.
- Protocols and data, such as LLC and above, are carried transparently between the MS and CN.
- The GANC terminates the GA-PSR protocol and inter-works it to the Gb-interface using BSSGP.

6.2.2 PS Domain - MS Architecture

The MS architecture for the PS domain is illustrated in more detail in figure 7.

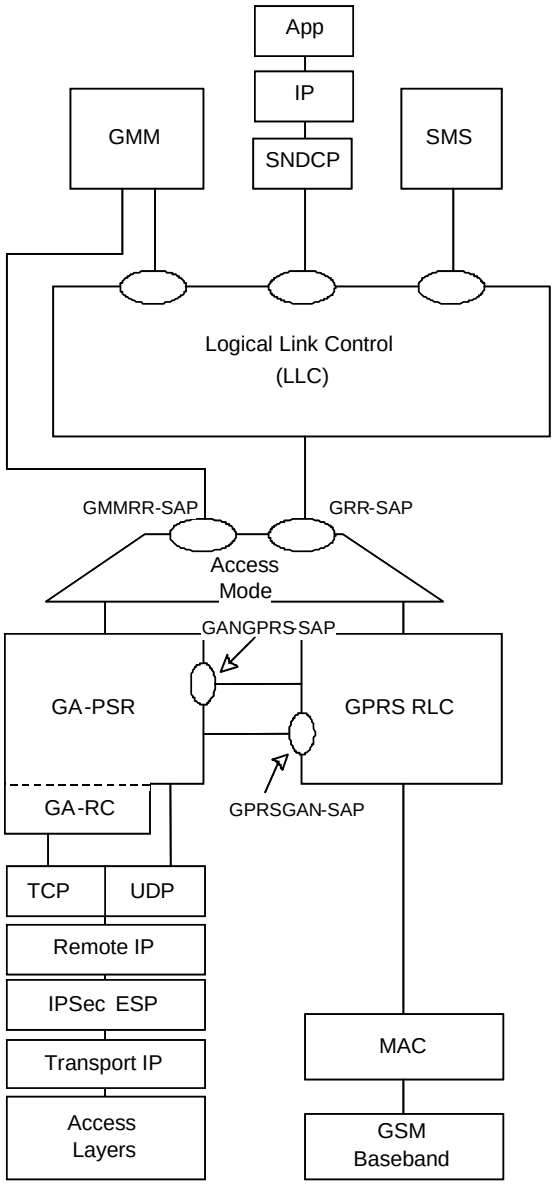


Figure 7: MS PS Domain Architecture

Figure 7 illustrates the main features of the MS PS Domain architecture, which are as follows:

- The GRR-SAP to the GPRS-LLC layer is preserved.
- The GMMRR-SAP interface to the GPRS-GMM layer is preserved.
- An access mode switch is provided to switch between GPRS and GAN modes.
- GA-PSR peers with GPRS-RLC to provide coordination for roving and handover.

7 Management functionality

7.1 State diagram for Generic Access

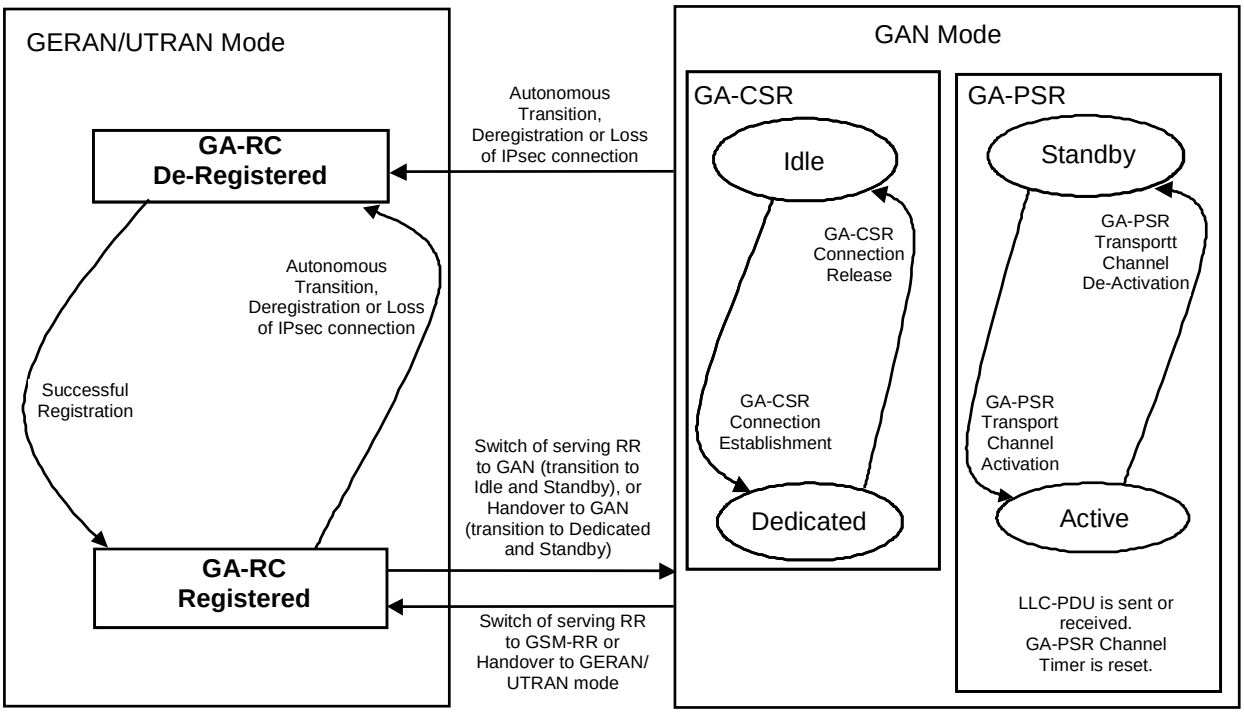


Figure 8: State diagram for Generic Access in the MS

7.2 GA-RC (Generic Access Resource Control)

7.2.1 General

The GA-RC protocol provides a resource management layer, with the following functions:

- discovery and Registration with GANC;
- registration Update with GANC;
- application level keep-alive with GANC; and
- support for identification of the AP being used for GAN access.

7.2.2 States of the GA-RC sub-layer

The GA-RC sub-layer in the MS can be in one of two states - GA-RC-DEREGISTERED or GA-RC-REGISTERED - as illustrated in figure 8.

In the GA-RC-DEREGISTERED state, the MS may be in a GAN coverage area; however, the MS has not registered successfully with the GAN. The MS may initiate the GAN Registration procedure when in the GA-RC-DEREGISTERED state. The MS returns to GA-RC-DEREGISTERED state on loss of TCP or IPsec connection.

In the GA-RC-REGISTERED state, the MS is registered with a GANC, has an IPsec and an TCP connection established to the Serving GANC, through which the MS may exchange GA-CSR or GA-PSR signaling messages with the GANC, and the SAP between the GA-CSR and MM entity and the GA-PSR and the GMM entity are not active. In the GA-RC-REGISTERED state, the MS may be camped on GERAN or UTRAN, active in GERAN or UTRAN (e.g. a GSM RR or a UTRAN RRC connection may be established) or may have no GERAN or UTRAN service while still maintaining the registration in the GAN. The MS may re-enter GA-RC-REGISTERED state from GA-CSR-DEDICATED when Handover from GAN is being performed.

7.3 GA-CSR (Generic Access Circuit Switched Resources)

7.3.1 General

The GA-CSR protocol provides a resource management layer, which is equivalent to the GSM-RR and provides the following functions:

- setup of bearer for CS traffic between the MS and GANC;
- handover support between GERAN and GAN; and
- functions such as GPRS suspension, paging, ciphering configuration, classmark change.

7.3.2 States of the GA-CSR sub-layer

The GA-CSR sub-layer in the MS can be in two states -GA-CSR-IDLE or GA-CSR-DEDICATED as illustrated in figure 8.

The MS enters GA-CSR-IDLE state from GA-RC-REGISTERED state, when the MS switches the serving RR entity to GA-CSR and the SAP between the MM and the GA-CSR is activated. Simultaneously, the GA-PSR acquires the control of the RLC GRR and GMMRR SAPs and transitions to GA-PSR- STANDBY state. While the MS remains in GAN mode it performs registration Update and application level keep-alive with the GANC as per the GA-RC-REGISTERED state.

The MS moves from the GA-CSR-IDLE state to the GA-CSR-DEDICATED state when the GA-CSR connection is established and returns to GA-CSR-IDLE state when the GA-CSR connection is released. Upon GA-CSR connection release an indication that no dedicated resources exist is passed to the upper layers.

The MS may also enter GA-CSR-DEDICATED state from GA-RC-REGISTERED state of GERAN/UTRAN mode when Handover to GAN is being performed. In the same way, the MS enters GA-RC-REGISTERED state of GERAN/UTRAN mode from GA-CSR-DEDICATED when Handover from GAN is being performed.

7.4 GA-PSR (Generic Access Packet Switched Resources)

The GA-PSR protocol provides the following services:

- delivery of GPRS signalling, SMS messages over the secure tunnel;
- paging, flow control, GPRS transport channel management; and
- transfer of GPRS user plane data.

The GA-PSR Transport Channel (GA-PSR TC) provides the association between the MS and GANC for the transport of GPRS user data over the Up interface. Given that the GAN user data transport is UDP based, the GA-PSR Transport Channel is associated with corresponding MS and GANC IP addresses and UDP ports used for GPRS user data transfer. The MS and GANC manage the GA-PSR Transport Channel based on the requests for data transfer and the configurable GA-PSR Channel Timer.

7.4.1 States of the GA-PSR sub-layer

The GA-PSR sub-layer in the MS can be in two states - GA-PSR-STANDBY or GA-PSR-ACTIVE - as illustrated in figure 8.

- **GA-PSR-STANDBY:** This is the initial/default state of the mobile station in GAN mode. The MS is not able to send or receive GPRS user data to and from the GANC. The GA-PSR Transport Channel does not exist when the MS is in GA-PSR-STANDBY state. The GANC or the MS needs to activate the GA-PSR Transport Channel before sending any GPRS user data. When the MS GA-PSR successfully establishes a GA-PSR Transport Channel, it transitions to the GA-PSR-ACTIVE state.

- **GA-PSR-ACTIVE:** The MS is able to send and receive GPRS user data to and from the GANC. The corresponding GA-PSR Transport Channel exists.

Upon a successful switch to GAN mode, the MS GA-PSR acquires the control of the RLC GRR and GMMRR SAPs and transitions to GA-PSR-STANDBY state.

After successful GA-PSR TC activation, the MS GA-PSR transitions to GA-PSR-ACTIVE state. The following are the possible triggers for GA-PSR TC activation on the MS side:

- The LLC initiates the uplink data transfer using LLC SAPI 3, 5, 9 or 11.

- The GANC initiates GA-PSR TC activation; i.e. the MS receives a GA-PSR-ACTIVATE-GPRS-TC-REQ message from the GANC.

While the GA-PSR is in the GA-PSR-ACTIVE state, the corresponding GA-PSR TC exists and the GPRS user data transport is enabled both in uplink and downlink direction. Upon the successful GA-PSR TC activation and in parallel with transition to GA-PSR-ACTIVE state, the MS GA-PSR starts the GA-PSR Channel Timer. When the GA-PSR Channel Timer expires, the MS sends a message to the GANC to initiate GA-PSR TC deactivation. Upon successful GA-PSR TC deactivation, the MS GA-PSR transitions to GA-PSR-STANDBY state.

At any time, while in GAN mode, if the serving RR entity is switched to GSM-RR, the GA-PSR is disconnected from GPRS SAPs and the MS enters GERAN/UTRAN mode. Simultaneously, the MS will release the associated GA-PSR TC regardless of the GA-PSR Channel Timer status.

The MS GA-PSR maintains one GA-PSR TC for all active user data flows; i.e. if the GA-PSR is in GA-PSR-ACTIVE state, any uplink user data packet is transferred using the active GA-PSR TC regardless of the associated PFC and LLC SAP. The GA-PSR Channel Timer is restarted whenever any uplink user data packet is sent or downlink user data packet received regardless of the associated PFC and LLC SAP.

7.5 Security Mechanisms

GAN supports security mechanisms at different levels and interfaces as depicted in figure 9.

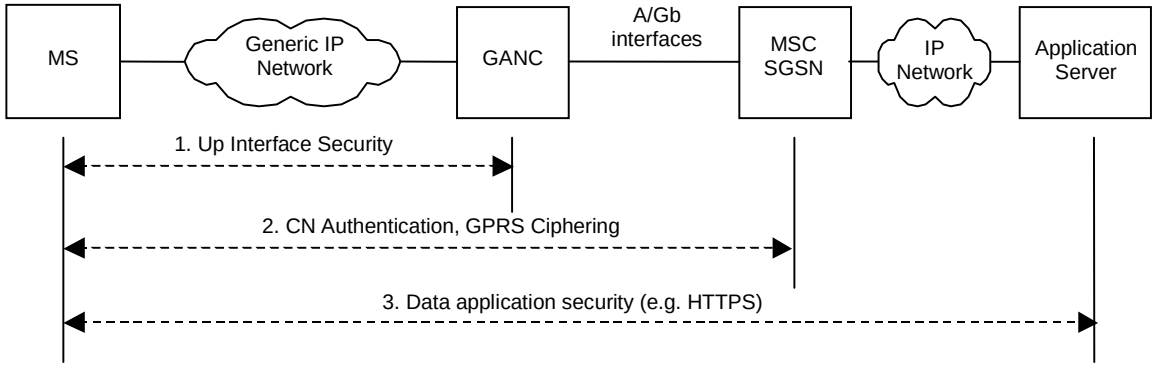


Figure 9: GAN Security Mechanisms

1. The security mechanisms over the Up interface protect signalling, voice and data traffic flows between the MS and the GANC from unauthorized use, data manipulation and eavesdropping; i.e. authentication, encryption and data integrity mechanisms are supported.

2. Authentication of the subscriber by the core network occurs between the MSC/VLR or SGSN and the MS and is transparent to the GANC - however, there is a cryptographic binding between the MS-CN authentication and the MS-GANC authentication to prevent man in the middle attacks. GPRS ciphering is the standard LLC layer ciphering that operates between the MS and the SGSN. These mechanisms are out of scope of the present document.

3. Additional application level security mechanisms may be employed in the PS domain to secure the end-to-end communication between the MS and the application server. For example, the MS may run the HTTP protocol over an SSL session for secure web access. These mechanisms are out of scope of the present document.

All signalling traffic and user-plane traffic sent between MS and GANC over the Up interface is protected by an IPsec tunnel between the MS and GANC-SEGW, that provides mutual authentication (using SIM credentials), encryption and data integrity using the same mechanisms as specified in 3GPP TS 33.234 [9].

8 High-Level Procedures

8.1 Mechanism of Mode Selection in Multi-mode terminals

A Generic Access capable terminal may support any IP access technology in addition to the GERAN and possibly UTRAN radio interfaces. The MS may be either in the GERAN/UTRAN mode or in GAN mode of operation.

The MS can be configured to operate in one of the above two modes at any given time. There may be preferred mode of operation that can be configured by the user, or by the operator through various mechanisms, e.g. device management.

On power up, the MS always starts in GERAN/UTRAN mode and executes the normal power-up sequence as specified in 3GPP TS 23.122 [4]. Following this, the MS may switch into GAN mode based on mode selection preference determined by user preferences or operator configuration.

The various preferences for the MS that are possible are as follows:

- GERAN/UTRAN -only:
  - The MS RR entity remains in GERAN/UTRAN mode and does not switch to GAN mode.
- GERAN/UTRAN -preferred:
  - The MS RR entity is in GERAN/UTRAN mode as long as there is a suitable GERAN cell or a suitable UTRAN cell available. If the MS cannot find a suitable GERAN cell or a suitable UTRAN cell to camp on, and MS has successfully registered with a GANC over the generic IP access network, then the MS switches to GAN mode. When the MS in GAN mode is able to find a suitable GERAN cell or a suitable UTRAN cell to camp on, or the MS has de-registered or loses connectivity with the GANC over the generic IP access network, the MS returns to GERAN/UTRAN mode.
- GAN-preferred:
  - When the MS has successfully registered with the GAN over the generic IP access network, the MS switches to GAN mode and stays in this mode as long as the GAN is available. When the MS deregisters, or otherwise loses connectivity with the GAN over the generic IP access network, the MS switches to GERAN/UTRAN mode.
- GAN-only:
  - The MS switches to GAN mode (after initial power up sequence in GERAN/UTRAN mode to obtain cellular network information, but excluding (G)MM procedures with GERAN core network) and does not switch to GERAN/UTRAN mode. During the initial power up sequence in GERAN/UTRAN mode the MS shall ignore paging message received through GERAN/UTRAN network.

8.2 PLMN Selection

There shall be no change from the PLMN selection procedures in the NAS layers (MM and above) in the MS, with the exception that in GAN mode the 'in VPLMN background scan' shall be disabled.

A GANC can be only connected to one PLMN.

The PLMN selection in the NAS layers shall not lead to change of mode between GERAN/UTRAN mode and GAN mode. For a specific instance of PLMN selection only PLMNs available via GAN or only PLMNs available via GERAN/UTRAN are provided to the NAS layer (i.e. no combination of the PLMNs available via GERAN/UTRAN and GAN).

In the case of a GAN capable MS, a GANC selection process also may be required as part of the process of establishing the connectivity between the MS and the GANC. This takes place when, during GAN registration, a GAN capable MS may have a choice among two or more GANC-PLMN pairs indicated by the Default GANC (i.e. in the GA-RC REGISTER REDIRECT message). The GANC selection process takes place while the MS is still in GERAN/UTRAN mode, and before the MS roves into GAN mode. If the current selected PLMN is available via GAN, it shall be selected. If not, the selection of GANC is implementation specific.

If the MS does not have any stored information related to the Serving GANC for the CGI or AP to which the MS is currently connected, the MS attempts to register with the Default GANC (always located in the HPLMN) stored in MS. The MS includes an indication, identifying the GANC as the Default GANC in the GA-RC REGISTER REQUEST message.

When an MS attempts to register on the Default GANC including an indication that it is in automatic PLMN selection mode:

- If the Default GANC wishes to serve the MS, the Default GANC responds with a GA-RC REGISTER ACCEPT message.
- If the Default GANC wishes to redirect the MS to another GANC within the HPLMN, the Default GANC responds with a GA-RC REGISTER REDIRECT message, not including a list of PLMN identities.
- If the Default GANC wishes to redirect the MS to a PLMN that is not the HPLMN, the Default GANC responds with a GA-RC REGISTER REDIRECT message and includes a list of PLMNs that may provide GAN service to the MS in its current location. The list contains one or more PLMN identities along with the identities of their associated GANC and SEGW nodes (either in IP address or FQDN format). Following the GANC selection process, the GA-RC shall attempt to register on the associated GANC.

If at any time the user wishes to perform manual PLMN selection or a "User reselection" irrespective of whether the MS is in manual or automatic PLMN selection mode, the MS sends a GA-RC REGISTER REQUEST message to the Default GANC, including an indication that it is in manual PLMN selection mode. The Default GANC is not allowed to accept the registration and responds with a GA-RC REGISTER REDIRECT message and includes a list of PLMNs that may provide GAN service to the MS in its current location.

If the MS includes the identity of the current serving GSM network in the GA-RC REGISTER REQUEST message, the Default GANC uses this to identify the list of PLMNs to send to the MS in the response message.

After successful registration with a serving GANC, the MS shall not store the PLMN list. The MS shall not use the PLMN list, provided to the MS during the registration procedure, for background scanning.

NOTE: An MS cannot use Generic Access in a VPLMN unless the HPLMN supports and authorises Generic Access.

8.3 Re-selection between GERAN/UTRAN and GAN modes

8.3.1 Rove-in (from GERAN/UTRAN mode to GAN mode)

This procedure is applicable only if GAN service is available, a MS is not in NC2 mode (as defined in 3GPP TS 45.008 [18]) and has an MS preference for:

- GAN-only;

- GAN-preferred or;
- GERAN/UTRAN-preferred and the MS cannot find a suitable GERAN cell or a suitable UTRAN cell to camp on.

Following successful GAN registration, the Access mode in the MS is switched to GAN mode. GA-CSR entity in the MS reports to the NAS, the NAS-related system information received in the GAN Registration Procedure. The NAS considers the GANC allocated CGI, as the current serving cell.

While in GAN mode, GERAN-RR and UTRAN RRC entities are detached from the RR-SAP in the MS, as a result the entities do not:

- inform NAS about any GERAN/UTRAN cell re-selection and/or the change of system information of the current camping cell;
- inform NAS about any newly found PLMN over GERAN or UTRAN; and
- act on any paging request message received over GERAN or UTRAN.

Rove-in may be applied to support CS call re-establishment following the loss of an RR connection in GSM or to support packet service re-establishment following abnormal TBF release with cell reselection in GPRS. The support for call re-establishment is indicated to the MS in the GAN system information.

8.3.2 Rove-out (from GAN mode to GERAN/UTRAN mode)

This procedure is applicable when MS detaches from the generic IP access network, and its mode selection is GAN-preferred or GERAN/UTRAN-preferred.

When the MS detaches from the generic IP access network, depending on prevailing circumstances the MS may be able to deregister first with the GANC.

For the GAN-preferred and GERAN/UTRAN-preferred mode selections, the MS detaches GA-CSR from the RR-SAP and re-attaches GERAN-RR or UTRAN RRC to RR-SAP and restores normal GERAN-RR or UTRAN RRC functionality.

