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Digital cellular telecommunications system (Phase 2+);
Enhanced Generic Access Networks (EGAN) study
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GSM® GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS

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Contents

Foreword

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Introduction

During the course of Release 6, 3GPP TS 43.318 [2] (Generic access to the A/Gb interface; Stage 2) and 3GPP TS 44.318 [3] (Generic access to the A/Gb interface; Stage 3) were developed that provide access to the 3GPP core network using generic IP connection. Generic Access Networks, or GAN, is an extension of GSM/GPRS mobile services into the customer's premises that is achieved by tunnelling certain GSM/GPRS protocols between the customer's premises and the Core Network over broadband IP network, and relaying them through an unlicensed radio link inside the customer's premises. GAN is a complement to traditional GSM/GPRS radio coverage, used to enhance customer premises coverage, increase network capacity and potentially lower costs.

Early deployments of GAN are now ongoing. As part of the continuous process of optimizing their network to better meet customer demand a number of operators have indicated a need to further enhance the GAN system. Various goals for such enhancements are documented in section four of the present document. After presentation of the goals, the present document technical alternatives for how to implement such enhancements to GAN.

1 Scope

The present document contains the results of the feasibility study into the enhancements to Generic Access Networks or GAN. Considerations include overall requirements for enhancements, architectural requirements, evaluation of potential architectural solutions and alternative architectures.

The objective is to identify an architectural solution that best meets the requirements as specified in first section. The feasibility study shall also investigate mechanisms for selecting the most appropriate network domain to serve the user.

Existing solutions developed by the 3GPP should be reused as much as possible.

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 TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 43.318: "Generic access to the A/Gb interface; Stage 2".

[3] 3GPP TR 44 318: "Generic Access (GA) to the A/Gb interface; Mobile GA interface layer 3 specification".

[4] 3GPP TS 24.008: "Mobile radio interface Layer 3 specification; Core network protocols; Stage 3".

[5] 3GPP TS 29.060: "General Packet Radio Service (GPRS); GPRS Tunnelling Protocol (GTP) across the Gn and Gp interface".

[6] 3GPP TS 23.060: "General Packet Radio Service (GPRS); Service description; Stage 2".

[7] 3GPP TS 23.078: "Customized Applications for Mobile network Enhanced Logic (CAMEL) Phase X; Stage 2".

[8] 3GPP TS 32.251: "Telecommunication management; Charging management; Packet Switched (PS) domain charging".

[9] 3GPP TS 24.007: "Mobile radio interface signalling layer 3; General aspects".

[10] 3GPP TS 33.107: "3G security; Lawful interception architecture and functions".

[11] IETF RFC 2784 (March 2000): "Generic Routing Encapsulation (GRE)".

[12] 3GPP TS 25.410: "UTRAN Iu interface: General aspects and principles".

[13] 3GPP TS 25.450: "UTRAN Iupc interface general aspects and principles".

[14] 3GPP TS 25.419: "UTRAN Iu-BC interface: Service Area Broadcast Protocol (SABP)".

[15] 3GPP TS 29.234, v11.2.0: "3GPP system to Wireless Local Area Network (WLAN) interworking; Stage 3".

[16] 3GPP TS 25.412: "UTRAN Iu interface signalling transport".

[17] 3GPP TS 25.414: "UTRAN Iu interface data transport and transport signalling".

[18] 3GPP TS 25.415: "UTRAN Iu interface user plane protocols".

[19] 3GPP TS 26.071: "AMR speech Codec; General description".

[20] 3GPP TS 33.102: "3G Security; Security architecture".

[21] 3GPP TS 33.234: "3G security; Wireless Local Area Network (WLAN) interworking security".

[22] 3GPP TS 23.122: "Non-Access-Stratum (NAS) functions related to Mobile Station (MS) in idle mode".

[23] 3GPP TS 25.331: "Radio Resource Control (RRC); Protocol specification".

[24] 3GPP TS 44.064: "Mobile Station - Serving GPRS Support Node (MS-SGSN); Logical Link Control (LLC) Layer Specification".

[25] 3GPP TS 44.065: "Mobile Station (MS) - Serving GPRS Support Node (SGSN); Subnetwork Dependent Convergence Protocol (SNDCP)".

