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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
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Contents

Foreword

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

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1 Scope

This document covers the architectural requirements for 3GPP systems based on UTRAN, E-UTRAN and Iu mode GERAN. In particular it details the high level requirements for the Circuit Switched (CS) Domain and the stage 2 procedures that span more than one domain/subsystem. The reference model to which these procedures apply can be found within TS 23.002 [1]. In addition, A mode to Iu mode handover for CS services is addressed. Detailed architectural requirements within the subsystems are contained within the remainder of the 23 series of specifications e.g. the requirements for the Packet Switched (PS) domain are contained within TS 23.060 [2], TS 23.401 [27] and the requirements for the Bearer Independent CS Core Network are contained in TS 23.205[14].

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 23.060: "General Packet Radio Service (GPRS) Service description; Stage 2".

[3] 3GPP TS 23.012: "Location management procedures".

[5] 3GPP TS 25.331: "Radio Resource Control (RRC) Protocol Specification".

[6] 3GPP TS 25.301: "Radio interface protocol architecture".

[7] 3GPP TS 25.303: "UE functions and inter-layer procedures in connected mode".

[8] 3GPP TR 21.905: "3G Vocabulary".

[9] 3GPP TS 25.413: "UTRAN Iu interface RANAP signalling".

[10] 3GPP TS 25.410: "UTRAN Iu Interface: General Aspects and Principles".

[11] 3GPP TS 23.228: "IP Multimedia Subsystem – Stage 2".

[12] 3GPP TS 43.051: "GERAN Overall Description".

[13] 3GPP TS 23.153: "Out of Band Transcoder Control - Stage 2".

[14] 3GPP TS 23.205: "Bearer Independent CS Core Network – Stage 2".

[15] 3GPP TR 25.931: "UTRAN Functions, examples on signalling procedures".

[16] RFC 2766: "Network Address Translation - Protocol Translation (NAT-PT)", G. Tsirtsis, P. Srisuresh. February 2000.

[17] RFC 2893: "Transition Mechanisms for IPv6 Hosts and Routers", R. Gilligan, E. Nordmark, August 2000.

[17a] RFC 4941: "Privacy Extensions for Stateless Address Autoconfiguration in IPv6", T. Narten, R. Daves, S. Krishnan, September 2007.

[18] 3GPP TS 25.401: "UTRAN Overall Description".

[19] 3GPP TS 25.304: "UE Procedures in Idle Mode and Procedures for Cell Reselection in Connected Mode".

[20] 3GPP TS 45.008: "Radio subsystem link control".

[21] RFC3316: "IPv6 for Some Second and Third Generation Cellular Hosts", June 2002.

[22] 3GPP TS 24.007: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface signalling layer 3 General aspects".

[23] 3GPP TS 24.229: "IP Multimedia Call Control Protocol based on SIP and SDP".

[24] 3GPP TS 23.008: "Organisation of subscriber data".

[25] 3GPP TS 24.008: "Mobile radio interface Layer 3 specification; Core network protocols; Stage 3".

[26] 3GPP TR 23.981: "Interworking aspects and migration scenarios for IPv4 based IMS implementations".

[27] 3GPP TS 23.401: "General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access".

[28] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access (E-UTRAN); Overall description; Stage 2".

[29] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".

[30] 3GPP TS 23.272: "Circuit Switched Fallback in Evolved Packet System; Stage 2".

[31] 3GPP TS 23.292: "IP Multimedia Subsystem (IMS) Centralized Services".

[32] 3GPP TS 23.237: "IP Multimedia Subsystem (IMS) Service Continuity".

[33] 3GPP TS 23.167: "IP Multimedia Subsystem (IMS) emergency sessions".

[34] 3GPP TS 24.301: "Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3".

[35] 3GPP TS 23.216: "Single Radio Voice Call Continuity (SRVCC); Stage 2".

[36] 3GPP TR 23.975: "IPv6 Migration Guidelines".

[37] 3GPP TS 29.061: "Interworking between the Public Land Mobile Network (PLMN) supporting packet based services and Packet Data Networks (PDN)".

[38] 3GPP TS 23.682: "Architecture Enhancements to facilitate communications with Packet Data Networks and Applications".