For the GAN-only mode selection, GA-CSR remains attached to NAS and the MS stays in GAN mode (in "No Service" condition).

8.4 GAN Registration related procedures

8.4.1 Discovery and Registration for Generic Access

8.4.1.1 General

The Discovery and Registration procedures are applicable only if the MS preference is operating in GAN-only, GAN-preferred or, if no allowable PLMN is available through GERAN/UTRAN, in GERAN/UTRAN-preferred mode.

Once the MS has established a connection to the generic IP access network, the mobile determines the appropriate GANC-SEGW to connect to, by completing the Discovery Procedure to the Provisioning GANC in the HPLMN of the MS. The Provisioning GANC provides the address of the Default GANC in the HPLMN of the MS, to which the mobile can register.

The MS attempts to register on the Default GANC provided by the Provisioning GANC during the Discovery procedure, by completing the Registration Procedure. The Default GANC may accept the Registration; redirect the MS to another GANC; or Reject the Registration.

8.4.1.2 Security Gateway Identification

The (U)SIM of the MS contains the FQDN (or IP address) of the Provisioning GANC and the associated SEGW or the MS derives this information based on information in the (U)SIM. If the MS does not have any information about other GANCs and associated SEGW stored, then the MS completes the Discovery procedure towards the Provisioning GANC.

As part of the Registration Procedure, the Default GANC can indicate whether this GANC and SEGW address or the address of a GANC that the MS is being redirected to, may be stored by the MS.

The MS may also store Serving GANC information for Serving GANCs with which the MS was able to complete a successful registration procedure. The default GANC is in control of whether the MS is allowed to store Serving GANC information. If there is no GERAN/UTRAN coverage in the AP location, the stored Serving GANC information shall be associated with the AP-ID. If there is GERAN/UTRAN coverage in the AP location, the stored Serving GANC information shall be associated with the GSM CGI or LAI and UTRAN CI. The stored Serving GANC information is:

- serving SEGW FQDN or IP address following successful registration;
- serving GANC FQDN or IP address following successful registration; and
- optionally, Serving GANC TCP port following successful registration and if returned from the network.

The number of such entries to be stored in the MS is implementation specific. Only the last successfully registered GANC association shall be stored when the Default GANC indicates that the MS is allowed to store these addresses. An MS may preferentially join a generic IP access network point of attachment whose association with a Serving GANC has been stored in memory.

On connecting to the generic IP access network, if the MS has a stored Serving GANC for the AP-ID or the GERAN/UTRAN cell, the MS shall attempt to register with the associated Serving GANC in its memory. The GANC may still reject the MS for any reason even though it may have served the MS before. The MS shall delete from its stored list the address of the Serving GANC on receiving a registration reject or if the registration fails for any other reason (e.g. not receiving any response).

If the MS does not receive a response to the Registration Request sent to the Serving GANC (and which is not the Default GANC), it shall re-attempt to register with the Default GANC. If the MS does not receive a response to the registration request sent to the Default GANC, it shall attempt the discovery procedure with the Provisioning GANC in order to obtain a new Default GANC.

In the case when a MS is attempting to register or discover a GANC after failing to register on a GANC, the MS provides in the Registration or Discovery procedure an indication that the MS has attempted to Register on another GANC, the failure reason, and the GANC and SEGW addresses of the failed registration.

When the MS connects to a generic IP access network, for which it does not have a stored Serving GANC in it's memory, it shall attempt to register with the Default GANC.

8.4.1.3 GANC capabilities

To be populated with GANC specific information that needs to be transferred to the MS on successful registration.

8.4.1.4 MS capabilities

To be populated with GAN specific capabilities of the MS that needs to be transferred to the GANC during registration and the interaction to what is reported to the CN is FFS.

8.4.1.4a Required GAN Services

The MS may request which GAN services it requires from the GANC as part of the Registration procedures.

8.4.1.5 Discovery Procedure

8.4.1.5.1 Normal Case

When an MS supporting GAN first attempts to connect to a GAN, the MS needs to identify the Default GANC. Each GAN capable MS can be configured with the FQDN (or IP address) of the Provisioning GANC and the associated SEGW or the MS can derive this FQDN based on information in the (U)SIM (see 3GPP TS 23.003 [43]). The MS first connects to a Provisioning GANC-SEGW and GANC in the HPLMN of the MS, by establishing a secure IPsec tunnel and a TCP connection using the provisioned or derived addresses. The MS obtains the FQDN or IP address of the Default GANC in the HPLMN and the associated SEGW, through the Discovery procedure.

If no GERAN/UTRAN coverage is available when an MS connects to the GANC for GAN service, then the GANC cannot necessarily determine the location of the MS for the purposes of assigning the MS to the correct serving GANC (to enable handover and location-based services). The GANC shall permit the operator to determine the service policy in this case; e.g. the operator could provide service to the user with certain limitations (possibly with a user interface indication on the MS).

NOTE: When the MS initiates the Discovery/Registration procedures and no GERAN/UTRAN coverage is available, the GANC may have insufficient information to correctly route subsequent emergency calls.

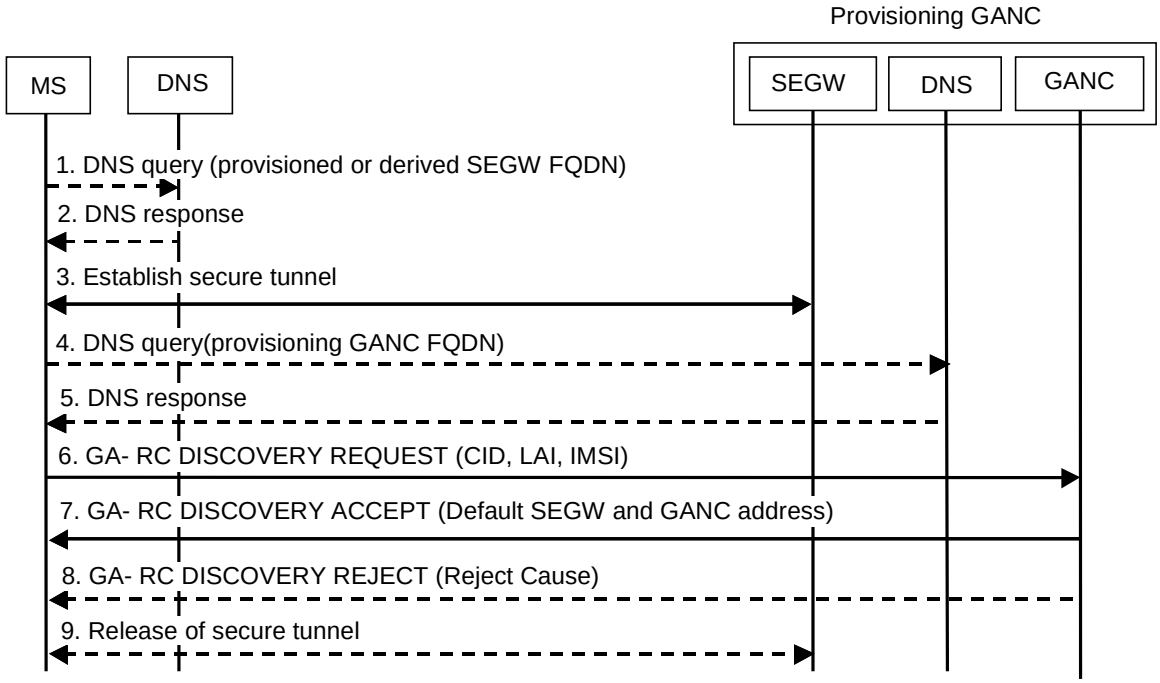


Figure 10: Discovery procedure

In the description below it is assumed that the MS has a mode selection of GAN-only or GAN-preferred or GERAN/UTRAN-preferred and that the MS has already connected to the generic IP access network.

NOTE: It is implementation specific what signal level should be deemed as sufficient for triggering the GAN Discovery and Registration procedures.

1. If the MS has a provisioned or derived FQDN of the Provisioning SEGW, it performs a DNS query (via the generic IP access network interface) to resolve the FQDN to an IP address. If the MS has a provisioned IP address for the Provisioning SEGW, the DNS step is omitted.

2. The DNS Server returns a response including the IP Address of the Provisioning SEGW.

3. The MS establishes a secure tunnel to the Provisioning SEGW.

4. If the MS has a provisioned or derived FQDN of the Provisioning GANC, it performs a DNS query (via the secure tunnel) to resolve the FQDN to an IP address. If the MS has a provisioned IP address for the Provisioning GANC, the DNS step will be omitted.

5. The DNS Server returns a response including the IP Address of the Provisioning GANC.

6. The MS sets up a TCP connection to a well-defined port on the Provisioning GANC. It then queries the Provisioning GANC for the Default GANC, using GA-RC DISCOVERY REQUEST. The message contains:

   - GSM Cell Info: Either current camping GSM CGI, or last CGI where the MS successfully registered, along with an indicator stating which one it is.

   - Generic IP access network attachment point information: AP-ID, as defined in annex C.

   - MS Identity: IMSI.

7. The Provisioning GANC returns the GA-RC DISCOVERY ACCEPT message, using the information provided by the MS (e.g. the CGI), to provide the FQDN or IP address of the Default GANC and its associated Default SEGW. This is done so the MS is directed to a "local" Default GANC in the HPLMN to optimize network performance. This message indicates whether the GANC and SEGW address provided shall or shall not be stored by the MS.

8. If the Provisioning GANC cannot accept the GA-RC DISCOVERY REQUEST message, it returns a GA-RC DISCOVERY REJECT message indicating the reject cause.

9. The secure IPsec tunnel to the Provisioning SEGW is released. It shall also be possible to reuse the same IPsec tunnel for GAN Registration procedures. In this case the IPsec tunnel is not released.

8.4.1.6 Registration procedure

8.4.1.6.1 Normal case

Following the Discovery procedure the MS establishes a secure tunnel with the secure gateway of the Default GANC, provided by the Provisioning GANC in the Discovery procedure, and attempts to register with the Default GANC. The Default GANC may become the Serving GANC for that connection by accepting the registration, or the Default GANC may redirect a mobile performing registration to a different Serving GANC.

GANC redirection may be based on information provided by the MS during the Registration procedure, operator chosen policy or network load balancing.

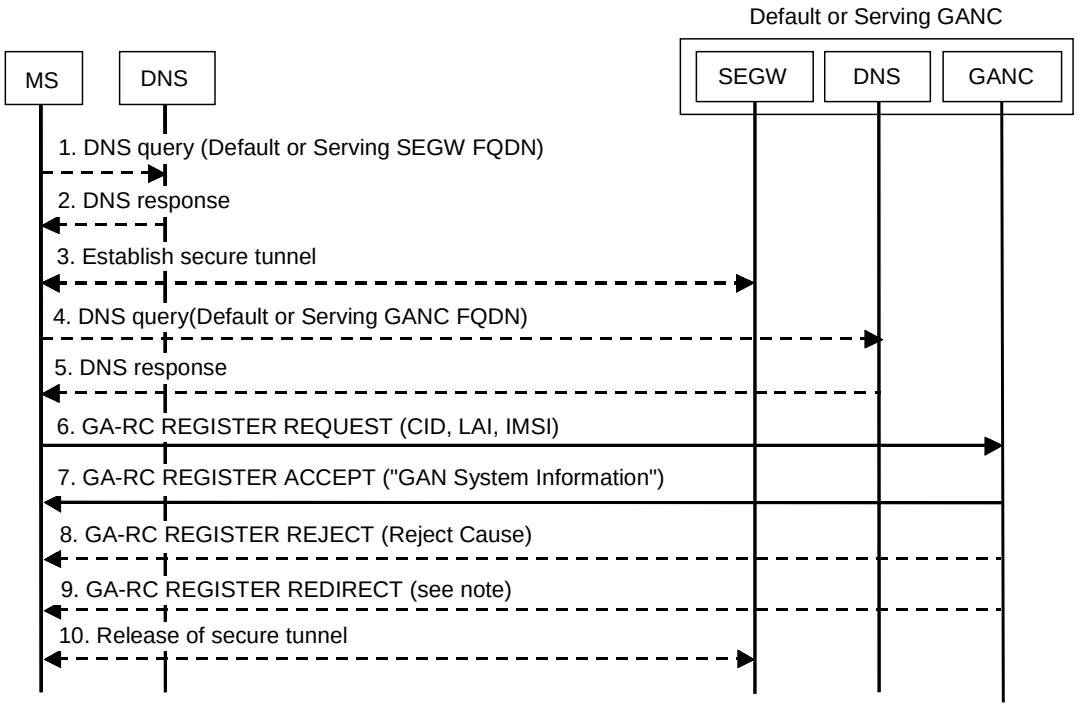
The GAN Registration procedure serves the following functions:

- Ensures the MS is registered to the appropriate GANC entity i.e. with use of the redirection process;

- Informs the GANC that the MS is now connected through a generic IP access network and is available at a particular IP address. The GANC maintains the registration context for the purposes of (for example) mobile-terminated calling; and

- Provides the MS with the operating parameters associated with the GAN service. The "GSM System Information" message content that is applicable to the GAN cell is delivered to the MS during the GAN registration process. This enables the MS to switch to GAN mode, and following the Registration procedure trigger NAS procedures with the core network (such as Location/Routing Area Update, mobile originated calls, mobile terminated calls, etc.).

- Enables the MS to request which GAN services are required.



NOTE: The GA-RC REGISTER REDIRECT message may contain: a single Serving SEGW and GANC address or a list of PLMN identities and associated Serving SEGW and GANC addresses; and an Indication of whether GANC address(es) can be stored in the MS for future use.

Figure 11: Registration procedure

1. If the MS was only provided the FQDN of the Default or Serving SEGW, the MS shall perform a DNS query (via the generic IP access network interface) to resolve the FQDN to an IP address. If the MS has a provisioned IP address for the SEGW, the DNS step is omitted.

2. The DNS Server returns a response.

3. The MS shall then set up a secure IPsec tunnel to the SEGW. This step may be omitted if an IPsec tunnel is being reused from an earlier Discovery or Registration.

4. If the MS was provided the FQDN of the Default or Serving GANC, the MS shall then perform a DNS query (via the secure tunnel) to resolve the FQDN to an IP address. If the MS has an IP address for the GANC, the DNS step is omitted.

5. The DNS Server returns a response.

6. The MS then sets up a TCP connection to a TCP port on the GANC. The TCP port can either be a well-known or one that has been earlier received from the network during Discovery or Registration. The MS shall attempt to register on the GANC by transmitting the GA-RC REGISTER REQUEST. The message contains:

   - GSM Cell Info: Either current camping GSM CGI, or last CGI where the MS successfully registered, along with an indicator stating which one it is.

   - Generic IP access network attachment point information: AP-ID, as defined in annex C.

   - MS Identity: IMSI.

   - MS Capability Information.

   - GAN Services Required

7. If the GANC accepts the registration attempt it shall respond with a GA-RC REGISTER ACCEPT. The message contains:

   - GAN specific system information (e.g.):

- Cell description comprising the BCCH ARFCN, PLMN colour code, and base-station colour code corresponding to the GAN cell.
- Location-area identification comprising the mobile country code, mobile network code, and location area code corresponding to the GANC cell.
- Cell identity identifying the cell within the location area corresponding to the GAN cell.

- GAN Capability Information.
- Application level Keep Alive timer value (see clause 8.4.4).

In this case the TCP connection and the secure IPsec tunnel are not released and are maintained as long as the MS is registered to this GANC.

8. Alternatively, the GANC may reject the request. In this case, it shall respond with a GA-RC REGISTER REJECT indicating the reject cause. The TCP connection and the secure IPsec tunnel are released and the MS shall act as defined in clause 8.4.1.3.2.

9. Alternatively, if the GANC wishes to redirect the MS to (another) Serving GANC, it shall respond with a GA-RC REGISTER REDIRECT providing the FQDN or IP address of the target Serving GANC and the associated SEGW. In this case the TCP connection is released and the secure IPsec tunnel is optionally released depending on if the network indicates that the same IPsec tunnel can be reused for the next registration.

8.4.1.6.2 Abnormal cases

If the Serving GANC rejects the Register request and does not provide redirection to another Serving GANC, the MS shall re-attempt Registration to the Default GANC including a cause indicating the failed registration attempt and the Serving GANC and SEGW with which the Register request failed. The MS should also delete all stored information about this Serving GANC.

If the Default GANC rejects a Registration Request and is unable to provide redirection to suitable Serving GANC, the MS may re-attempt the Discovery procedure to the Provisioning GANC (including a cause indicating the failed registration attempt and the Default GANC provided in the last Discovery procedure). The MS should also delete all stored information about the Default GANC.

8.4.2 De-Registration

The GA-RC De-Registration procedure allows the MS to explicitly inform the GANC that it is leaving GAN mode (e.g. when it detaches from the generic IP access network), by sending a GA-RC DEREGISTER message to the GANC, allowing the GANC to free resources that it assigned to the MS. The GANC also supports "implicit GAN deregistration", when the TCP connection to the MS is abruptly lost.

The GANC can also autonomously release the MS registration context, and send a GA-RC DEREGISTER message to the MS. Alternatively, the GANC can implicitly deregister the MS by closing the TCP connection with the MS.

NOTE: At power-down the GA-RC sublayer of the MS ensures that the MS explicitly detaches from the network, where possible, before completing the GA-RC De-Registration procedure.

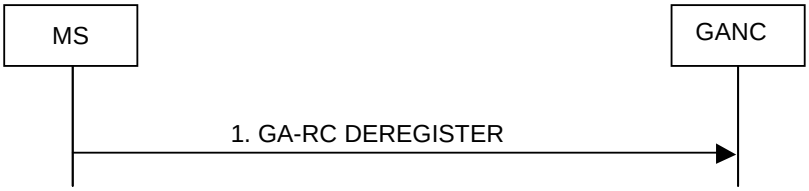


Figure 12: De-Registration initiated by the MS

1. The MS sends the GA-RC DEREGISTER to the GANC, which removes the MS context in the GANC.

Figure 13: De-Registration initiated by the GANC

1. The GANC sends the GA-RC DEREGISTER to the MS.

8.4.3 Registration Update

The GA-RC Registration Update procedure allows the MS to update information in the GANC regarding changes to the identity of the overlapping GERAN cell or changes to the generic IP access network point of attachment, by sending a GA-RC REGISTER UPDATE UPLINK message to the GANC carrying the updated information. This may result in the MS being redirected to another serving GANC, or being denied service e.g. due to operator policy.

The GAN Registration Update procedure also allows the GANC to update the GAN system information in the MS, if needed, by sending a GA-RC REGISTER UPDATE DOWNLINK message to the MS carrying the updated information.

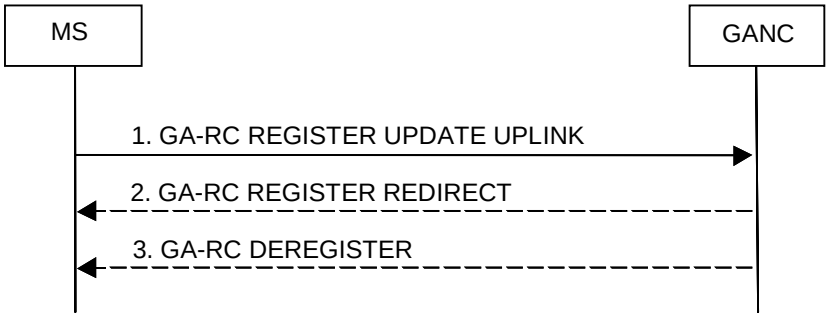


Figure 14: Registration Update Uplink

1. When the MS detects GSM coverage after reporting no coverage during GAN registration, it shall send the GA-RC REGISTER UPDATE UPLINK to the GANC with the updated information. Whenever the generic IP access network point of attachment changes, the MS shall send a GA-RC REGISTER UPDATE UPLINK to the GANC with the updated generic IP access network point of attachment information. If the MS requires to update the GANC with a new list of GAN Services required, then the MS sends GA-RC REGISTER UPDATE UPLINK message to the GANC including the new GAN Services Required list.

2. The GANC may optionally send the GA-RC REGISTER REDIRECT when it wants to redirect the MS based on updated information.

3. The GANC may also optionally deregister the MS on receiving an update by sending GA-RC DEREGISTER to the MS.

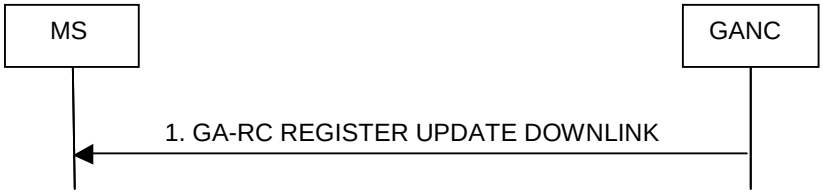


Figure 15: Registration Update Downlink

1. The GANC sends GA-RC REGISTER UPDATE DOWNLINK with the updated system information.

8.4.4 Keep Alive

The Keep Alive process is a mechanism between the peer GA-RC entities to indicate that the MS is still registered to the GANC. Using periodic transmissions of the GA-RC KEEP ALIVE message the MS in turn determines that the GANC is still available using the currently established lower layer connection.