[26] 3GPP TS 23.003: "Numbering, addressing and identification".

[27] 3GPP TS 23.236: "Intra-domain connection of Radio Access Network (RAN) nodes to multiple Core Network (CN) nodes".

[28] 3GPP TS 43.129: "Packed-switched handover for GERAN A/Gb mode; Stage 2".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

3.2 Symbols

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

Up Interface between UE and GANC

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

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
DNS	Domain Name System
DTM	Dual Transfer Mode
EAP	Extensible Authentication Protocol
ETSI	European Telecommunications Standards Institute
FQDN	Fully Qualified Domain Name
GA-CSR	Generic Access - Circuit Switched Resources
GAN	Generic Access Network
GANC	Generic Access Network Controller
GA-PSR	Generic Access - Packet Switched Resources
GA-RC	Generic Access - Resource Control
GA-RRC	Generic Access - Radio 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
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 Requirements

4.1 Objectives

1. GAN Enhancements shall be backwards compatible with GAN in 3GPP Rel-6 and Rel-7.

Two levels of enhancements may be considered that are either:

a) Forwards compatible from Rel-6: Rel-6 and Rel-7 terminals work with the enhancements i.e. network-only enhancements

b) Not forwards compatible from Rel-6 (respectively Rel-7): Rel-6 (respectively Rel-7) terminals do not work with the enhancements

GAN Enhancements shall:

- Support at minimum the same services as GAN in 3GPP Rel-6 and Rel-7; and
- Support existing QoS management as specified in 3GPP; and
- Minimize the impact on the Core Network.

2. GAN Enhancements shall abide as per the unchanged GAN principle to keep the transparent support for any given service between UTRAN or GERAN, and GAN.
   - E.g. preserve the existing APN mechanism.
3. GAN Enhancements shall minimize the additional complexity on existing GANCs if applicable.
4. GAN Enhancements shall minimize the additional complexity on terminals (see case 1b above).
5. GAN Enhancements shall reduce the complexity for delivery of CS and PS services.
   - E.g. by reducing the number of functions and/or protocol overhead.
6. GAN Enhancements shall reduce the user-plane latency for delivery of PS services.
   - E.g. by reducing the number of functions and/or protocol overhead.
7. GAN Enhancements shall be compatible / shall align with other 3GPP Core Network enhancements e.g. "one tunnel approach" for PS services.
8. GAN Enhancements shall overcome the limitations imposed by using the Gb interface.
9. GAN Enhancements shall provide optimized support for operators using GSM-only, UMTS-only, or combined GSM/UMTS networks.
   - E.g. no changes to existing core network nodes/interfaces.

NOTE 1: The term "GSM" also refers to GPRS.

10. GAN Enhancements shall provide seamless mobility for CS and seamless mobility for PS including PS conversational services.
11. GAN Enhancements shall minimize "Enhanced GAN mode" power consumption on handsets.

NOTE 2: "Enhanced GAN mode" refers to the peer of GAN mode when operating as per a given GAN Enhancement.

4.2 Benefits

The following items constitute a non-exhaustive list of benefits that may characterize the proposals on GAN Enhancements:

- PS Optimization independent of CS Changes.
- Support the services/network deployed with GPRS APNs.
- No impact on 3GPP TS 24.008 [4].
- Minimize the load on existing network elements (e.g. HLR).

4.3 For further investigation

The following items require further investigation:

- Whether "Enhanced GAN" Terminals shall support GAN specified in 3GPP Rel-6 and Rel-7.
- Whether there is any limitations induced by LLC protocol.

5 Architecture alternatives

5.1 A/Gn based architectures

5.1.1 Enhanced Up

5.1.1.1 Architecture

Figure 1 shows the architecture of enhanced Up solution. The CS domain remains unchanged and the PS domain is enhanced to increase the performance of the broadband data services.