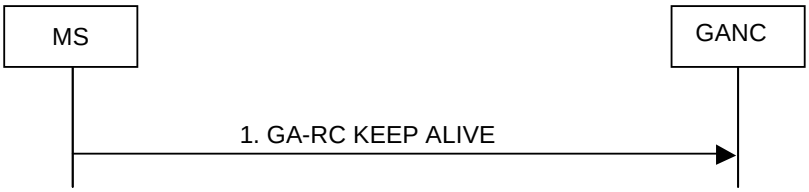


Figure 16: Keep Alive procedure

1. The MS sends GA-RC KEEP ALIVE to the GANC.

8.4.5 Cell Broadcast Information

The Cell Broadcast Information is a mechanism between the peer GA-RC entities, allowing the GANC to pass the MS information relating to the Cell Broadcast Services. The MS includes GAN Service Required information in the GA-RC REGISTER REQUEST and GA-RC REGISTER UPDATE UPLINK messages passed to the GANC, indicating that the MS requires the Cell Broadcast Service. The GANC then passes the required information to the MS in the GA-RC CELL BROADCAST INFO message.

Figure 16a: Cell Broadcast Information

1. The GANC sends the CELL BROADCAST INFO message to the MS, including information required by the MS.

8.5 Authentication

The Up interface shall support the ability to authenticate the MS with the GANC (for the purposes of establishing the secure tunnel) using GSM or UMTS credentials. Authentication between MS and GANC shall be performed using EAP-SIM or EAP-AKA within IKEv2.

The MS and GANC-SEGW establish a secure association for protecting signalling traffic and user-plane (voice and data) traffic. The protocol for authentication is IKEv2. Mutual authentication and key generation is provided by EAP-SIM or EAP-AKA.

The basic elements of these procedures are the following:

- The MS connection with the GANC-SEGW is initiated by starting the IKEv2 initial exchanges (IKE_SA_INIT). The EAP-SIM or EAP-AKA procedure is started as a result of these exchanges.
- The EAP-SIM procedure for MS with SIM only or MS with USIM, but not capable of UMTS AKA, is performed between MS and AAA server (that has access to the AuC/HLR/HSS to retrieve subscriber information). The EAP-AKA procedure for MS with USIM and the MS is capable of UMTS AKA, is performed between MS and AAA server. The GANC-SEGW acts as relay for the EAP-SIM/EAP-AKA messages.
- When the EAP-SIM/EAP-AKA procedure has completed successfully, the IKEv2 procedure can be continued to completion and the signalling channel between MS and GANC-SEGW is secured. The MS and GAN can then continue with the discovery or registration procedure.

- Signalling flows for EAP-SIM and EAP-AKA authentication and fast re-authentication are shown in annex A.

8.6 Encryption

All control and user plane traffic over the Up interface shall be sent through the IPsec tunnel that is established as a result of the authentication procedure. Encryption shall use the negotiated cryptographic algorithm, based on core network policy, enforced by the GANC-SEGW.

The MS and GANC-SEGW set up one Secure Association through which all traffic is sent. A single negotiated ciphering algorithm is applied to the connection.

8.6.1 Establishment of a Secure Association

After the authentication procedure (clause 8.5), the MS shall request an IP address on the network protected by the GANC-SEGW (i.e. the public IP interface of the GANC). The MS shall set up one IPsec Security Association (SA) between MS and GANC-SEGW.

The MS shall initiate the creation of the SA i.e. it shall act as initiator in the Traffic Selector negotiation. The protocol ID field in the Traffic Selectors (TS) shall be set to zero, indicating that the protocol ID is not relevant. The IP address range in the TSi shall be set to the address assigned to the MS (within the network protected by the GANC-SEGW). The IP address range in the TSr shall be set to 0.0.0.0 - 255.255.255.255. The MS and GANC-SEGW shall use the IKEv2 mechanisms for detection of NAT, NAT traversal and keep-alive.

All control and user plane data over the Up interface between MS and GANC shall be sent through the SA.

The ciphering mode is negotiated during connection establishment. During setup of the SA, the MS includes a list of supported encryption algorithms as part of the IKE signalling, which include the mandatory and supported optional algorithms defined in the IPsec profile, and NULL encryption. The GANC-SEGW selects one of these algorithms, and signals this to the MS.

When NULL encryption is applied, both control and user-plane traffic is sent unencrypted. This configuration can be selected e.g. when the connection between the generic IP access network and the GANC is under operator control. The integrity algorithm is the same as for either configuration i.e. non-ciphered traffic is still integrity protected.

8.7 GA-CSR Connection handling

The GA-CSR connection is a logical connection between the MS and the GANC for the CS domain. It is established when the upper layers in the MS request GA-CSR to enter dedicated mode. When a successful response is received from the network, GA-CSR replies to the upper layer that it has entered dedicated mode. The upper layers have then the possibility to request transmission of NAS messages to the network.

8.7.1 GA-CSR Connection Establishment

Figure 17 shows successful establishment of the GA-CSR Connection.

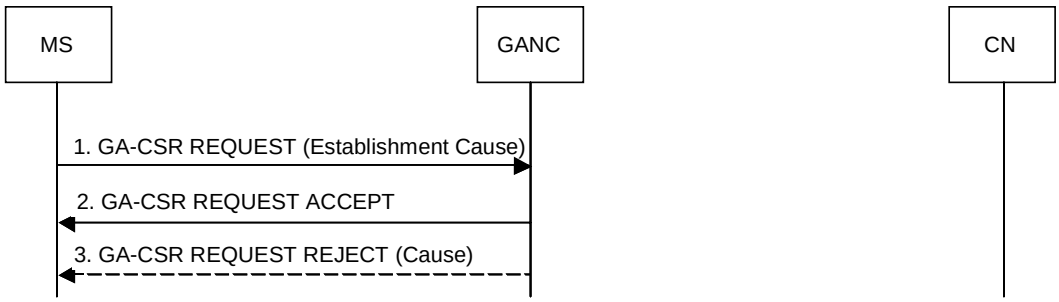


Figure 17: GA-CSR Connection Establishment

1. The MS initiates GA-CSR connection establishment by sending the GA-CSR REQUEST message to the GANC. This message contains the Establishment Cause indicating the reason for GA-CSR connection establishment.

2. GANC signals the successful response to the MS by sending the GA-CSR REQUEST ACCEPT and the MS enters dedicated mode and the GA-CSR state changes to GA-CSR-DEDICATED.

3. Alternatively, the GANC may return a GA-CSR REQUEST REJECT indicating the reject cause.

8.7.2 GA-CSR Connection Release

Figure 18 shows release of the logical GA-CSR connection between the MS and the GANC.

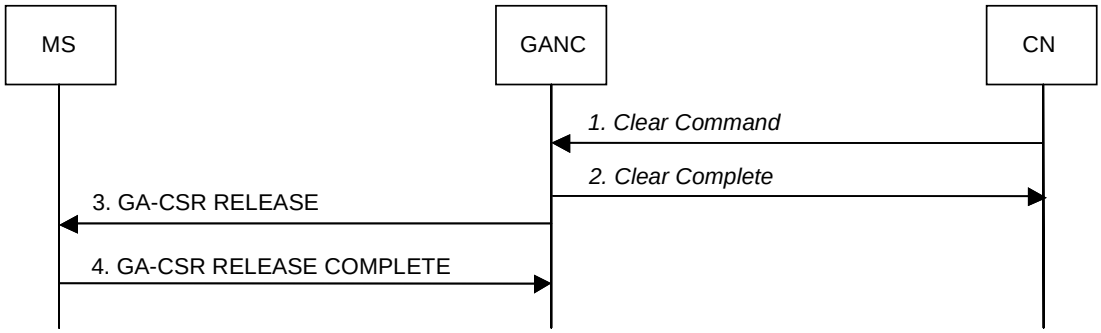


Figure 18: GA-CSR Connection Release

1. The CN indicates to the GANC to release the user plane connection allocated to the MS, via the *Clear Command*.

2. The GANC confirms resource release to CN using the *Clear Complete* message.

3. The GANC commands the MS to release resources, using the GA-CSR RELEASE message.

4. The MS confirms resource release to the GANC using the GA-CSR RELEASE COMPLETE message and the MS enters idle mode and the GA-CSR state in the MS changes to GA-CSR-IDLE.

8.8 Ciphering Configuration

The message flow for ciphering configuration is shown in figure 19.

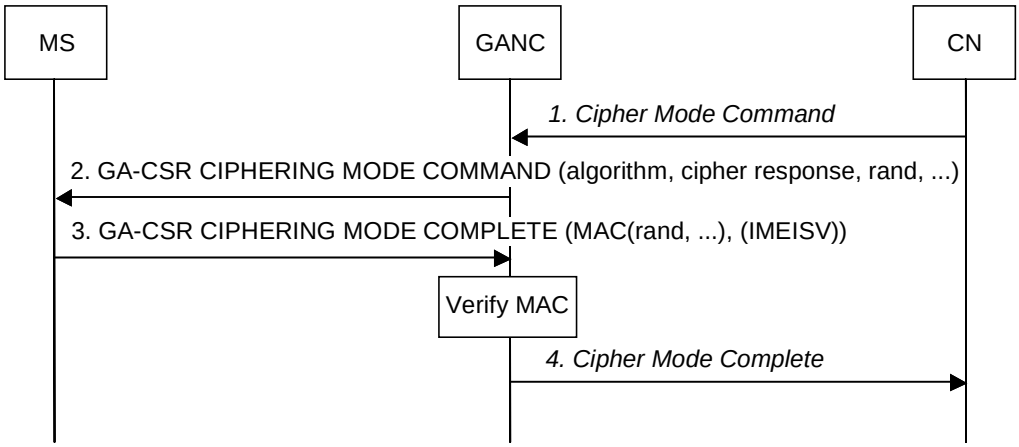


Figure 19: Ciphering Configuration

1. The CN sends BSSMAP "*Cipher Mode Command*" message to GANC. This message contains the cipher key Kc, and the encryption algorithms that the GANC may use.

2. The GANC sends GA-CSR CIPHERING MODE COMMAND to the MS. This message indicate whether stream ciphering shall be started or not (after handover to GERAN) and if so, which algorithm to use, and a random number. The mobile station stores the information for possible future use after a handover to GERAN. The

message also indicates whether the MS shall include IMEISV in the GA-CSR CIPHERING MODE COMPLETE message.

3. The MS computes a MAC based on the random number, the MS IMSI and the key Kc. The MS then sends GA-CSR CIPHERING MODE COMPLETE message to signal its selected algorithm, the computed MAC, and the IMEISV, if indicated so in the GA-CSR CIPHERING MODE COMMAND.

4. This GANC verifies the MAC. If the GANC verifies MAC to be correct it sends *Cipher Mode Complete* message to the CN.

NOTE: The MAC proves that the identity that is authenticated to the GANC is the same as the identity authenticated to the core network. The configuration option of not enabling ciphering in the network will therefore open up the network to more security threats than in GERAN.

8.9 GA-CSR Signalling and SMS Transport Procedures

8.9.1 Network initiated CS Signalling

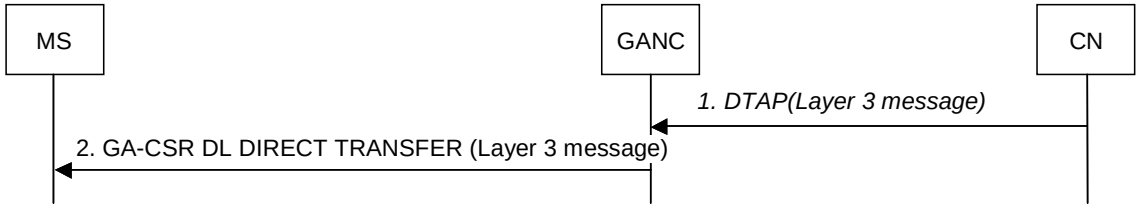


Figure 20: Downlink Control Plane Transport

1. For Network initiated signalling/SMS, the Core Network sends a MM/CC signalling or SMS message to the GANC via the A interface.

2. The GANC encapsulates the received message within a GA-CSR DL DIRECT TRANSFER message that is forwarded to the MS via the existing TCP connection.

8.9.2 MS initiated CS Signalling

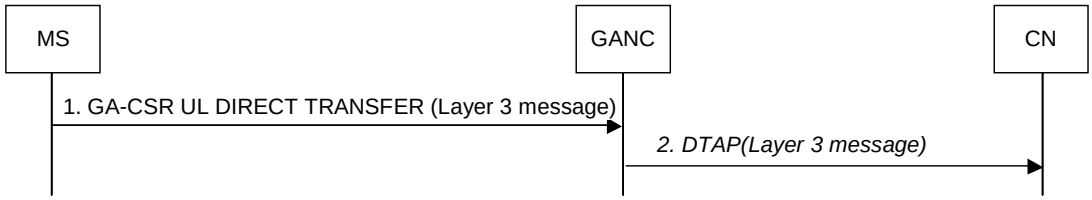


Figure 21: Uplink Control Plane Transport

1. For MS initiated signalling/SMS, the MS GA-CSR receives a request from the NAS layer to transfer an uplink NAS signalling message or SMS message. The MS GA-CSR encapsulates the NAS message within a GA-CSR UL DIRECT TRANSFER message and sends the message to the GANC.

2. The GANC relays the received message to the Core Network encapsulated in DTAP.

8.10 Mobile Originated Call Flow

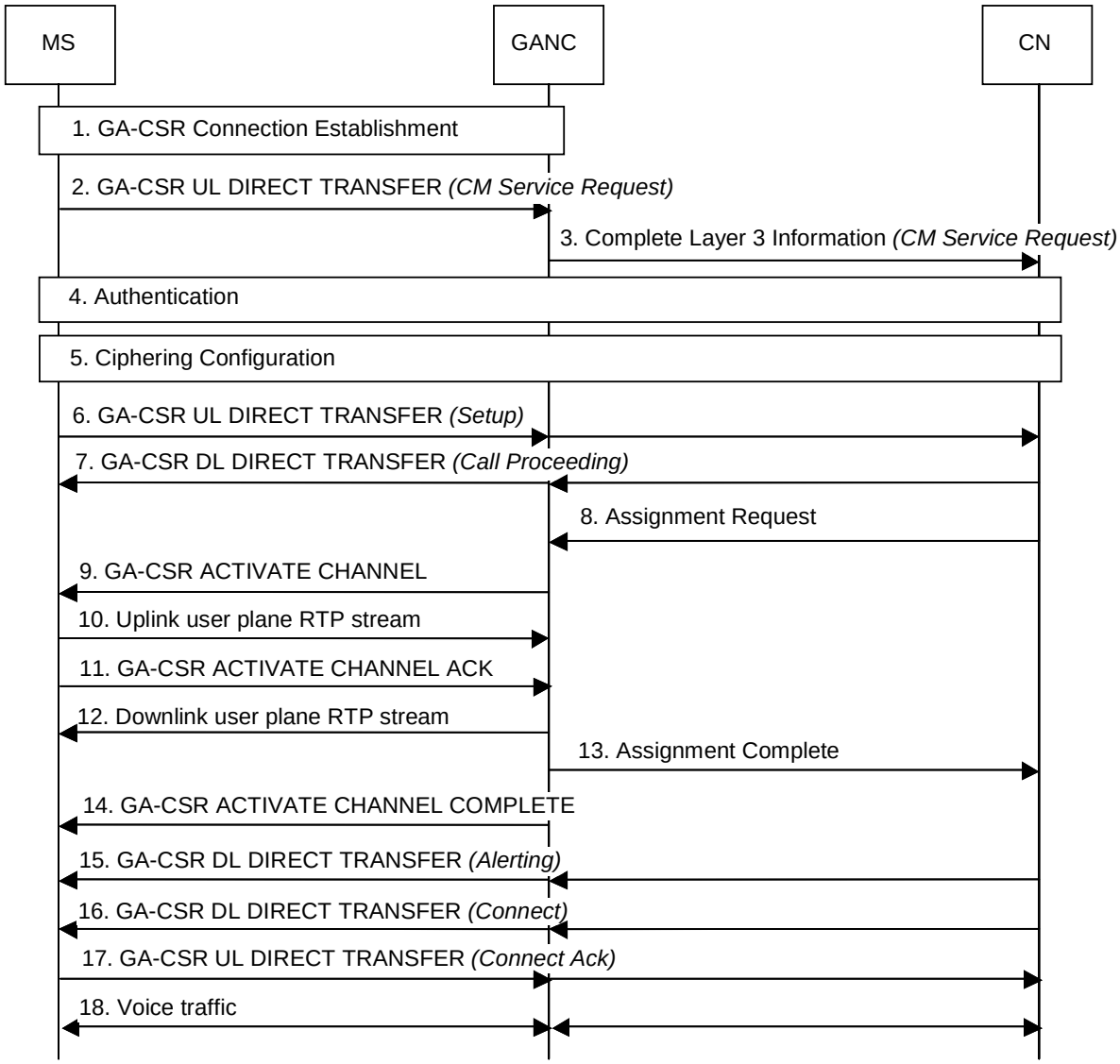


Figure 22: Mobile Originated Call

The description of the procedure in this sub-clause assumes the MS is in GAN mode i.e. it has successfully registered with the GANC and GA-CSR is the serving RR entity in the MS.

1. The GA-CSR Connection Establishment procedure is performed as described in clause 8.7.1.

2. Upon request from the upper layers, the MS sends the *CM Service Request* to the GANC in the GA-CSR UL DIRECT TRANSFER.

3. The GANC establishes an SCCP connection to the CN and forwards the *CM Service Request* to the CN using the *Complete Layer 3 Information*. Subsequent layer-3 messages between mobile station and core network will be sent between GANC and CN via DTAP.

4. The CN may optionally authenticate the MS using standard GERAN authentication procedures.

5. The CN may optionally initiate the Ciphering Configuration procedure described in clause 8.8.

6. The MS sends the *Setup* message providing details on the call to the CN and its bearer capability and supported codecs. This message is contained within the GA-CSR UL DIRECT TRANSFER between the MS and the GANC. The GANC forwards the *Setup* message to the CN.

7. The CN indicates it has received the call setup and it will accept no additional call-establishment information using the *Call Proceeding* message to the GANC. GANC forwards this message to the MS in the GA-CSR DL DIRECT TRANSFER.

8. The CN requests the GANC to assign call resources using *Assignment Request*.

9. The GANC sends the GA-CSR ACTIVATE CHANNEL to the MS including bearer path setup information such as:

   - Channel mode.

   - Multi-rate codec configuration.

   - UDP port & the IP address for the uplink RTP stream.

   - Voice sample size.

10. The MS establishes the RTP path to the GANC. MS optionally sends idle RTP/UDP packets to the GANC but has not connected the user to the audio path.

11. The MS sends the GA-CSR ACTIVATE CHANNEL ACK to the GANC indicating the UDP port for the downlink RTP stream.

12. The GANC establishes the downlink RTP path between itself and the MS. The GANC may start sending idle RTP/UDP packets to the MS.

13. The GANC signals to the CN that the call resources have been allocated by sending an *Assignment Complete* message.

14. The GANC signals the completion of the bearer path to the MS with the GA-CSR ACTIVATE CHANNEL COMPLETE message. An end-to-end audio path now exists between the MS and the CN. The MS can now connect the user to the audio path.

15. The CN signals to the MS, with the *Alerting* message, that the B-Party is ringing. The message is transferred to the GANC and GANC forwards the message to the MS in the GA-CSR DL DIRECT TRANSFER. If the MS has not connected the audio path to the user, it shall generate ring back to the calling party. Otherwise, the network-generated ring back will be returned to the calling party.

16. The CN signals that the called party has answered, via the *Connect* message. The message is transferred to the GANC and GANC forwards the message to the MS in the GA-CSR DL DIRECT TRANSFER. It connects the user to the audio path. If the mobile station is generating ring back, it stops and connects the user to the audio path.

17. The MS sends the *Connect Ack* in response, and the two parties are connected for the voice call. This message is contained within the GA-CSR UL DIRECT TRANSFER between the MS and the GANC. The GANC forwards the *Connect Ack* message to the CN.

18. Bi-directional voice traffic flows between the MS and CN through the GANC.

8.11 Mobile Terminated Call Flow

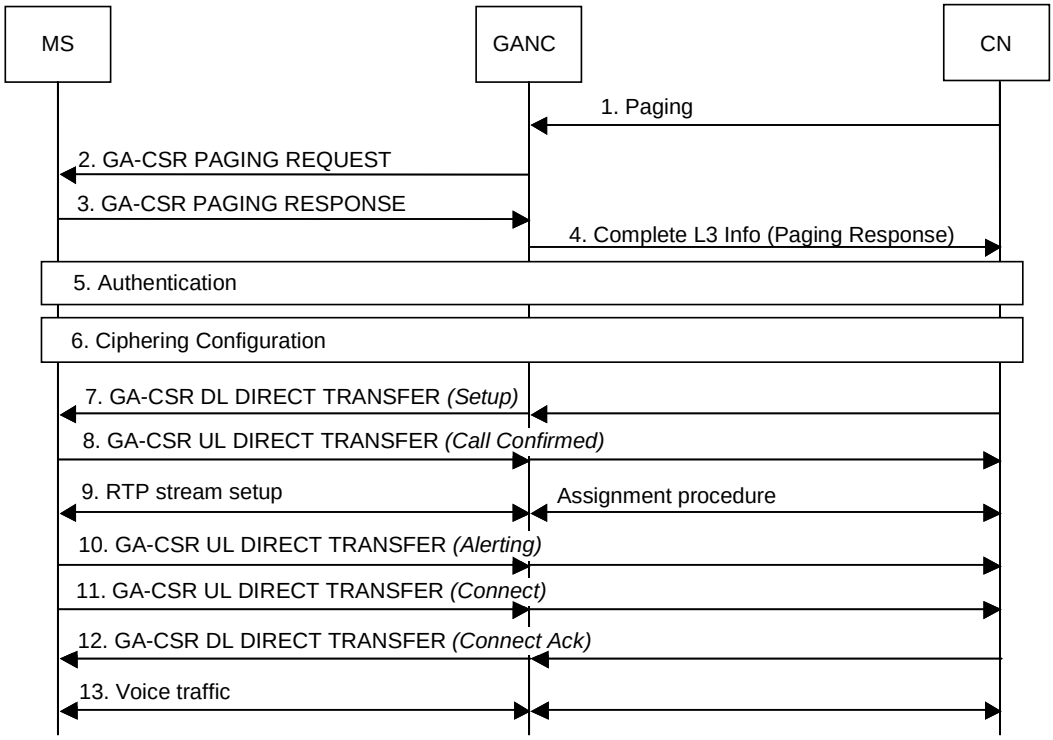


Figure 23: Mobile Terminated Call

The description of the procedure in this clause assumes the MS is in GAN mode i.e. it has successfully registered with the GANC and GA-CSR is the serving RR entity in the MS.

1. A mobile-terminated call arrives at the CN. The CN sends a *Paging message* to the GANC identified through the last *Location Update* received by it and includes the TMSI if available. The IMSI of the mobile being paged is always included in the request.

2. GANC identifies the MS registration context using the IMSI provided by the CN. It then pages the MS using the GA-CSR PAGING REQUEST message. The message includes the TMSI, if available in the request from the CN, else it includes only the IMSI of the mobile.

3. The MS responds with a GA-CSR PAGING RESPONSE including the MS Classmark and ciphering key sequence number. The MS enters dedicated mode and the GA-CSR state changes to GA-CSR-DEDICATED.

4. The GANC establishes an SCCP connection to the CN. The GANC then forwards the paging response to the CN using the *Complete Layer 3 Information* message.

5. The CN may optionally authenticate the MS using standard GERAN authentication procedures.

6. The CN may optionally update the ciphering configuration in the MS, via the GANC, as described in clause 8.8.

7. The CN initiates call setup using the *Setup* message sent to the MS via GANC. GANC forwards this message to the MS in the GA-CSR DL DIRECT TRANSFER message.

8. The MS responds with *Call Confirmed* using the GA-CSR UL DIRECT TRANSFER after checking it's compatibility with the bearer service requested in the *Setup* and modifying the bearer service as needed. If the *Setup* included the signal information element, the MS alerts the user using the indicated signal, else the MS alerts the user after the successful configuration of the user plane. The GANC forwards the *Call Confirmed* message to the CN.

9. The CN initiates the assignment procedure with the GANC, which triggers the setup of the RTP stream (voice bearer channel) between the GANC and MS, same as steps 8-13 in MO call scenario.

10. The MS signals that it is alerting the user, via the *Alerting* message contained in the GA-CSR UL DIRECT TRANSFER. The GANC forwards the *Alerting* message to the CN. The CN sends a corresponding alerting message to the calling party.

11. The MS signals that the called party has answered, via the *Connect* message contained in the GA-CSR UL DIRECT TRANSFER. The GANC forwards the *Connect* message to the CN. The CN sends a corresponding *Connect* message to the calling party and through connects the audio. The MS connects the user to the audio path.

12. The CN acknowledges via the *Connect Ack* message to the GANC. GANC forwards this message to the MS in the GA-CSR DL DIRECT TRANSFER. The two parties on the call are connected on the audio path.

13. Bi-directional voice traffic flows between the MS and CN through the GANC.

8.12 Call Clearing

Figure 24 shows call clearing initiated by the mobile station.

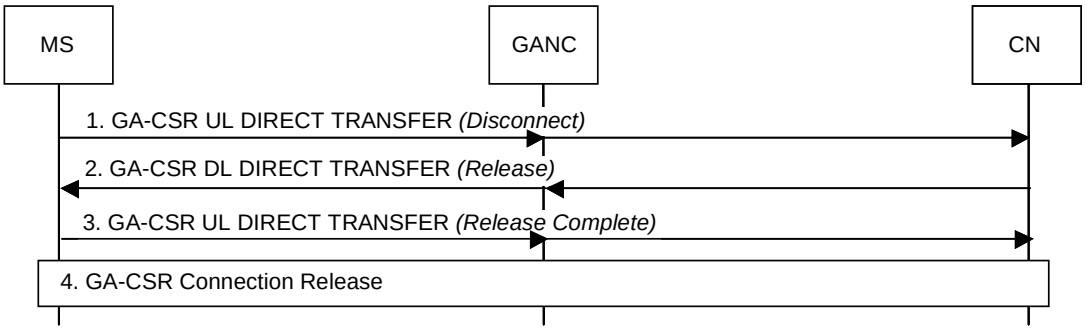


Figure 24: Mobile Station initiated Call clearing

1. The MS sends the *Disconnect* message to the CN to release the call. This message is contained in the GA-CSR UL DIRECT TRANSFER message between MS and GANC. The GANC forwards the *Disconnect* message to the CN.

2. The CN responds with a *Release* message to the GANC. The GANC forwards this message to the MS using the GA-CSR DL DIRECT TRANSFER message.

3. The MS responds with the *Release Complete* message. This message is contained within the GA-CSR UL DIRECT TRANSFER message between MS and GANC. The GANC forwards the *Disconnect* message to the CN.

4. The CN triggers the release of connection as described in clause 8.7.2.

8.13 Channel Modify

The GANC may use the Channel Modify procedures to modify parameters used for an ongoing call, this procedure may be used if coding scheme should be changed, in fault or congestion situations if the GANC for example detects "packet loss" and Handover to another GERAN/UTRAN mode is not possible or desired.

The GANC may modify the following parameters:

- Channel mode.
- Sample Size.
- IP address.
- RTP UDP port.
- RTCP UDP port.

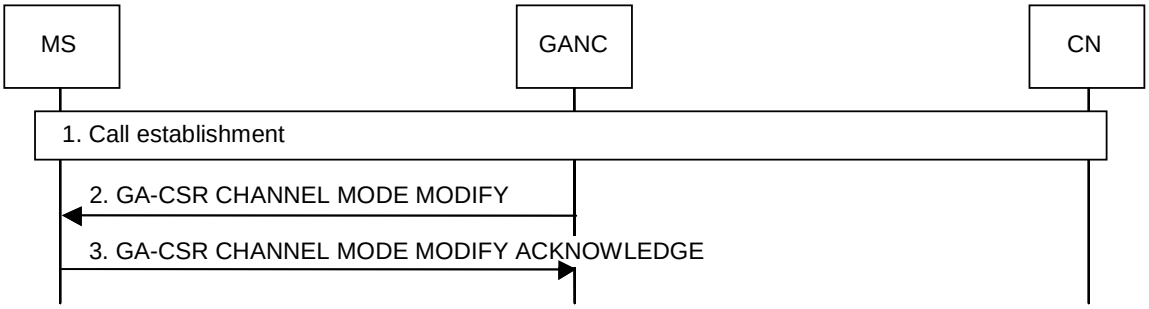


Figure 25: Channel Mode Modify

1. A call is established as described in clauses 8.10 or 8.11.
2. The GANC sends the GA-CSR CHANNEL MODE MODIFY message to the MS to modify parameters for the established call.
3. The MS responds with the GA-CSR CHANNEL MODE MODIFY ACKNOWLEDGE message to the GANC.

8.14 Handovers between GAN mode and GERAN/UTRAN mode

8.14.1 Handover to GAN

8.14.1.1 GERAN to GAN Handover

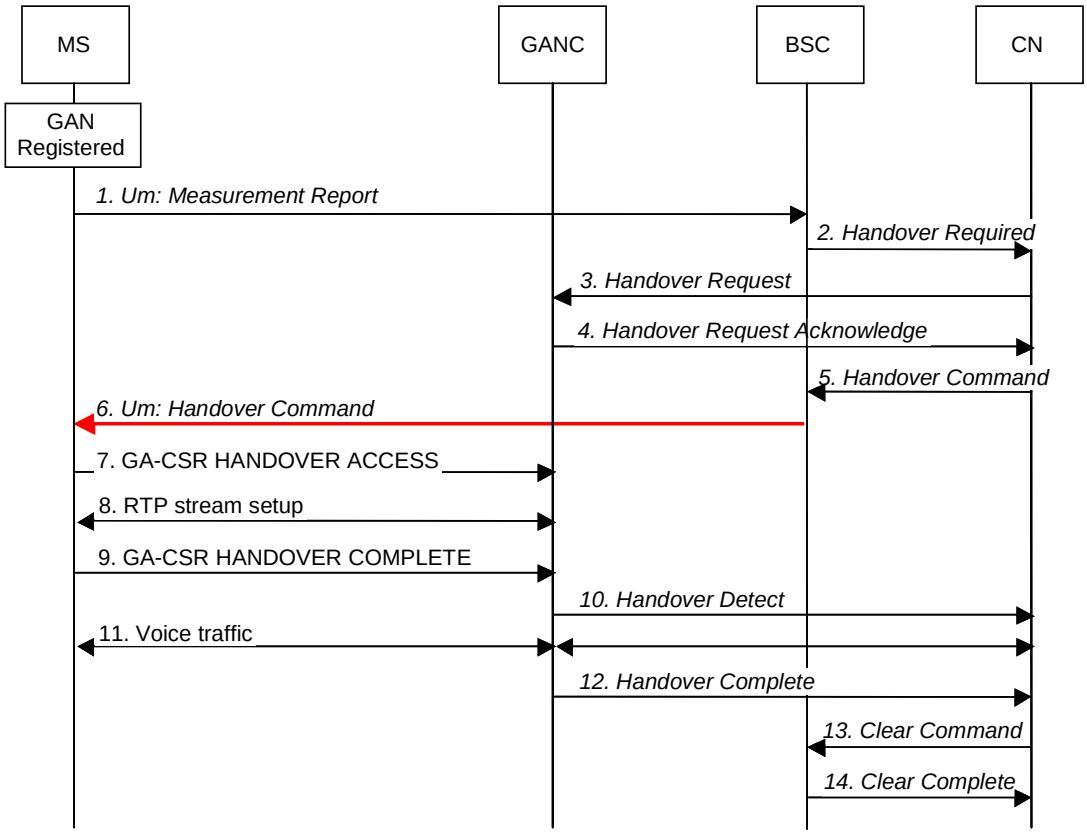


Figure 26: GERAN to GAN Handover

The description of the GERAN to GAN handover procedure assumes the following:

- the MS is on an active call on the GERAN; and
- its mode selection is GAN-preferred, or if GERAN/UTRAN-preferred the RxLev from the current serving cell drops below a MS implementation specific threshold; and
- the MS has successfully registered with a GANC, allowing the MS to obtain GAN system information; and
- the GERAN provides information on neighbouring cells such that one of the {ARFCN, BSIC} in the neighbour list matches the {ARFCN, BSIC} associated with the GANC, as provided in the AS-related component of the system information obtained from GANC.

1. The MS begins to include GAN cell information in the *Measurement Report message* to the GERAN. The MS reports the highest signal level for the GAN cell {ARFCN, BSIC}. This is not the actual measured signal level on GAN, rather an artificial value (i.e. RxLev = 63), allowing the MS to indicate preference for the GAN.
2. Based on MS measurement reports and other internal algorithms, GERAN decides to handover to the GAN cell, using an internal mapping of {ARFCN, BSIC} to CGI. The GERAN starts the handover preparation by sending a *Handover Required* message to the CN, identifying the target (GAN) cell.
3. The CN requests the target GANC to allocate resources for the handover, using *Handover Request message*.
4. The target GANC acknowledges the *Handover Request* message, using *Handover Request Acknowledge* message, indicating it can support the requested handover, and provides a *Handover Command message* that indicates the radio channel to which the mobile station should be directed.
5. The CN forwards the *Handover Command* message to the GERAN, completing the handover preparation.
6. GERAN sends *Handover Command* message to the MS to initiate handover to GAN. The *Handover Command message* includes among other parameters information about the target GAN such as BCCH ARFCN, PLMN colour code and BSIC. The MS does not switch its audio path from GERAN to GAN until handover completion, i.e. until it sends the GA-CSR HANDOVER COMPLETE message, to keep the audio interruption short.
7. The MS accesses the GANC using the GA-CSR HANDOVER ACCESS message, and provides the entire *Handover Command* message received from GERAN. Information in the Handover Command message (e.g. Handover Reference) allows the GANC to correlate the handover to the *Handover Request Acknowledge* message earlier sent to the CN and identify the successful completion of the handover.
8. The GANC sets up the bearer path with the MS, using the same steps as in steps 9 to 14 of Mobile Originated Call Flow as defined in sub-clause 8.10.
9. The MS transmits the GA-CSR HANDOVER COMPLETE message to indicate the completion of the handover procedure at its end. It switches the user from the GERAN user plane to the GAN user plane.
10. The GANC indicates to the CN that it has detected the MS, using *Handover Detect* message. The CN can optionally now switch the user plane from the source GERAN to the target GAN.
11. Bi-directional voice traffic is now flowing between the MS and CN, via GANC.
12. The target GANC indicates the handover is complete, using the *Handover Complete* message. If it had not done so before, the CN now switches the user plane from source GERAN to target GAN. The CN may use the target CGI used in the Handover procedure for charging purposes.
13. Finally, the CN tears down the connection to the source GERAN, using *Clear Command* message.
14. The source GERAN confirms the release of GERAN resources allocated for this call, using *Clear Complete* message.

8.14.1.2 UTRAN to GAN Handover

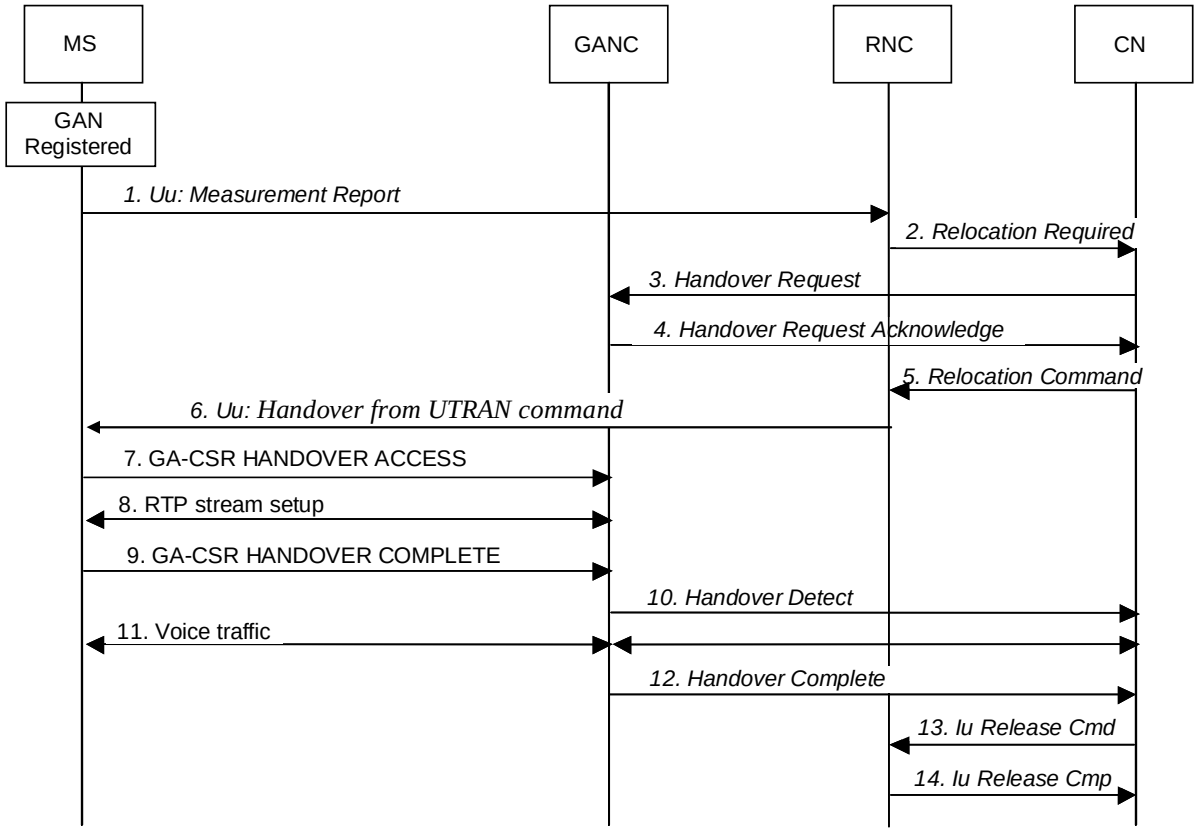


Figure 26b: UTRAN to GAN Handover

The description of the UTRAN to GAN Handover procedure assumes the following:

- the MS is on an active call on the UTRAN; and
- the MS has included the *Support of Handover to GAN* indication in the UE RAC; and
- the UE has been ordered by the RNC to make inter-RAT measurements, and
  - if the MS is in GAN preferred mode with an Event 3A configured, the MS handles parameters associated with the Event 3A in a GAN specific manner (as described in 3GPP TS 44.318) for the reporting of the GAN cell {ARFCN, BSIC}; and
  - when the UE is in GERAN/UTRAN preferred mode and an event 3A has been configured for the GAN cell (and possibly for GERAN cells), the UE shall only send a measurement about the GAN cell, when this event is triggered and no GERAN cells from the neighbour cell list of the UE satisfy the triggering condition of this Event (as described in 3GPP TS 25.331);
- the UTRAN provides information on neighbouring cells such that one of the {ARFCN, BSIC} in the neighbour list matches the {ARFCN, BSIC} associated with the GANC, as provided in the AS-related component of the system information obtained from GANC. The selection of the RF channel numbers (ARFCNs) used for the UTRAN to GAN handover procedure should not correspond to a channel from a frequency band supported by any UE, to avoid UEs that do not require compressed mode from unnecessarily powering up their GSM receivers.

1. The MS begins to include information about a GAN cell in the *Measurement Report message sent* to the RNC. The MS reports the highest signal level for the GAN cell {ARFCN, BSIC}. This is not the actual measured signal level on GAN, rather an artificial value (i.e., GSM carrier RSSI = 63) allowing the UE to indicate preference for the GAN.

2. Based on MS measurement reports and other internal algorithms, the RNC decides to initiate handover to the GAN cell, using an internal mapping of {ARFCN, BSIC} to CGI. The RNC starts the preparation phase of the Relocation procedure by sending a *Relocation Required* message to the CN, identifying the target (GAN) cell.

3. The CN requests the target GANC to allocate resources for the handover, using *Handover Request message*.

4. The target GANC acknowledges the handover request message, using *Handover Request Acknowledge message*, indicating it can support the requested handover, and including a *Handover Command message* that indicates the radio channel to which the mobile station should be directed.

5. The CN sends the *Relocation Command* message to the RNC, completing the relocation preparation.

6. The RNC sends *HANDOVER FROM UTRAN COMMAND message* to the MS to initiate handover to GAN. The *HANDOVER FROM UTRAN COMMAND message* includes the RR HANDOVER COMMAND message, specified in 44.018, which contains other parameters about the target GAN such as BCCH ARFCN, PLMN colour code and BSIC. The MS does not switch its audio path from UTRAN to GAN until handover completion, i.e. until it sends the GA-CSR HANDOVER COMPLETE message, to keep the audio interruption short.

7. The MS accesses the GANC using the GA-CSR HANDOVER ACCESS message, and provides the entire *HANDOVER FROM UTRAN COMMAND* received from RNC. The handover reference in the *HANDOVER FROM UTRAN COMMAND* message allows the GANC to correlate the handover to the *Handover Request Acknowledge* message earlier sent to the CN and identify the successful completion of the handover.

8. The GANC sets up the bearer path with the MS, using the same steps as in steps 9 to 14 of Mobile Originated Call Flow as defined in sub-clause 8.10.

9. The MS transmits the GA-CSR HANDOVER COMPLETE to indicate the completion of the handover procedure from its perspective. It switches the user from the UTRAN user plane to the GAN user plane.

10. The GANC indicates to the CN that it has detected the MS, using *Handover Detect* message. The CN can optionally now switch the user plane from the source RNC to the target GANC.

11. Bi-directional voice traffic is now flowing between the MS and CN, via GANC.

12. The target GANC indicates the handover is complete, using the *Handover Complete* message. If it has not done so before, the CN now switches the user plane from source RNC to target GAN.