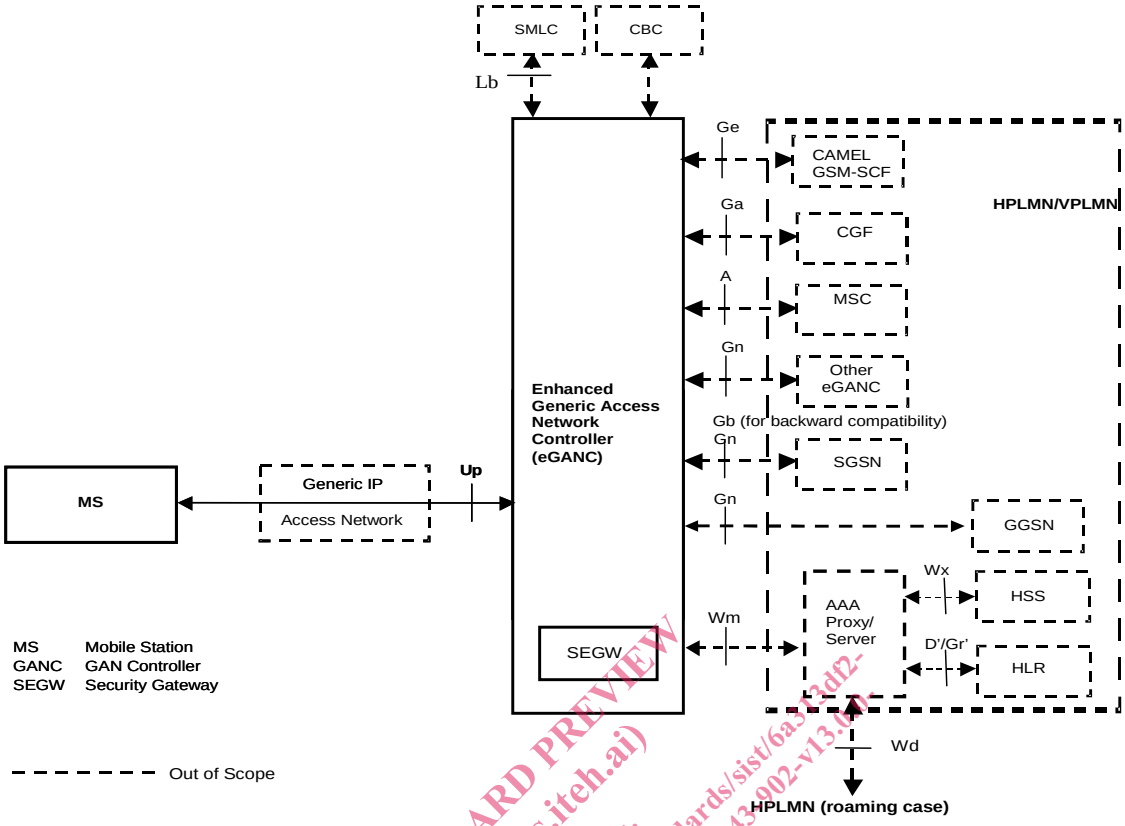

Figure 1: Enhanced Up A/Gn solution architecture

EGANC is a combination of legacy GANC and part of SGSN functionalities. The EGANC provides the Gn reference point and enhanced Up reference point for enhanced PS efficiency and performance.

- Gn reference point: This reference point to GGSN removes one node in the path for PS services, hence reducing the latency and overhead. It also moves the EGANC close to the core network, making the GERAN/UTRAN radio-specific procedures unnecessary in the EGANC.
- Enhanced Up reference point: This reference point removes the unnecessary protocol stacks between UE and the EGANC, hence enhancing the performance of the PS services. The Up reference point for CS domain remains unchanged so that all the current procedures keep working. The legacy Up reference point for PS domain is also supported for backward compatibility.

The main features of the architecture are as follows:

- No changes to CS domain - reuse of A interface.
- Reuse of Up procedures for authentication, security, discovery/registration. -reuse of Wm interface.
- This proposal only affects the PS domain.
- Direct connectivity to GGSN via unchanged Gn per 3GPP TS 29.060 [5].
- New Enhanced Up protocol for PS domain.
- GA-PSR and 3GPP TS 24.008 [4] MM/SM are not used in PS EGAN mode.
- Single enhanced Up PS stack in the terminal for 2G and 3G networks and terminals environment.
- Gb is kept for backward compatibility with R6 GAN terminals.