13. Finally, the CN tears down the connection to the source RNC, using *Iu Release Command*.

14. The source RNC confirms the release of UTRAN resources allocated for this call, using *Iu Release Complete*.

8.14.2 Handover from GAN to GERAN

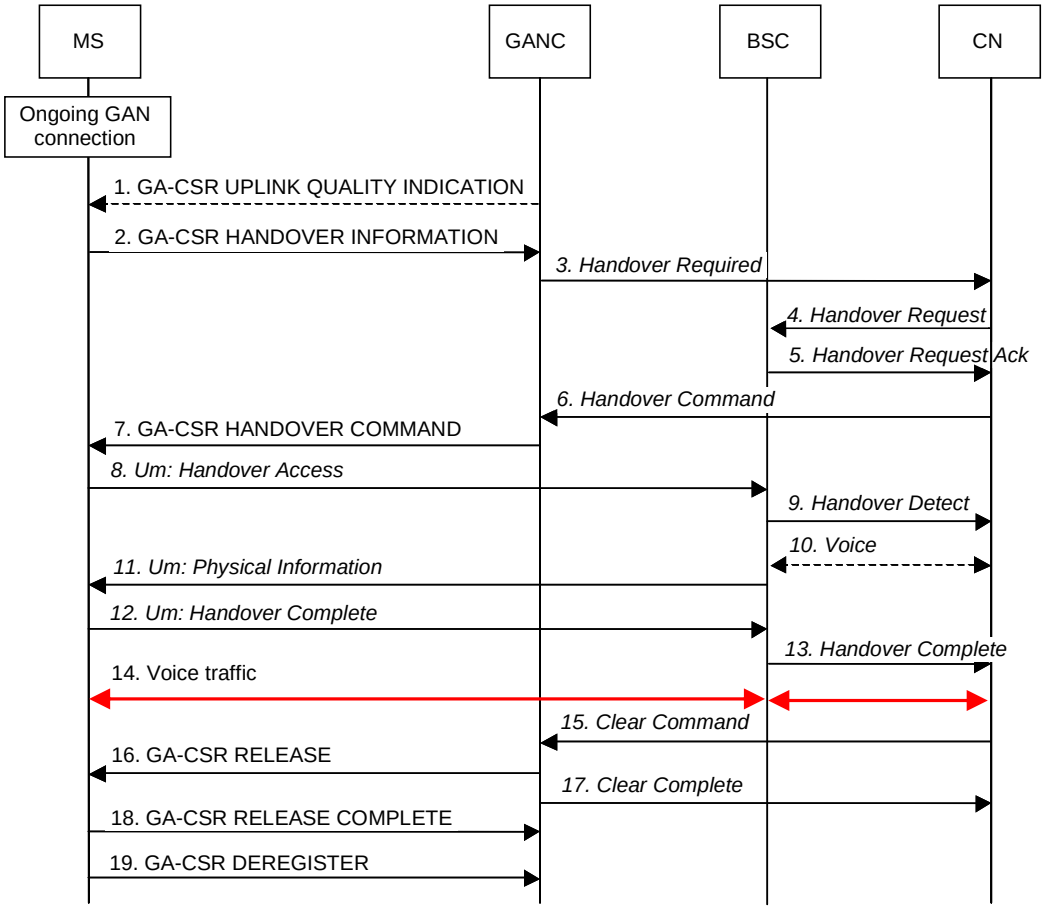


Figure 27: Handover from GAN to GERAN

The procedure description in this sub-clause assumes the following:

- the MS is on an active call on the GAN; and
- the GERAN becomes available; and
  - the MS mode selection is GERAN/UTRAN-preferred; or
  - the MS mode selection is GAN-preferred and the MS begins to leave GAN coverage, based on its local measurements, received RTCP reports, as well as any uplink quality indications received from the GANC.

The handover from GAN to GERAN procedure is always triggered by the MS.

1. The GANC may send a GA-CSR UPLINK QUALITY INDICATION if there is a problem with the uplink quality for the ongoing call. Uplink Quality Indication is information sent by the GANC to the MS indicating the crossing of a uplink quality threshold in the uplink direction. Whenever the MS receives an indication of bad quality, it should start the handover procedure, as described in the next step. Alternatively, MS can use its local measurements or received RTCP reports, to decide to initiate the handover procedure.

2. The MS sends the GA-CSR HANDOVER INFORMATION message to the GANC indicating the Channel Mode and a list of target GERAN cells, identified by CGI, in order of preference (e.g. ranked by C1 path loss parameter) for handover, and includes the received signal strength for each identified GERAN cell. This list is the most recent information available from the GSM RR subsystem. In addition, the GA-CSR HANDOVER INFORMATION message may include a list of target UTRAN cells ranked in order of preference for handover, and the received signal strength for each identified UTRAN cell.

3. If the Serving GANC selects a target GERAN cell, the handover to GERAN procedure is performed. The Serving GANC starts the handover preparation by signalling to the CN the need for handover, using *Handover Required*, and including the GERAN cell list provided by the MS. The GANC may include only a subset of the cell list provided by the MS.

4. The CN selects a target GERAN cell and requests it to allocate the necessary resources, using *Handover Request*.

5. The target GERAN builds a *Handover Command* message providing information on the channel allocated and sends it to the CN through the *Handover Request Acknowledge* message.

6. The CN signals the GANC to handover the MS to the GERAN, using *Handover Command* message, ending the handover preparation phase.

7. GANC transmits the GA-CSR HANDOVER COMMAND to the MS including the details sent by the GERAN on the target resource allocation.

8. The MS transmits the *Um: Handover Access* containing the handover reference element to allow the target GERAN to correlate this handover access with the *Handover Command* message transmitted earlier to the CN in response to the *Handover Required*.

9. The target GERAN confirms the detection of the handover to the CN, using the *Handover Detect* message.

10. The CN may at this point switch the user plane to the target BSS.

11. The GERAN provides *Physical Information* to the MS i.e. *Timing Advance*, to allow the MS to synchronize with the GERAN.

12. The MS signals to the GERAN that the handover is completed, using *Handover Complete*.

13. The GERAN confirms to the CN the completion of the handover, via *Handover Complete* message. The CN may use the target CGI used in the Handover procedure for charging purposes.

14. Bi-directional voice traffic is now flowing between the MS and CN, via the GERAN.

15. On receiving the confirmation of the completion of the handover, the CN indicates to the GANC to release any resources allocated to the MS, via the *Clear Command*.

16. GANC commands the MS to release resources, using the GA-CSR RELEASE message.

17. GANC confirms resource release to CN using the *Clear Complete* message.

18. The MS confirms resource release to the GANC using the GA-CSR RELEASE COMPLETE message.

19. The MS may finally deregister from the GANC, using GA-CSR DEREGISTER message.

8.14.3 Handover from GAN to UTRAN

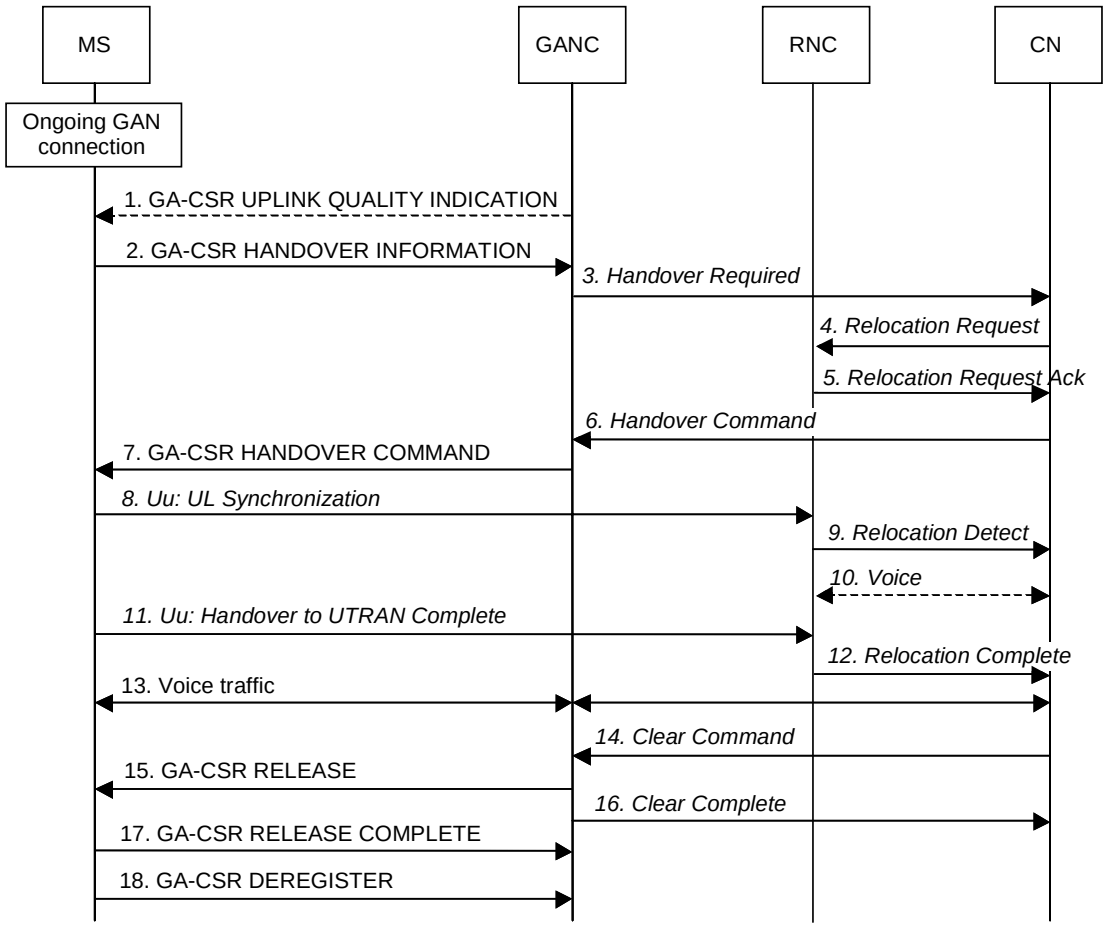


Figure 28: Handover from GAN to UTRAN

The procedure description in this sub-clause assumes the following:

- the MS is on an active call on the GAN; and
- the MS is capable of operating in all of the GAN, GERAN and UTRAN modes; and
- the UTRAN becomes available; and
  - the MS is in GERAN/UTRAN-preferred mode; or
  - the MS mode selection is GAN preferred and begins to leave GAN coverage, based on its local measurements, received RTCP reports, as well as any uplink quality indications received from the GANC.

The Inter-RAT handover from GAN procedure is always triggered by the MS.

1. The GANC may send a GA-CSR UPLINK QUALITY INDICATION if there is a problem with the uplink quality for the ongoing call. Uplink Quality Indication is information sent by the GANC to the MS indicating the crossing of a uplink quality threshold in the uplink direction. Whenever the MS receives an indication of bad quality, it should start the handover procedure, as described in the next step. Alternatively, MS can use its local measurements or received RTCP reports, to decide to initiate the handover procedure.

2. The MS sends the GA-CSR HANDOVER INFORMATION message to the Serving GANC indicating the Channel Mode and a list of candidate target UTRAN and GERAN cells, in order of preference for handover, and includes the received signal strength for each identified cell. The UTRAN cells are identified by the PLMN ID, the LAC and the 3G Cell identity (defined in 3GPP TS 25.331 [40]).

NOTE: The choice of the candidate target UTRAN cells is out of the scope of this technical specification.

3. If the Serving GANC selects UTRAN as a target RAT, the inter-RAT handover procedure is performed. The Serving GANC starts the handover preparation by signaling to the CN the need for handover, using *Handover Required* and including the UTRAN cell list provided by the MS. The GANC may include only a subset of the cell list provided by the MS.

4. The CN starts the inter-RAT handover procedure towards the target RNC identified by the Serving GANC. The CN requests from the target RNS to allocate the necessary resources using *Relocation Request.*

5. The target UTRAN builds a *Handover to UTRAN Command* message providing information on the allocated UTRAN resources and sends it to the CN through the *Relocation Request Acknowledge* message.

6. The CN signals the Serving GANC to handover the MS to the UTRAN, using *Handover Command* message (which includes the INTER SYSTEM TO UTRAN HANDOVER COMMAND information element), ending the handover preparation phase.

7. The Serving GANC transmits the GA-CSR HANDOVER COMMAND to the MS including the details sent by the UTRAN on the target resource allocation.

8. Target RNS achieves uplink synchronization on the Uu interface.

9. The target UTRAN confirms the detection of the handover to the CN, using the *Relocation Detect* message.

10. The CN may at this point switch the user plane to the target RNS.

11. The MS signals to the UTRAN that the handover is completed, using *Handover to UTRAN Complete*.

12. The UTRAN confirms to the CN the completion of the handover, via *Relocation Complete* message. If the user plane has not been switched in step 10, the CN switches the user plane to the target RNS.

13. Bi-directional voice traffic is now flowing between the MS and CN, via the UTRAN.

14. On receiving the confirmation of the completion of the handover, the CN indicates to the Serving GANC to release any resources allocated to the MS, via the *Clear Command*.

15. The Serving GANC commands the MS to release resources, using the GA-CSR RELEASE message.

16. The Serving GANC confirms resource release to CN using the *Clear Complete* message.

17. The MS confirms resource release to the Serving GANC using the GA-CSR RELEASE COMPLETE message.

18. The MS may finally deregister from the Serving GANC, using GA-CSR DEREGISTER message.

8.15 Cell Change Order between GAN mode and GERAN/UTRAN mode

While in GERAN/UTRAN, a mobile station may be ordered to perform a cell reselection to GAN, by using the Cell Change Order procedures used in GERAN/UTRAN, with no modifications. The mobile station regards the procedure as completed when it has successfully performed Rove In to GAN.

While the mobile station is involved in a PS session in the GAN, there is no identified need for a Cell Change Order procedure.

8.16 GA-PSR Transport Channel Management Procedures

The GA-PSR Transport Channel (GA-PSR TC) management procedures are the basic GA-PSR procedures specified to facilitate the control of the GA-PSR connection for the user data transfer. A UDP based GA-PSR connection between the MS and the GANC for GPRS data transfer is referred to as the GA-PSR Transport Channel.

The GA-PSR Transport Channel consists of the following:

- The IP address and destination UDP port number to be used for GPRS data transfer at both the GANC and MS.

- The GA-PSR Channel Timer.

The MS or GANC will activate a GA-PSR Transport Channel only when needed; i.e. when the GPRS user data transfer is initiated.

The GA-PSR can be in two different states, GA-PSR-STANDBY or GA-PSR-ACTIVE state. The state of the GA-PSR and the corresponding transport channel are always synchronized.

- In GA-PSR-STANDBY state:
  - The MS is not able to send or receive GPRS data to and from the GANC. The GANC or the MS needs to activate the GA-PSR Transport Channel before sending any GPRS data.
  - A corresponding GA-PSR Transport Channel does not exist. When the GA-PSR Transport Channel is activated, the MS enters the GA-PSR-ACTIVE state.
- In GA-PSR-ACTIVE state:
  - The MS is able to send and receive GPRS data to and from the GANC. Furthermore there exists a corresponding GA-PSR Transport Channel for this MS.

A GA-PSR Channel Timer is also defined to control the transition from GA-PSR-ACTIVE to GA-PSR-STANDBY state as follows:

- The MS GA-PSR layer implements a timer that is started when the MS enters GA-PSR-ACTIVE state and restarted each time a LLC-PDU is transmitted to or received from the network. When the timer expires, the MS deactivates the GA-PSR Transport Channel and the MS GA-PSR enters GA-PSR-STANDBY state.

The GA-PSR Channel Timer value is returned to the MS as part of the GAN Registration procedure (i.e. in GA-RC REGISTER ACCEPT message).

8.16.1 MS initiated Activation of GA-PSR Transport Channel

Figure 29 depicts the MS initiated GA-PSR Transport Channel activation procedure. The basic idea is that the GANC and MS can dynamically negotiate the IP address and UDP port numbers for data transfer. This procedure can facilitate the GANC load balancing; moreover, it allows the GANC to optimize the processing and maintain the context for active users only.

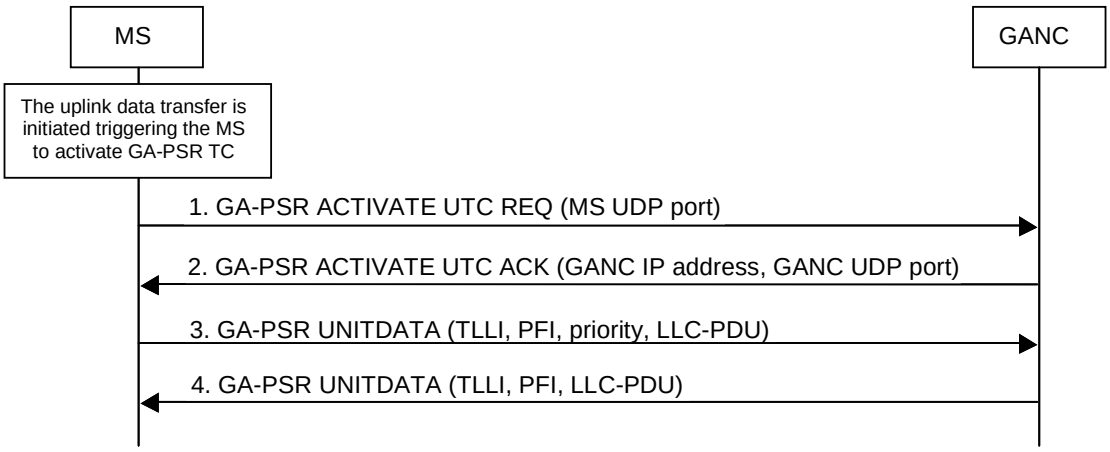


Figure 29: Activation of GA-PSR Transport Channel

Initially, the MS GA-PSR is in the GA-PSR-STANDBY state as the LLC layer requests the transfer of one or more uplink LLC-PDUs. As the MS GA-PSR is in GA-PSR-STANDBY state, the corresponding GA-PSR Transport Channel does not exist. This is a trigger for the MS to activate the GA-PSR Transport Channel (TC).

1. The GA-PSR-layer sends a GA-PSR ACTIVATE UTC REQ message to the GANC to request the activation of the GA-PSR Transport Channel. This message contains MS UDP port number that the GANC can use for the downlink transfer.

2. The GANC replies with a GA-PSR ACTIVATE UTC ACK message that contains the IP-address of and the UDP port number to be used for the uplink user data transfer. Upon receiving the acknowledgment, the MS GA-PSR transitions to GA-PSR-ACTIVE state.

3. After successful GA-PSR TC activation, the MS forwards the LLC-PDU to the GANC IP-address and UDP-port received in the acknowledgment message using GA-PSR UNITDATA message. The GANC forwards the LLC-PDU and other parameters to the core network as per procedure described in clause 8.17.2.3 (not shown in the sequence). The MS restarts the GA-PSR Channel Timer.

4. The GANC receives a downlink user data message for the MS as per procedure described in clause 8.17.2.2 (not shown in the sequence) while the GA-PSR TC is still active. The LLC-PDU and the required parameters are sent to the MS encapsulated in a GA-PSR UNITDATA message using the associated GA-PSR Transport Channel information (MS IP-address and UDP-port received in step 1).

8.16.2 MS initiated Deactivation of the GA-PSR Transport Channel

The following message sequence depicts the scenario when the MS deactivates the GA-PSR Transport Channel after the GA-PSR Channel Timer expires.

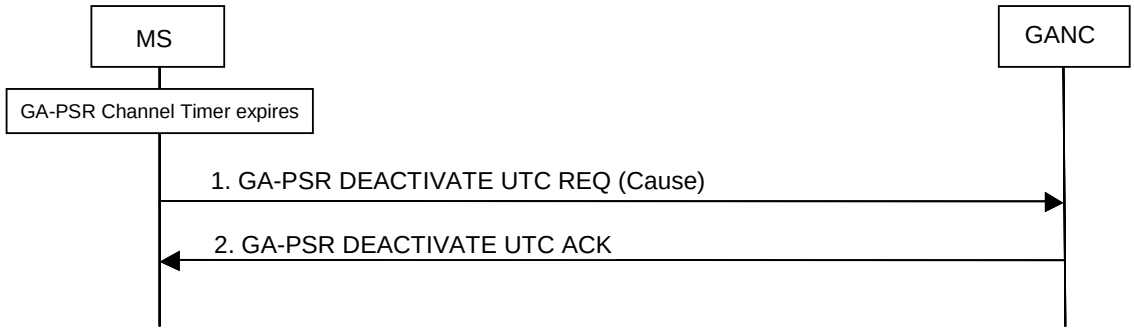


Figure 30: Deactivation of GA-PSR Transport Channel

1. GA-PSR-layer in the MS sends the GA-PSR DEACTIVATE UTC REQ message to the GANC to request the deactivation of the GA-PSR Transport Channel. The message includes cause parameter to indicate "normal deactivation".

2. The GANC deletes the related MS information associated with the GA-PSR Transport Channel and replies to the MS with a GA-PSR DEACTIVATE UTC ACK message. Upon receiving the acknowledgment message, the MS enters GA-PSR-STANDBY state.

8.16.3 Implicit Deactivation of the GA-PSR Transport Channel due to MS Deregistration

When a GA-CSR DEREGISTER message is received by the GANC or if the MS is implicitly deregistered, the GA-PSR Transport Channel associated with the MS, if any, is automatically released by the GANC.

8.16.4 Network initiated GA-PSR Transport Channel Activation

Figure 31 depicts a scenario when the GANC activates a GA-PSR Transport Channel for a GAN registered MS. This scenario covers the case when the GANC receives a downlink user data packet (LLC PDU) from the core network and the specified MS does not have an active GA-PSR Transport Channel.

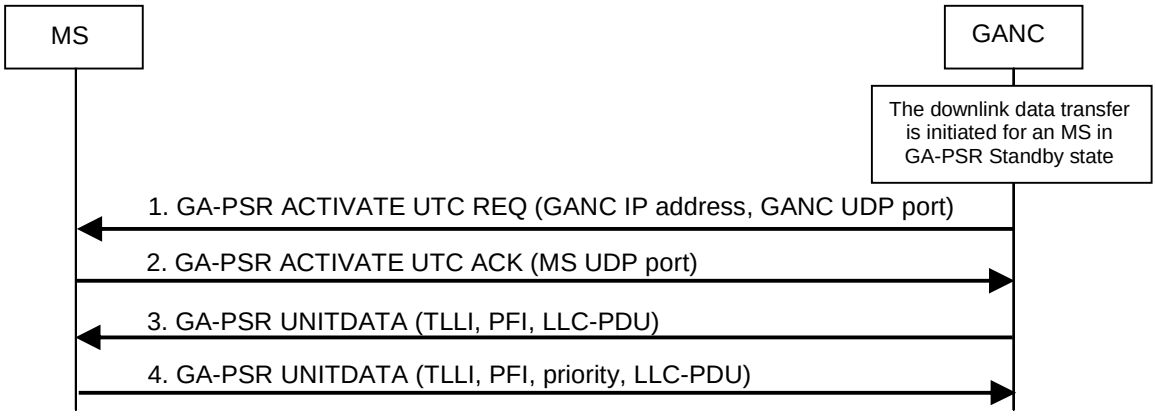


Figure 31: Network initiated GA-PSR Transport Channel Activation

1. The GANC sends a GA-PSR ACTIVATE UTC REQ message to the MS to request the activation of the corresponding GA-PSR TC. The message contains the GANC IP address and UDP port number assigned to the GA-PSR TC and the MS GA-PSR transitions to GA-PSR-ACTIVE state.

2. The MS replies with a GA-PSR ACTIVATE UTC ACK message that contains the selected UDP-port number. Subsequently, the MS enters GA-PSR-ACTIVE state and starts the GA-PSR Channel Timer.

3. The GANC forwards the previously received downlink LLC-PDU to the MS using GA-PSR UNITDATA message as per procedure described in clause 8.17.1.

4. The GA-PSR Transport Channel is active and the MS can send the uplink data using GA-PSR UNITDATA procedure described in clause 8.17.1.

8.17 GPRS Data, Signalling and SMS Transport

8.17.1 GA-PSR GPRS Data Transport Procedures

Figure 32 illustrates the transport of GPRS user data messages via GAN.

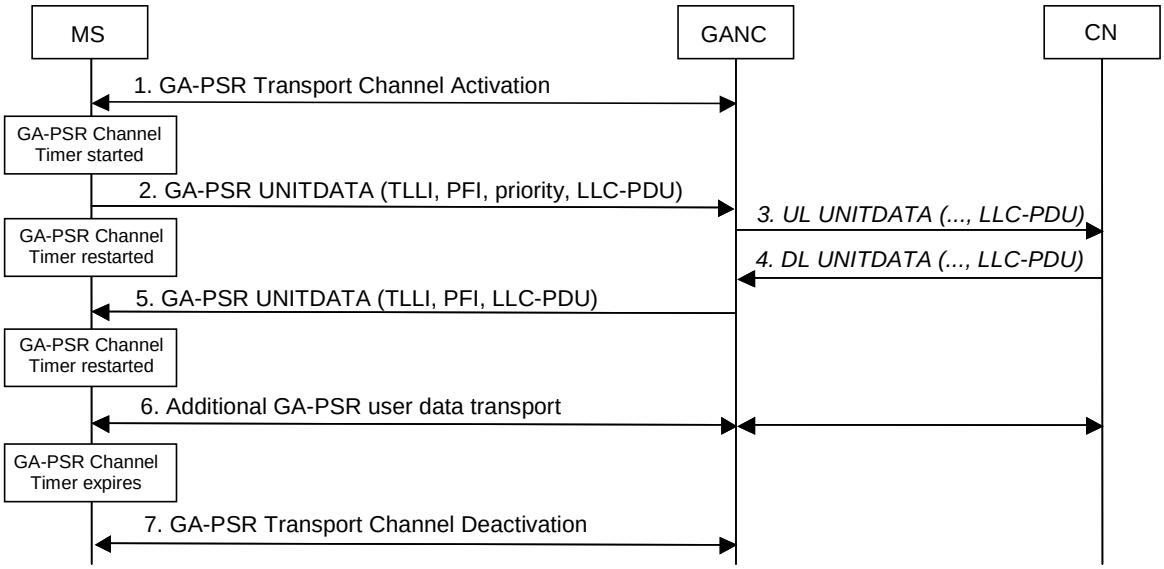


Figure 32: User Plane Data Transport

1. Optionally, if the GA-PSR is in GA-PSR-STANDBY state, the GA-PSR Transport Channel is activated as per description in clauses 8.16.1 or 8.16.4. Upon successful activation, the MS starts the GA-PSR Channel Timer.

2. The MS encapsulates the uplink LLC-PDU within the GA-PSR UNITDATA message that is forwarded to the GANC. The message includes parameters required for Gb interface procedures and TLLI as MS identifier. The MS restarts the GA-PSR Channel Timer.

3. The GANC forwards the LLC-PDU to the Core Network as per standard Gb interface procedures.

4. The Core Network sends the downlink LLC-PDU that contains GPRS user data via the Gb interface. The MS is identified with the TLLI.

5. Assuming that the corresponding GPRS TC is available, the GANC forwards the LLC-PDU to the MS encapsulated in the GA-PSR UNITDATA message. Upon receiving this message, the MS restarts the GA-PSR Channel Timer.

6. The GPRS data transfer (steps 2 to 5), both in uplink and downlink direction, can be processed as many times as necessary while the GA-PSR TC is active.

7. When the GA-PSR Channel Timer expires, the corresponding GA-PSR TC is deactivated as per description in clause 8.16.2.

8.17.2 GA-PSR GPRS Signalling and SMS Transport Procedures

8.17.2.1 General

The TCP connection that is used for GA-CSR signalling is also used for GA-PSR GPRS signalling and SMS transport identified by LLC SAPI 1 and SAPI 7 respectively. This TCP connection is available after GAN registration, so establishment of a separate channel, i.e. a TCP connection, for GPRS signalling and SMS transport is not required.

8.17.2.2 Network initiated GPRS Signalling

For Network initiated signalling/SMS, the Core Network sends a GMM/SM signalling or SMS message to the GANC via the Gb interface as per standard GPRS; e.g. the LLC PDU may include GMM attach accept or SM PDP context activation accept message. The GANC encapsulates the received LLC PDU within a GA-PSR DATA message that is forwarded to the MS via the existing TCP connection.

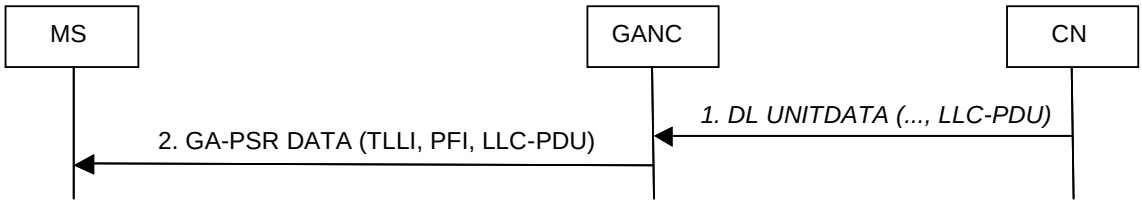


Figure 33: Downlink Control Plane Data Transport

1. The Core Network sends a GMM/SM signalling message or an SMS message as per GPRS via the Gb interface; e.g. the LLC-PDU may include GMM attach accept or SM PDP context activation accept message.

2. The GANC encapsulates the received LLC-PDU within a GA-PSR DATA message that is forwarded to the MS.

8.17.2.3 MS initiated GPRS Signalling

For MS initiated signalling/SMS, the MS GA-PSR receives a request from the LLC layer to transfer an uplink GMM/SM signalling message or SMS message; e.g. this could be a GMM attach request or SM PDP context activation message. The GMM/SM signalling messages are identified with LLC SAPI 1 and SMS messages with LLC SAPI 7. The MS GA-PSR encapsulates the LLC PDU within a GA-PSR DATA message including the parameters that will be required for Gb interface procedures. Subsequently, the message is forwarded to the GANC, and the GANC forwards the message to the Core Network as per standard Gb interface procedures.

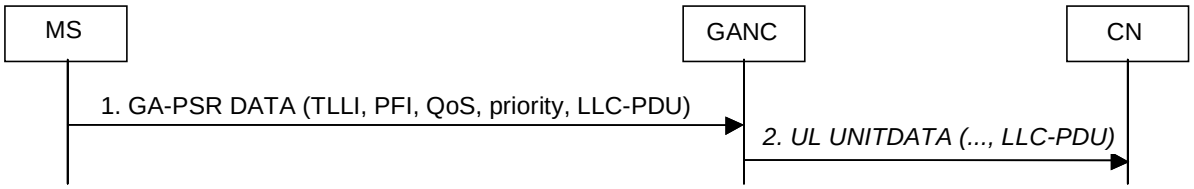


Figure 34: Uplink Control Plane Data Transport

1. The MS GA-PSR receives a request from the LLC layer to transfer an uplink GMM/SM signalling message or SMS message; e.g. this could be a GMM attach request or SM PDP context activation message. The MS GA-PSR encapsulates the LLC-PDU within a GA-PSR DATA message including the parameters that will be required for Gb interface procedures. Subsequently, the message is forwarded to the GANC.

2. The GANC forwards the message to the Core Network as per standard Gb interface procedure.

8.18 GA-PSR Specific Signalling Procedures

8.18.1 Packet Paging for GPRS Data Service

The Core Network sends a PS page for a mobile station that is currently GPRS attached via the GAN.

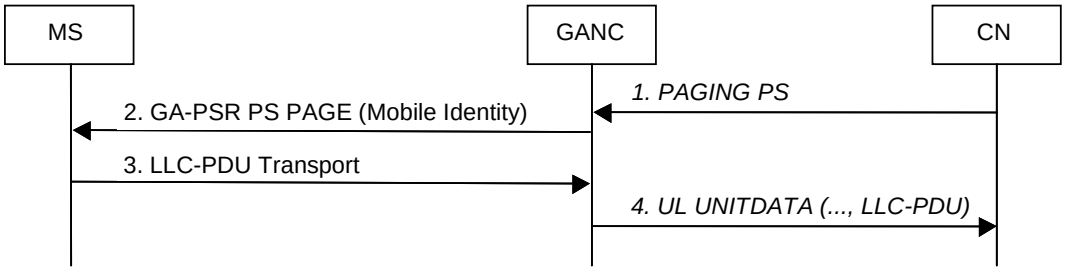


Figure 35: Packet Paging for GPRS

1. The Core Network sends a *PAGING PS* for a mobile station that is currently GPRS attached via the GAN. This message contains always IMSI and it may also contain P-TMSI.

2. GANC identifies the MS registration context using the IMSI provided by the CN and pages the MS using the GA-PSR PS PAGE message on the existing TCP signalling connection. The GA-PSR PS PAGE message on the Up interface includes the P-TMSI, if received in the *PAGING PS* message from the CN, else it includes the MS IMSI.

3. The mobile station sends any LLC-PDU to respond to the page, activating GA-PSR TC, if needed. The uplink LLC-PDU is forwarded to the GANC using the GPRS data or signalling transfer mechanism as described in clause 8.17.2.3.

4. The GANC forwards the LLC-PDU to the Core Network via the standard Gb interface procedures.

8.18.2 Packet Paging for CS Domain Service

The Core Network may send a CS page for a mobile station that is currently GPRS attached via the GAN.

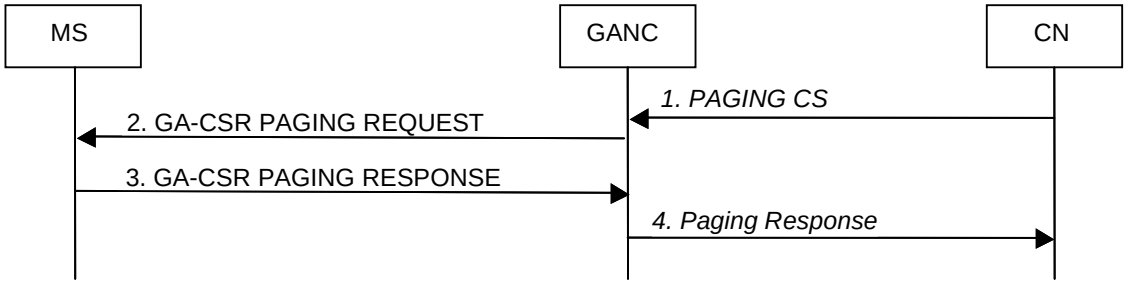


Figure 36: Packet Paging for CS Service

1. The Core Network sends a *PAGING CS* for a GAN registered mobile station via the Gb interface. The mobile station is currently GPRS attached via the GAN. The *PAGING CS* message always contains IMSI as Mobile Identity and it may also contain TMSI.

2. GANC identifies the MS registration context using the IMSI provided by the CN and pages the MS using the GA-CSR PAGING REQUEST message on the existing TCP signalling connection. The GA-CSR PAGING REQUEST message on the Up interface includes the TMSI, if received in the PAGING CS message from the CN, else it includes the MS IMSI.

3-4. The mobile station initiates the standard CS page response procedure via the GAN as described in clause 8.11.

8.18.3 GPRS Suspend Procedure

The GPRS Suspend procedure is invoked if a mobile station is unable to support simultaneous voice and data services and is transitioning to dedicated mode.

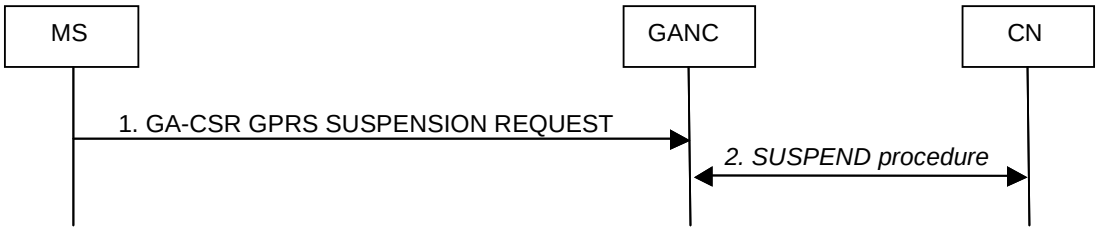


Figure 37: GPRS Suspend

1. While transitioning to dedicated mode and if unable to support simultaneous voice and data services, the mobile station sends a GA-CSR GPRS SUSPENSION REQUEST message to the GANC to suspend downlink GPRS traffic. The request is transferred via the existing TCP signalling connection and includes TLLI and Suspension Cause parameters as per standard GPRS.

2. The GANC initiates and completes the standard GPRS Suspend procedure as defined for Gb interface.

8.18.4 GPRS Resume Procedure

If the GPRS service has been suspended while the mobile station entered the dedicated mode, it needs to be resumed when the mobile station leaves the dedicated mode.

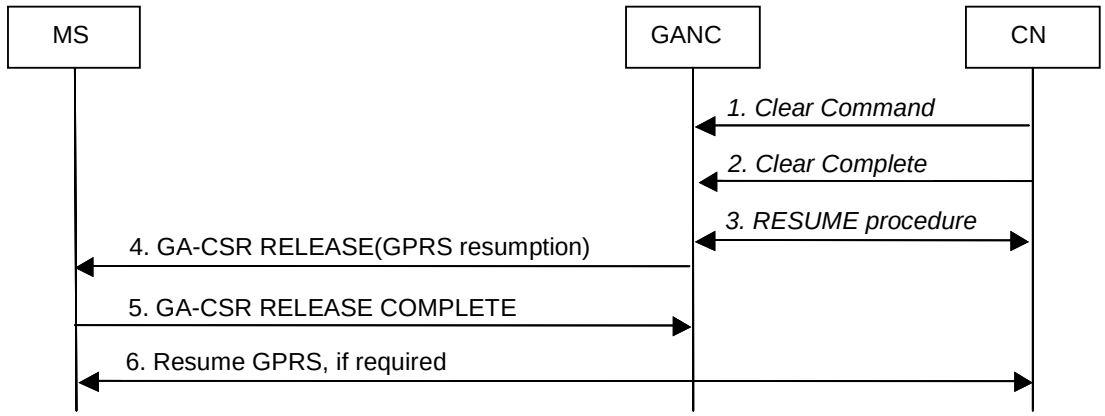


Figure 38: GPRS Resume

Initially, the MS is in the dedicated mode and the GPRS service is suspended.

1. The Core Network sends a *Clear Command* message to release the resources associated with the dedicated mode procedure.
2. The GANC responds with a Clear Complete message.
3. Optionally, the GANC may initiate the standard BSSGP GPRS resume procedure.
4. The GANC sends a GA-CSR RELEASE message to instruct the MS to release the GA-CSR Connection. The message includes GPRS resumption indication as per standard GSM/GPRS to indicate whether or not the network successfully resumed GPRS service.
5. The MS replies with a GA-CSR RELEASE COMPLETE message and resumes GPRS service internally.
6. Optionally, if the Core Network indicated unsuccessful resumption, the MS initiates GPRS service resumption as per standard GPRS.

8.18.5 MS Initiated Downlink Flow Control

The principle of the MS Initiated Downlink Flow Control is that the MS sends to the GANC flow control parameters, which allow the GANC to perform standard Gb interface procedures towards CN for downlink Flow Control either on MS or PFC level.

The following figure illustrates the message flow involved in the normal case when the MS sends a GAN flow control request to the GANC as an indication that the MS is not able to handle current data rate. The GANC will utilize the standard MS based Gb interface flow control mechanism to adjust the data rate.

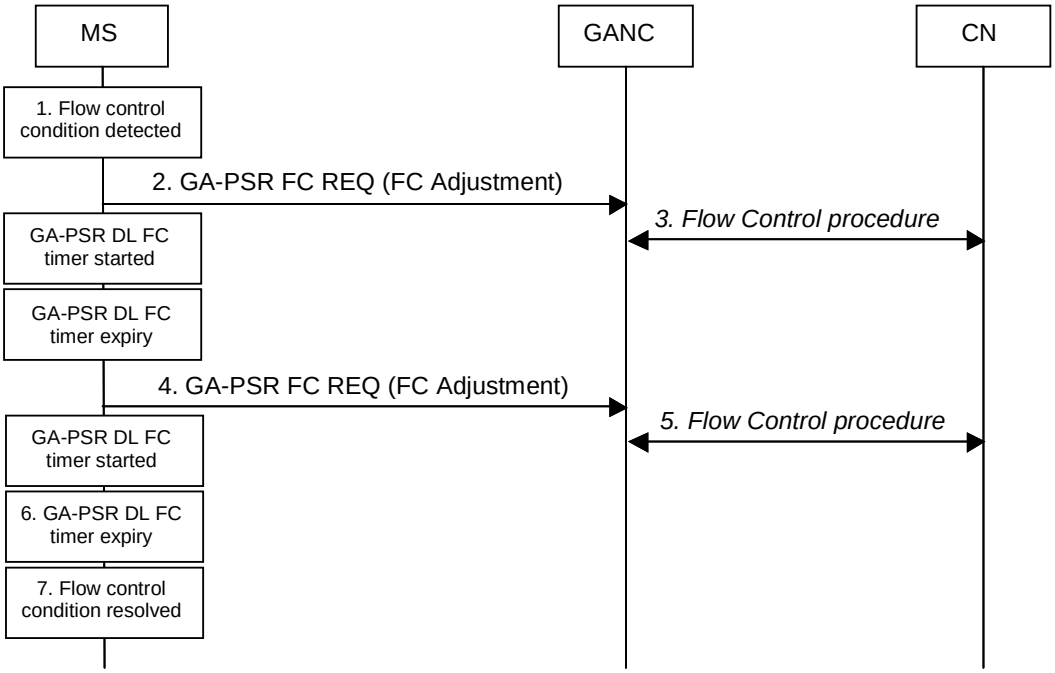


Figure 39: Downlink Flow Control

1. The MS detects a flow control condition related to the downlink data traffic.

2. The MS constructs a flow control request message (GA-PSR FC REQ) that is sent to the GANC via the GA-PSR TC and starts a GA-PSR downlink flow control timer to continue monitoring the flow control condition. The message includes the flow control adjustment IE to specify the required data rate correction.

3. Upon receiving the indication, the GANC calculates adjusted flow control parameters for the MS and sends the corresponding request to the Core Network to reduce the downlink data rate for the MS. The Core Network adjusts the downlink data rate for the MS as per request.

4. Upon the expiry of the GA-PSR downlink flow control timer, the MS evaluates the flow control condition and if it has not been resolved, calculates the adjustment again and forwards another request to the GANC.

5. The GANC processes the request and sends another request to the Core Network to adjust the downlink data rate for the MS.

6. The GA-PSR downlink flow control timer expires again.

7. Steps 4 to 6 are repeated until the flow control condition is resolved.

8.18.6 Uplink Flow Control

The principle of the Uplink Flow Control is that the GANC sends to the MS flow control parameters, which guide the MS on sending of GPRS data towards the GANC.

The following figure illustrates the message flow involved in the normal case when the GANC initiates GAN flow control procedure when it is not able to handle current uplink data rate.

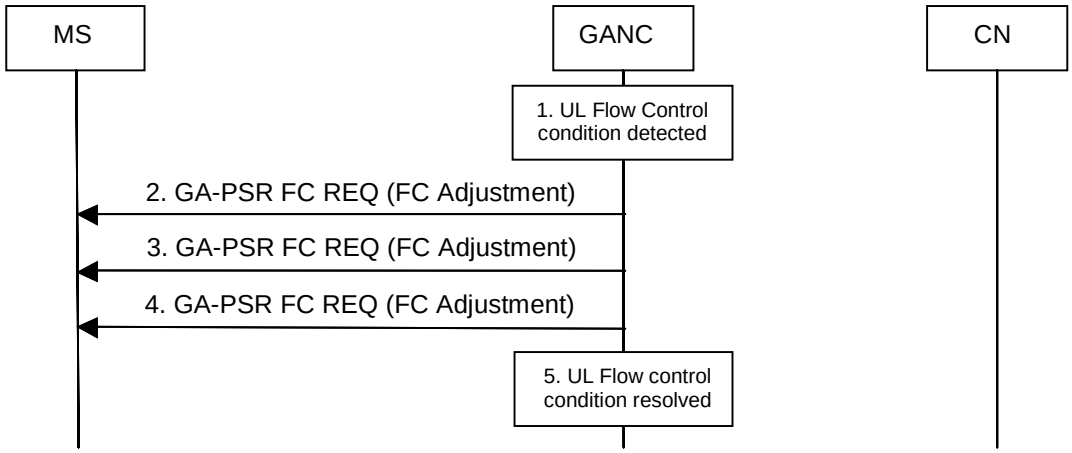


Figure 40: Uplink Flow Control

1. The GANC detects a flow control condition related to the uplink data traffic associated with a specific MS.
2. The GANC constructs a flow control request message (GA-PSR-FC-REQ) that is sent to the MS via the GA-PSR TC and starts a timer to continue monitoring the flow control condition. The message includes the flow control adjustment IE to specify the required data rate correction. Upon receiving the message, the MS adjusts the uplink data rate accordingly.
3. After the timer expires, the GANC evaluates the flow control condition and if it has not been resolved, calculates the adjustment again and forwards another request to the MS.
4. The GANC timer expires again. The GANC evaluates the flow control condition and determines that the condition has been resolved. Based on the GANC algorithm that is implemented, it may gradually increase the uplink data rate using the same GA-PSR-FC-REQ message.
5. The flow control condition does not exist any more and the procedure is complete.

8.19 Short Message Service

GAN provides support for both Circuit Switched (GSM based) and Packet Switched (GPRS based) SMS services. GAN-attached and GPRS enabled mobile stations will be able to send and receive GSM and GPRS SMS messages via the GAN, regardless of the GPRS class (B or C) with the restriction that the class C mobiles can support only GPRS based SMS.

8.19.1 GSM based SMS

GSM SMS support in GAN is based on the same mechanism that is utilized for GSM mobility management and call control. On the MS side, the SMS layers (including the supporting CM sub layer functions) utilize the services of the MM layer to transfer SMS messages per standard circuit switched GSM implementation. The SM-CP protocol is effectively tunnelled between the MS and the CN, using GA-CSR messages from the MS to the GANC, where the GANC relays the SM-CP to BSSAP DTAP messages for transport over the A interface.

As with GSM mobility management and call control procedures, the secure IPsec tunnel and TCP session are used to provide secure and reliable SMS delivery over the IP network.

8.19.2 GPRS based SMS

GPRS SMS message transfer is based on the same mechanism as the transfer of the GPRS MM/SM signalling messages. On the MS side, the SMS layers (including the supporting CM sub layer functions) utilize the services of the LLC layer to transfer SMS messages per standard packet switched GPRS implementation.

As with GPRS signalling, the secure IPsec tunnel and TCP session is used to provide secure and reliable GPRS SMS delivery over the IP network.

8.20 Supplementary Services

GSM has a large number of standardized supplementary services. These supplementary services involve procedures that operate end-to-end between the MS and the MSC. The DTAP messages used for the supplementary service are relayed between the MS and MSC in the same manner as in the other call control and mobility management scenarios described in this document.

8.21 Emergency Services

8.21.1 General

The GANC can indicate, in the GAN Registration procedures, an Access Network preference for the placement of emergency calls.

Based on the Access Network preference, and if GERAN/UTRAN coverage is available, the MS should switch from GAN mode to GERAN/UTRAN mode and place the emergency call over GERAN/UTRAN, to leverage the location determination infrastructure in GERAN/UTRAN. During the emergency call, the MS should not attempt to handover the call to GAN. After the emergency call is completed, the MS may perform normal rove-in procedures to re-enter GAN mode, if GAN coverage is still available. Alternatively there may be a penalty timer configured to ensure that the MS remains in GERAN/UTRAN for call-back purposes. On expiry of the penalty timer the MS may perform normal rove-in procedures to re-enter GAN mode, if GAN coverage is still available.

Based on the Access Network preference, or if a GSM PLMN is not available, the MS places the emergency call over GAN. In GAN, the emergency call is handled just like a GSM emergency call origination. The CGI associated with the GANC provides an indication of the location of the MS. Additionally, more accurate location information may be obtained by the GANC either directly from the MS (e.g. using AGPS) or from the generic IP access network point of attachment (e.g. using a database of IP or MAC addresses). If available, the GANC can pass this location information through BSSMAP to the core network, when requested. However, location services based on mechanisms using the GERAN physical layer cannot be applied.

NOTE: A mechanism may be required in the GANC to force the MS to GERAN/UTRAN mode, if the location accuracy is not deemed sufficient for emergency calls in GAN mode.

8.21.2 North American Emergency Calls

8.21.2.1 Phase 1 Solution

8.21.2.1.1 Phase 1 Requirements

Wireless service providers were required by the FCC to have the capability to send wireless 911 calls to an E911 public safety answering point (PSAP) containing two important sets of data:

1. The location of the cell tower through which the E911 call was processed.
2. The mobile directory number (MDN) or "call back number" of the wireless phone placing the 911 call.

8.21.2.1.2 Phase 1 Mechanism

The GANC shall indicate during registration, when entering GAN mode, whether GERAN/UTRAN or GAN is preferred for support of emergency calls.

- If GAN mode is the preferred emergency call mode, the emergency call shall be placed over GAN if the mobile is in GAN mode. The GANC can reject the call depending on operator policy.
- If GERAN/UTRAN mode is the preferred emergency mode, the emergency call shall be placed over the GERAN/UTRAN when a GERAN/UTRAN network is available. If a GERAN/UTRAN network is not available the emergency call shall be placed over GAN.

8.21.2.2 Phase 2 Solution

8.21.2.2.1 Phase 2 Requirements

Wireless service providers are required by the FCC to have the ability to provide the actual caller's location to the E911 PSAP. The location accuracy requirements differ depending on whether a network-based or handset-based approach is chosen.

- Network-based requirement: Within 100 meters, 67% of the time and within 300 meters, 95% of the time.
- Handset-based requirement: Within 50 meters, 67% of the time and within 150 meters, 95% of the time.

The handset-based requirements apply to terminals supporting location determining mechanisms (e.g. A-GPS, E-OTD). This may require new, modified or upgraded terminals.

8.21.2.2.2 Phase 2 Mechanism

The emergency call is placed over GERAN/UTRAN or GAN. If the emergency call is placed over GAN, the GANC will need to provide accurate location information for the MS or the AP through which the MS is placing the emergency call. This can be done in a number of ways:

- the GANC can reference an AP-ID to location mapping database for the GAN service;
- the MS can provide its current location (e.g. obtained via AGPS) in GA-RC REGISTER REQUEST/UPDATE message;
- the GANC can reference an MS (public) IP address to location mapping database;
- the GANC can deliver the required location information to the SMLC via Lb interface and the SMLC is responsible for final location determination.

The GANC passes this location information through BSSMAP to the CN, when requested.

8.22 Location Services

The GANC uses information received from the MS during the GAN Registration and GAN Registration Update procedures to determine the geographic location of an MS.

1. **Cell-Info:** The MS provides the identity of the GSM cell it is camped on, in case GERAN/UTRAN coverage is available, at the time of GAN registration. The GANC determines the MS location to the resolution of a single cell. This enables location services that require location resolution provided by a cell (e.g. E911 Phase 1).

NOTE 1: The accuracy of the location may be reduced if no up-to-date cellular coverage information is available.

2. **Generic IP access network point of attachment information (AP-ID):** The MS provides the AP-ID at the time of GAN registration. The GANC may maintain an internal database of mapping between AP-ID and AP location. The AP Location may be defined as street address, postcode or zip code and would require a translation function to a GAD shape as defined in 3GPP TS 23.032 [41]. The GANC may then determine the MS location to the resolution of a single attachment point's coverage area. This can enable location services that require a location with greater resolution than that provided by a GSM cell (e.g. E911 Phase 2).

NOTE 2: The location of the point of attachment may not be reliable, and is dependent on up-to-date information being provided either by the MS or by the owner of the point of attachment.

Annex A (normative): Security mechanisms

A.1 EAP based Authentication

A.1.1 EAP-SIM Procedure for authentication

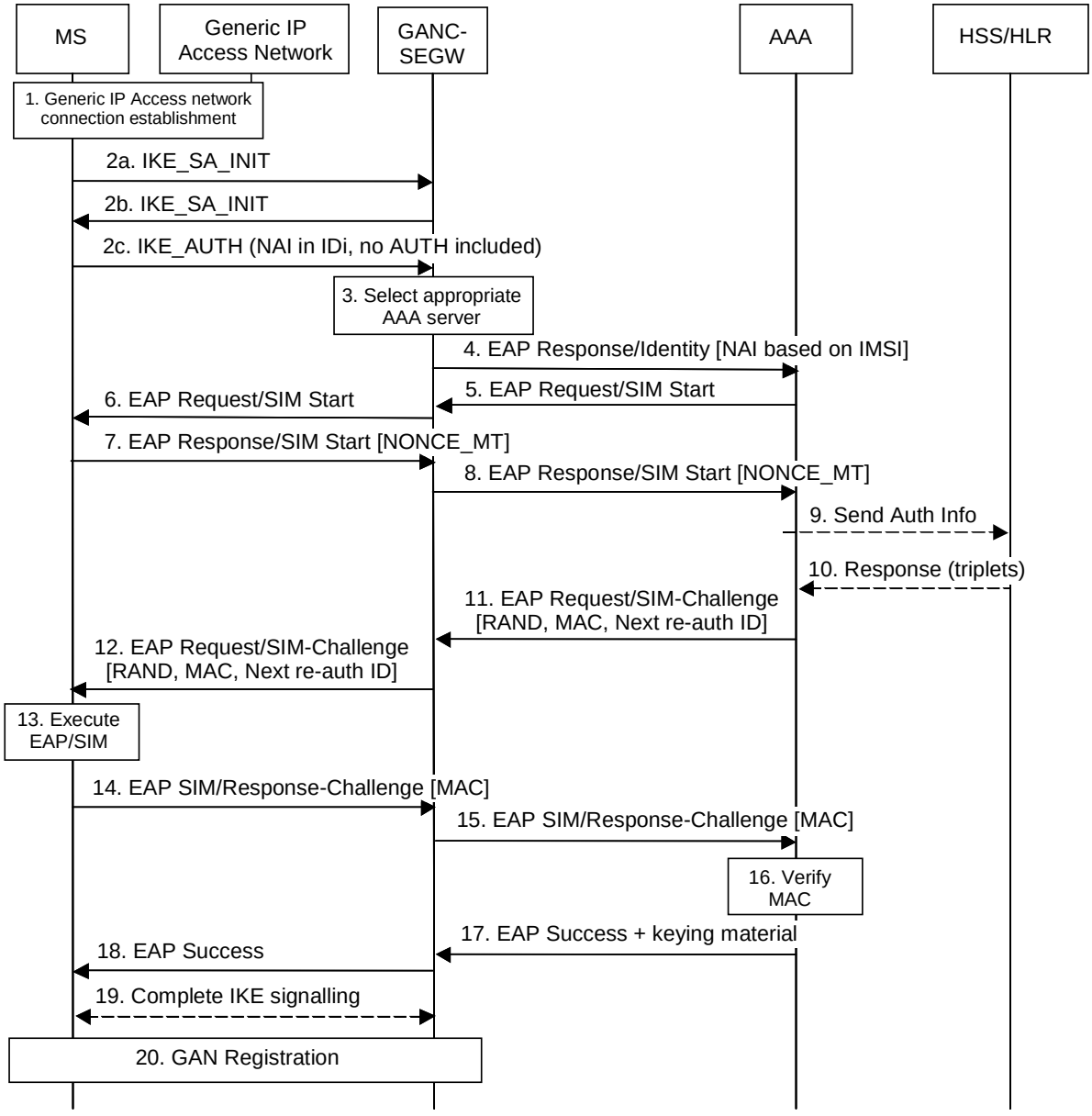


Figure A.1: EAP-SIM authentication procedure

The EAP-SIM authentication mechanism is specified in [30]. This clause describes how this mechanism is used in GAN.

1. The MS connects to the generic IP access network.
2. The MS obtains the IP address of the GANC-SEGW, and initializes the IKEv2 authentication procedure by starting the IKE_SA_INIT exchange. It indicates the desire to use EAP by leaving out the AUTH payload from message 3 of the IKE_AUTH exchange, and the initiator identity is composed compliant with the Network Access Identifier (NAI) format specified in RFC 2486 [36], which contains the IMSI.
3. The GANC-SEGW communicates with the local AAA server through the Wm interface, which in turn determines the proper AAA Server based on the realm part of the NAI. The routing path may include one or several AAA proxies (not shown in figure A.1).
4. The GANC-SEGW sends an EAP Response/Identity message to the AAA server, containing the identity included in the third IKE message. This triggers the start of EAP-SIM.
5. The AAA Server identifies the subscriber as a candidate for authentication with EAP-SIM, based on the received identity, and sends the EAP Request/SIM-Start packet to GANC-SEGW.
6. The GANC-SEGW forwards the EAP Request/SIM-Start packet to MS.
7. The MS chooses a fresh random number NONCE_MT. The random number is used in network authentication. The MS sends the EAP Response/SIM-Start packet, containing NONCE_MT, to the GANC-SEGW.
8. The GANC-SEGW forwards the EAP Response/SIM-Start packet to the AAA Server.
9. The AAA server requests authentication data from the HLR, based on the IMSI. Note that the AAA server could instead use cached triplets previously retrieved from the HLR to continue the authentication process.
10. The AAA server receives multiple triplets from the HLR.
11. The AAA server formulates an EAP-SIM/Challenge with multiple RAND challenges, and includes a message authentication code (MAC) whose master key is computed based on the associated Kc keys, as well as the NONCE_MT. A new re-authentication identity may be chosen and protected (i.e. encrypted and integrity protected) using EAP-SIM generated keying material. The AAA Server sends this RAND, MAC and re-authentication identity to the GANC-SEGW in the EAP Request/SIM-Challenge message.
12. The GANC-SEGW forwards the EAP Request/SIM-Challenge message to the MS.
13. The MS runs N times the GSM A3/A8 algorithm in the SIM, once for each received RAND. This computing gives N SRES and Kc values. The MS calculates its copy of the network authentication MAC with the newly derived keying material and checks that it is equal with the received MAC. If the MAC is incorrect, the network authentication has failed and the MS cancels the authentication. The MS continues the authentication exchange only if the MAC is correct. The MS calculates a new MAC with the new keying material covering the EAP message concatenated to the N SRES responses. If a re-authentication ID was received, then the MS stores this ID for future authentications.
14. The MS sends EAP Response/SIM-Challenge containing calculated MAC to the GANC-SEGW.
15. The GANC-SEGW forwards the EAP Response/SIM-Challenge packet to the AAA Server.
16. The AAA Server verifies that its copy of the response MAC is equal to the received MAC.
17. If the comparison in step 16 is successful, then the AAA Server sends the EAP Success message to the GANC-SEGW. The AAA Server includes derived keying material for confidentiality and/or integrity protection between MS and GANC-SEGW, in the underlying AAA protocol message (i.e. not at EAP level).
18. The GANC-SEGW informs the MS about the successful authentication with the EAP Success message.
19. Now the EAP-SIM exchange has been successfully completed, the IKE signalling can be completed
20. The Secure Association between MS and GANC-SEGW has been completed and the MS can continue with the discovery or registration procedure.

A.1.2 EAP-AKA Procedure for authentication

The EAP-AKA authentication mechanism is specified in [EAP AKA]. This section describes how this mechanism is used in GAN.

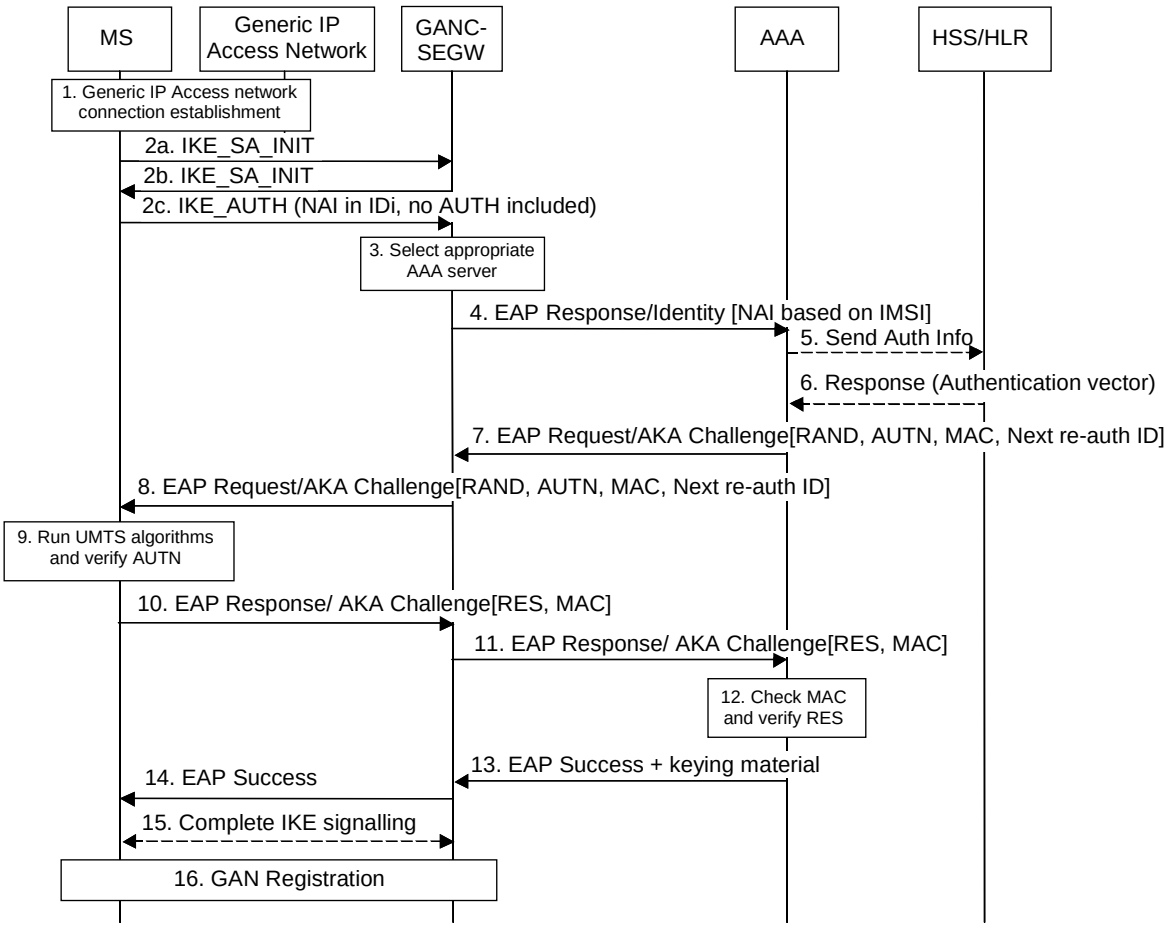


Figure A.2: EAP-AKA authentication procedure

1. The MS connects to the generic IP access network.

2. The MS obtains the IP address of the GANC-SEGW, and initializes the IKEv2 authentication procedure by starting the IKE_SA_INIT exchange. It indicates the desire to use EAP by leaving out the AUTH payload from message 3, the first message of the IKE_AUTH exchange, and the initiator identity is composed compliant with the Network Access Identifier (NAI) format specified in RFC 2486, which contains the IMSI and an indication that EAP-AKA should be used.

3. The GANC-SEGW communicates with the local AAA server through the Wm interface, which in turn determines the proper AAA Server based on the realm part of the NAI. The routing path may include one or several AAA proxies (not shown in figure A.2).

4. The GANC-SEGW sends an EAP Response/Identity message to the AAA server, containing the initiator identity included in the third IKE message. The leading digit of the NAI indicates that the MS wishes to use EAP-AKA.

5. The AAA server identifies the subscriber as a candidate for authentication with EAP-AKA, based on the received identity, and verifies that EAP-AKA shall be used based on subscription information, The AAA server requests the user profile and UMTS authentication vector(s) from the HSS/HLR, if these are not available in the AAA server.

6. Optionally, the AAA receives user subscription and UMTS authentication vector(s) from the HSS/HLR. The UMTS authentication vector consists of random part (RAND), an authentication part (AUTH), an expected result part (XRES) and sessions keys for integrity check (IK) and encryption (CK).
   AAA server determines the EAP method (SIM or AKA) to be used, according to the user subscription and/or the indication received from the MS.
   In this sequence diagram, it is assumed that the MS holds a USIM and EAP-AKA will be used.

7. The AAA server formulates an EAP-Request/AKA Challenge with RAND, AUTN and includes a message authentication code (MAC) whose master key is computed based on the associated IK and CK. A new re-authentication identity may be chosen and protected (i.e. encrypted and integrity protected) using EAP-AKA generated keying material. The AAA Server sends the RAND, AUTN, MAC and re-authentication identity to the GANC-SEGW in the EAP Request/AKA-Challenge message.

8. The GANC-SEGW forwards the EAP Request/AKA-Challenge message to the MS.

9. The MS runs UMTS algorithm on the USIM. The USIM verifies that the AUTN is correct and hereby authenticates the network. If AUTN is incorrect, the MS rejects the authentication (not shown in figure A.3). If AUTN is correct, the USIM computes RES, IK and CK. The MS calculates a new MAC with the new keying material (IK and CK) covering the EAP message.
   If a re-authentication ID was received, then the MS stores this ID for future authentications.

10. The MS sends EAP Response/AKA-Challenge containing calculated RES and MAC to the GANC-SEGW.

11. The GANC-SEGW forwards the EAP Response/AKA-Challenge message to the AAA Server.

12. The AAA Server verifies the received MAC and compares XRES to the received RES.

13. If the checks in step 12 are successful, then the AAA Server sends the EAP Success message to the GANC-SEGW. The AAA Server includes derived keying material for confidentiality and/or integrity protection between MS and GANC-SEGW, in the underlying AAA protocol message (i.e. not at EAP level).

14. The GANC-SEGW informs the MS about the successful authentication with the EAP Success message.

15. Now the EAP-SIM exchange has been successfully completed, the IKE signaling can be completed.

16. The Secure Association between MS and GANC-SEGW has been completed and the MS can continue with the GAN discovery or registration procedure.

A.1.3 Fast Re-authentication

When the authentication process is performed frequently, especially with a large number of connected Mobile Stations, performing fast re-authentication can reduce the network load resulting from this authentication. The fast re-authentication process allows the AAA server to authenticate a user based on keys derived from the last full authentication process.

The MS and GANC-SEGW can use a procedure for fast re-authentication in order to re-authenticate an MS e.g. when setting up a new SA because the IP address of the MS has changed as a result of a handover between generic IP access network attachment points connected to different IP subnets. Fast re-authentication is provided by EAP-SIM and EAP-AKA, and does not make use of the GSM A3/A8 or UMTS algorithms. The MS may use the re-authentication ID in the IKE_SA_INIT. The decision to make use of the fast re-authentication procedure is taken by the AAA server.

The basic elements of these procedures are the following:

- The MS initiates a new SA with a GANC-SEGW that it was previously connected to and uses the re-authentication ID (re-authentication ID received during the previous full authentication procedure) in the IKE_SA_INIT exchange. The EAP-SIM or EAP-AKA procedure is started as a result of these exchanges.

- The AAA server and MS re-authenticate each other based on the keys derived on the preceding full authentication.

A.1.3.1 EAP-SIM Fast Re-authentication

The EAP-SIM specification [30] includes support for fast re-authentication. The use of this mechanism may be subject to operator policy.

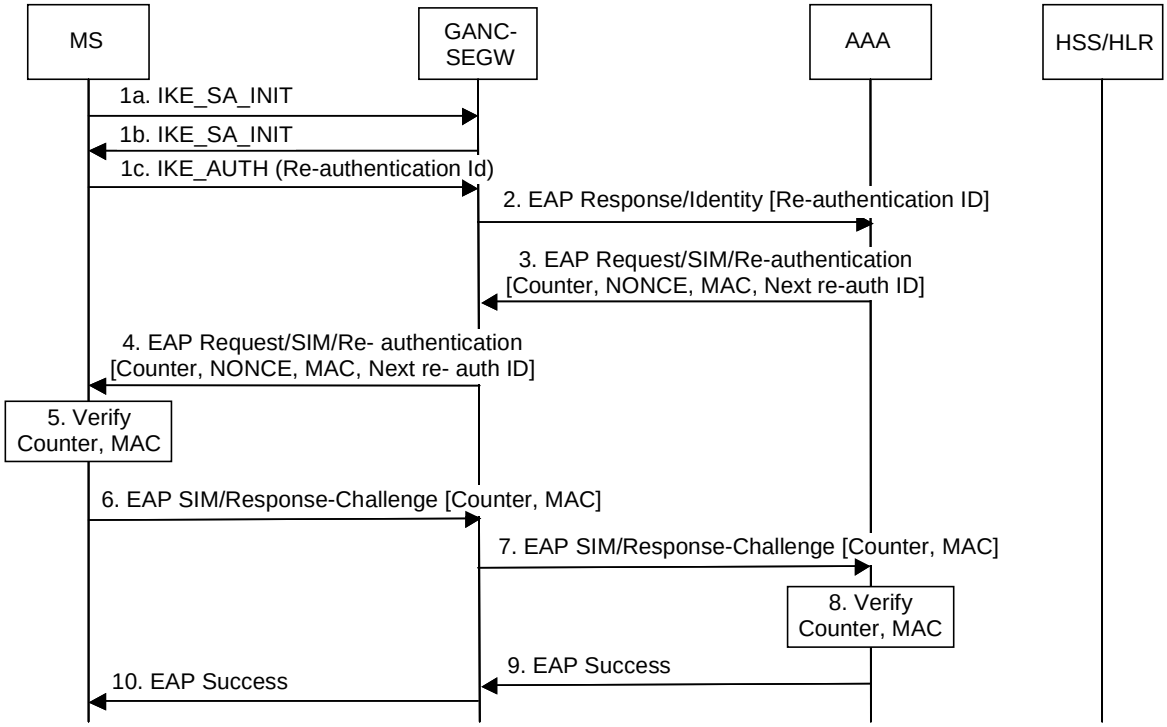


Figure A.3: EAP-SIM fast re-authentication procedure

1. The MS initializes the IKEv2 authentication procedure by starting the IKE_SA_INIT exchange. It indicates the desire to use EAP by leaving out the AUTH payload from message 3 of the IKE_AUTH exchange, and the initiator identity contains the re-authentication identity (this identity was previously delivered by AAA server in a full authentication procedure).

2. The GANC-SEGW sends an EAP Response/Identity message to the AAA server, containing the re-authentication ID as was included in the third IKE message. This triggers the start of EAP-SIM.

3. The AAA server initiates the Counter (which was initialized to one in the full authentication process) and sends it in the EAP Request message, together with the NONCE, the MAC (calculated over the NONCE) and a re-authentication id for a next fast re-authentication. If the AAA server is not able to deliver a re-authentication identity, then the MS shall force a full-authentication next time (to avoid the use of the re-authentication identity more than once).

4. The GANC-SEGW forwards the EAP Request message to the MS.

5. The MS verifies that the Counter value is fresh and the MAC is correct.

6. The MS sends the EAP Response message with the same Counter value and a calculated MAC to the GANC-SEGW.

7. The GANC-SEGW forwards the response to the AAA server.

8. The AAA server verifies that the Counter value is the same as it sent, and that the MAC is correct.

9. The AAA server sends an EAP Success message to the GANC-SEGW.

10. The GANC-SEGW forwards the EAP Success message to the MS.

A.1.3.2 EAP-AKA Fast Re-authentication

The EAP-AKA specification [38] includes support for fast re-authentication. The use of this mechanism may be subject to operator policy.

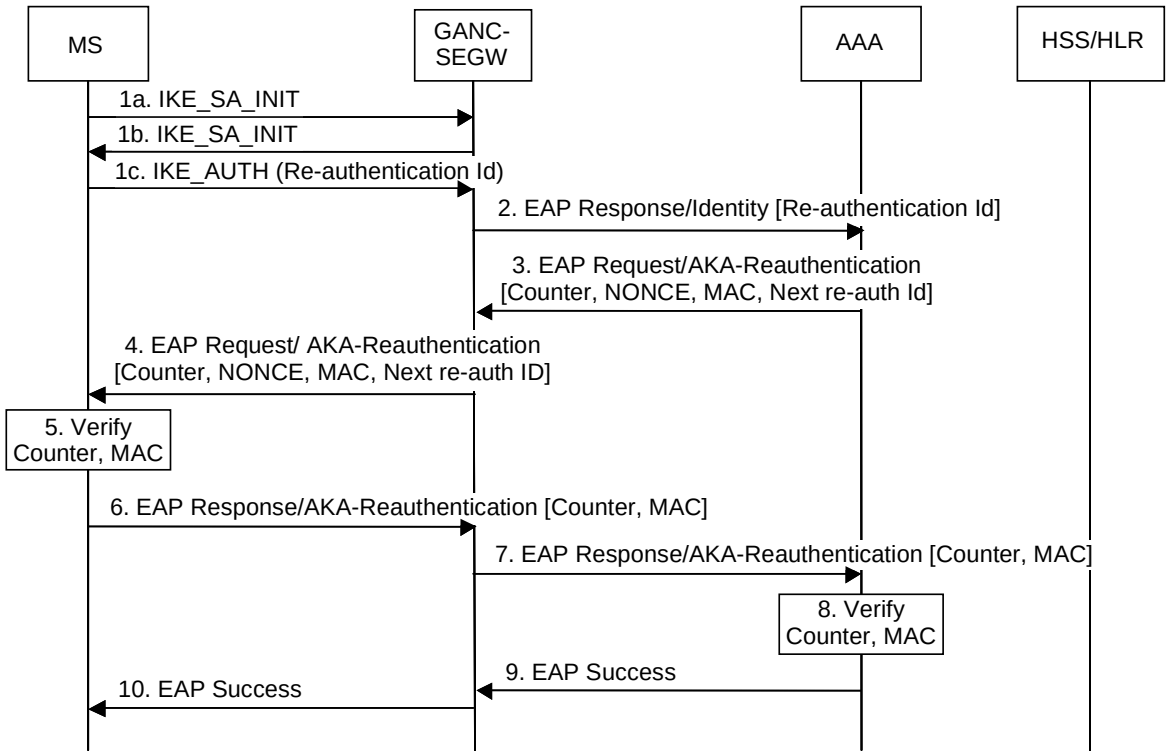


Figure A.4: EAP-AKA fast re-authentication procedure

1. The MS initializes the IKEv2 authentication procedure by starting the IKE_SA_INIT exchange. It indicates the desire to use EAP by leaving out the AUTH payload from message 3, the first message of the IKE_AUTH exchange, and the initiator identity contains the re-authentication identity (this identity was previously delivered by AAA server in a EAP-AKA full authentication procedure).

2. The GANC-SEGW sends an EAP Response/Identity message to the AAA server, containing the re-authentication ID as was included in the third IKE message. This triggers the start of EAP-AKA.

3. The AAA server initiates the Counter (which was initialized to one in the full authentication process) and sends it in the EAP Request/AKA-Reauthentication message, together with the NONCE, the MAC (calculated over the NONCE) and a re-authentication id for a next fast re-authentication. If the AAA server is not able to deliver a re-authentication identity, then the MS shall force a full-authentication next time (to avoid the use of the re-authentication identity more than once).

4. The GANC-SEGW forwards the EAP Request/AKA-Reauthentication message to the MS.

5. The MS verifies that the Counter value is fresh and the MAC is correct.

6. The MS sends the EAP Response/AKA-Reauthentication message with the same Counter value and a calculated MAC to the GANC-SEGW.

7. The GANC-SEGW forwards the response to the AAA server.

8. The AAA server verifies that the Counter value is the same as it sent, and that the MAC is correct.

9. The AAA server sends an EAP Success message to the GANC-SEGW.

10. The GANC-SEGW forwards the EAP Success message to the MS.

A.2 Profile of IKEv2

IKEv2, as specified in [32], contains a number of options, where some are not needed for the purposes of this specification and others are required. IKEv2 is therefore profiled in this section. When IKEv2 is used in the context of this specification the profile specified in this section shall be supported. The profile is aligned with 3GPP WLAN Interworking, Scenario 3 as defined in 3GPP TS 33.234 [9].

Access to GAN services follows a VPN-like approach. In [34] can be found a set of recommendations of IKEv2 profiles, suitable for VPN-like solutions. On the other hand, [33] sets rules and recommendations for individual algorithms support. Following recommendation from both papers, the below three profiles shall be supported by the MS and GANC-SEGW - GANC-SGW shall support all three profiles, while the MS shall support at least one of the three profiles in order of preference stated below:

- First cryptographic suite:
  - Confidentiality: AES with fixed key length in CBC mode. The key length is set to 128 bits (also known as ENCR_AES_CBC) per RFC 3602 [22].
  - Pseudo-random function: HMAC-SHA1 (also known as PRF_HMAC_SHA1) per RFC 2104 [23].
  - Integrity: HMAC-SHA1-96 (also known as AUTH_HMAC_SHA1_96) per RFC 2404 [25].
  - Diffie-Hellman group 2 (1024-bit MODP) per RFC 2409 [42].
- Second cryptographic suite:
  - Confidentiality: 3DES in CBC mode (also known as ENCR_3DES) per RFC 2451 [21].
  - Pseudo-random function: HMAC-SHA1 (also known as PRF_HMAC_SHA1) per RFC 2104 [23].
  - Integrity: HMAC-SHA1-96 (also known as AUTH_HMAC_SHA1_96) per RFC 2404 [25].
  - Diffie-Hellman group 2 (1024-bit MODP) per RFC 2409 [42].
- Third cryptographic suite:
  - Confidentiality: AES with fixed key length in CBC mode. The key length is set to 128 bits (also known as ENCR_AES_CBC) per RFC 3602 [22].
  - Pseudo-random function: AES-XCBC-PRF-128 (also known as PRF_AES128_XCBC) per RFC 4434 [28].
  - Integrity: AES-XCBC-MAC-96 (also known as AUTH_AES_PRF_128) per RFC 3566 [27].
  - Diffie-Hellman group 2 (1024-bit MODP) per RFC 2409 [42].

A.3 Profile of IPsec ESP

The IPsec specification contains a number of options for the cryptographic algorithms for IPsec ESP. In order to limit the implementation requirements, a specified profile of IPsec ESP is applied. The profile is aligned with 3GPP WLAN Interworking, Scenario 3 as defined in 3GPP TS 33.234 [9].

Rules and recommendations in [33] and [34] have been followed, as in case of IKEv2. The below three profiles shall be supported by the MS and GANC-SEGW - GANC-SEGW shall support all three profiles, while the MS shall support at least one of the three profiles in order of preference stated below:

- First cryptographic suite:
  - Confidentiality: AES with fixed key length in CBC mode. The key length is set to 128 bits (also known as ENCR_AES_CBC) per RFC 3602 [22].
  - Integrity: HMAC-SHA1-96 (also known as AUTH_HMAC_SHA1_96) per RFC 2404 [25].
  - Tunnel mode must be used.

- Second cryptographic suite:
  - Confidentiality: 3DES in CBC mode (also known as ENCR_3DES) per RFC 2451 [21].
  - Integrity: HMAC-SHA1-96 (also known as PRF_HMAC_SHA1). The key length is 160 bits, according to RFC 2104 and RFC 2404 [25].
  - Tunnel mode must be used.
- Third cryptographic suite:
  - Confidentiality: AES with 128-bit keys in CBC mode. The key length is set to 128 bits (also known as ENCR_AES_CBC) per RFC 3602 [22].
  - Integrity: AES-XCBC-MAC-96 (also known as AUTH_AES_PRF_128) per RFC 3566 [27].
  - Tunnel mode must be used.

Annex B (informative): Configuration Information

B.1 GAN ARFCN/BSIC for handover-to-GAN

Selection of ARFCN may use the following guidelines:

1. The ARFCN should not be allocated from the operator's existing BCCH pool so that a scarce BCCH is not used.
2. The ARFCN maybe desired to be the same unique number across the whole operator network to minimize the BSS configuration effort.

The following are available options for the selection of the ARFCN:

1. Ideally, the GAN is assigned an ARFCN value, which is not in the frequency bands currently used by the operator.
2. Typically, different PLMNs in the same country have disjoint frequency allocations. For each PLMN, some of the frequencies are reserved for BCCH beacon; BCCH will be transmitted with constant max power on time slot 0. Other frequencies are dedicated as traffic channels. The GAN ARFCN could use any non-BCCH frequency from the carrier's existing frequency pool. Standard GSM MSs will be able to tune onto this channel but will not be able to find the FCCH burst.
3. Alternatively, in a PCS-only (1 900 MHz) network, ARFCN can be any value falling within the GSM (900 MHz) or DCS (1 800 MHz) band. Standard GSM handsets operating in PCS-only mode will ignore this ARFCN. Tri-band handsets supporting automatic band change will not be able to find a BCCH on the associated frequency.

Annex C (informative): Identifiers in GAN

C.1 Identifiers for MSs and generic IP access network

The following are the key MS and generic IP access network addressing parameters.

1. The IMSI associated with the (U)SIM in the terminal.

   - The MS provide the IMSI to the GANC during the Registration procedure. The GANC maintains a record for each registered MS. For example, IMSI is used by the GANC to index the appropriate MS record when the GANC receives a BSSMAP PAGING message.

2. Public IP Address of the MS.

   - The Public IP address of MS is the source IP present in the outermost IP header of packets received from the MS by the GANC-SEGW. If available, this identifier may be used by the GANC to support location services and fraud detection or by service providers to signal Managed IP networks IP flows that require special QoS treatment.

3. The generic IP access network point of attachment address (AP-ID).

   - The MS provides the AP-ID to the GANC at Registration. The AP-ID may be used by the GANC to support location services or by the service provider to restrict GAN access to authorized APs.

C.2 Cell identifiers for GAN

C.2.1 GAN Cell Id for Location Services & Billing

Cell Global Identities (CGI) may be used to perform location-basing routeing of a call for services such as: emergency services; operators; announcements and freephone numbers. Cell identities can be also used by the core network to identify the location of where a call was originated/terminated for charging purposes. The GANC provides a CGI to the core network indicating the GAN cell.

C.2.1.1 Assigning GAN Cell Id based on GSM location

In the GAN architecture, the MS has a direct IP-based connection to the GANC. The GAN coverage area may overlay the GERAN coverage area. Logical mapping of GAN Cells to a CGI can be completed at various resolutions, for example (but not limited to):

- a GAN cell for each GSM cell;
- a GAN cell for each GSM routeing area; or
- a GAN cell for each GSM location area.

A single GANC could represent one or more cells (CGI) in one or more location areas (LAI).

C.2.2 GAN Cell Id for handover-to-GAN

The GAN cell id used for location and charging can be independent from the GAN cell id used for handover.

A single GANC represents a single cell, and referred to as GAN cell, for the purpose of handover from GERAN to GAN. This "handover-GANC-CGI" is not visible to the MS. It is only used in the GERAN and CN for identifying a target cell (i.e. target GANC) for handover from GERAN to GAN, and ignored by the GANC, when received during the handover via the A-interface.

The "handover-GANC-CGI" assigned to the GANC is configured as the target handover cell in all neighbouring GERAN cells (in the ARFCN/BSIC-to-CGI mapping table). Neighbouring GERAN cells are those whose service area "overlaps" the GANC service area, for the purpose of handover.

For example, neighbour cells are:

- All GERAN cells attached to the same MSC as the GANC.
- All GERAN cells attached to a different MSC but that can handover to the MSC to which the GANC is attached.

When the MS reports measurements to the GERAN BSS on the GAN cell identified by its ARFCN/BSIC, then the GERAN BSS maps the ARFCN/BSIC to the "handover-GANC-CGI" through its mapping table, and is thus able to identify the target cell (GANC) for handover-to-GAN.

C.2.3 GAN ARFCN/BSIC for handover-to-GAN

The GERAN-to-GAN handover method makes use of an RF channel number (ARFCN) and base station identity code (BSIC) parameters to identify the GAN target cell. All GANCs in a given operator domain can share the same ARFCN/BSIC values, if there is a single GANC neighbour per GSM cell. This ARFCN/BSIC is indicated to the MS by the GANC during GAN registration.

The selection of the RF channel number (ARFCN) used for the UTRAN to GAN handover procedure should not correspond to a channel from any frequency band defined in 3GPP TS 45.005, to avoid UEs not requiring compressed mode for GSM measurements from unnecessarily powering up their GSM receivers.

C.3 void

Annex D (informative): Change history

Change history							
Date	**TSG GERAN#**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2005-01	23	GP-050544	-	-	Version for Release 6 approved at TSG GERAN#23	2.0.0	6.0.0
2005-04	24	GP-050934	001		Introduction of the support for Cell Broadcast in GAN	6.0.0	6.1.0
2005-06	25	GP-051594	003		Editorial correction PCCO to GAN	6.1.0	6.2.0
2005-06	25	GP-051595	004		GERAN preferred mode MS behaviour	6.1.0	6.2.0
2005-06	25	GP-051763	005	1	GAN only mode MS behaviour	6.1.0	6.2.0
2005-06	25	GP-051704	007		Clarification to the CS charging description for GAN	6.1.0	6.2.0
2005-09	26	GP-052142	0009		Removal of addressing for the Generic Access Network	6.2.0	6.3.0
2005-11	27	GP-052796	0010	1	Clarifications to GAN Stage 2	6.3.0	6.4.0
2006-01	28	GP-060460	0008	6	Introduction of the Inter RAT Handover to GAN definition	6.4.0	6.5.0
2006-01	28	GP-060391	0012	1	Clarifications to GAN Stage 2	6.4.0	6.5.0
2006-04	29	GP-060929	0013	1	Clarification on GANC Selection	6.5.0	6.6.0
2006-04	29	GP-060924	0014	1	Rove-in description alignment with "Call re-establishment"	6.5.0	6.6.0
2006-05	30	GP-061188	0016		Clarification of GAN selection when MS in GERAN/UTRAN preferred mode	6.6.0	6.7.0
2006-11	32	GP-062357	0018	1	GAN cell selection : Alignment with stage 3	6.7.0	6.8.0
2006-11	32	GP-062272	0019		Cryptographic algorithm update	6.7.0	6.8.0
2007-02	33	GP-070498	0020	3	Correction of BSSMAP messages in the Mobile Terminated Call Flow	6.8.0	6.9.0

History

Document history		
V6.0.0	January 2005	Publication
V6.1.0	April 2005	Publication
V6.2.0	June 2005	Publication
V6.3.0	September 2005	Publication
V6.4.0	November 2005	Publication
V6.5.0	January 2006	Publication
V6.6.0	April 2006	Publication
V6.7.0	June 2006	Publication
V6.8.0	November 2006	Publication
V6.9.0	March 2007	Publication