[39] 3GPP TS 22.011: "Service accessibility".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms defined in TR 21.905 [8] apply, in addition, the following terms apply:

3GPP PS Data Off Exempt Services: For PDN Connection or PDU Session of type IP, up to two sets of operator services (i.e. the exempt services enumerated in clause 10.2 of TS 22.011 [39], including the signalling used to enable such services) that are allowed even if the 3GPP PS Data Off status set to active in the UE by the user. One set is used when UE is in HPLMN, the other set is used when UE is roaming in VPLMN. For PDN connection of type non-IP, or PDU Session of type Ethernet or Unstructured, no 3GPP Data Off Exempt Service is defined.

In Iu mode: see TR 21.905 [8].

In A/Gb mode: see TR 21.905 [8].

RAN: within this document, the term RAN (Radio Access Network) is used to refer to UTRAN and/or GERAN in Iu mode and/or E-UTRAN.

For the purposes of the present document, the following terms and definitions given in TS 22.011 [39] apply:

3GPP PS Data Off: See TS 22.011 [39].

3.2 Symbols

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

3.3 Abbreviations

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

ATM	Asynchronous Transfer Mode
CM	Connection Management
CN	Core Network
CS	Circuit Switched
CSCF	Call/Session Control Function
CSFB	Circuit Switched Fallback
CS-MGW	Circuit Switched Media Gateway
DHCP	Dynamic Host Configuration Protocol
EPS	Evolved Packet System
E-UTRAN	Evolved UMTS Terrestrial Radio Access Network
GERAN	GSM/EDGE Radio Access Network
GGSN	Gateway GPRS Support Node
GPRS	General Packet Radio Service
GTP	GPRS Tunnelling Protocol
HLR	Home Location Register
IM	IP Multimedia
IMS	IP Multimedia Subsystem
IMSI	International Mobile Subscriber Identity
IP	Internet Protocol
IPSec	IP Security protocol
LA	Location Area
LAC	Location Area Code
LAN	Local Area Network
LLC	Logical Link Control
LM	Location Management
MAP	Mobile Application Part
MGCF	Media Gateway Control Function
MGW	Media Gateway
MM	Mobility Management
MME	Mobility Management Entity
MRF	Media Resource Function
MSC	Mobile Switching Centre
NAT	Network Address Translator
NGN	Next Generation Networks
OoBTC	Out of Band Transcoder Control
P-GW	PDN Gateway
PDA	Personal Digital Assistant
PDP	Packet Data Protocol
PLMN	Public Land Mobile Network
PS	Packet Switched
RA	Routing Area
RAC	Routing Area Code
RAI	Routing Area Identifier
RAN	Radio Access Network
RANAP	Radio Access Network Application Part

RLC	Radio Link Control
RNC	Radio Network Controller
RNTI	Radio Network Temporary Identifier
RRC	Radio Resource Control
S-GW	Serving Gateway
SGSN	Serving GPRS Support Node
SGW	Signalling gateway
SIP	Session Initiation Protocol
SRNS	Serving Radio Network Subsystem
SS7	Signalling System No. 7
STM	Synchronous Transfer Mode
SRNS	Serving Radio Network Subsystem
TCP	Transmission Control Protocol
TMSI	Temporary Mobile Station Identifier
TrFO	Transcoder Free Operation
UDP	User Datagram Protocol
UE	User Equipment
UMTS	Universal Mobile Telecommunications System
URA	UTRAN Registration Area
UTRAN	UMTS Terrestrial Radio Access Network
VHE	Virtual Home Environment
VLR	Visited Location Register

4 3GPP system domains and subsystems

4.1 Allowed network and terminal configurations

A 3GPP network is divided into a radio AN and a CN, which are connected via an open interface over the Iu or S1 or A/Gb reference point(s). The A/Gb mode is not further described in this specification. Furthermore, the core network is from a functional point of view divided into a PS Domain, IM Subsystem and a CS Domain (see TS 23.002 [1]). Any deployment of the IM subsystem requires a PS domain.

The following network configurations shall be allowed:

a) networks which provide the functionality of CS Domain and PS Domain (and optionally IM Subsystem);

b) networks which only provide the functionality of the CS Domain (only with GERAN or UTRAN access);

c) networks which only provide the functionality of the PS Domain (and optionally IM Subsystem).

The following terminal configurations shall be allowed:

a) terminals which are able to access both to the CS Domain and PS Domain (and optionally IM Subsystem);

b) terminals which are only able to access to the PS Domain (and optionally IM Subsystem);

c) terminals which are only able to access to the CS Domain.

It shall be noted that a terminal which is only able to access to e.g. the PS Domain supports only mobility management, protocols etc. of that domain. The different configurations given above shall not prevent CS-type services from being delivered over the PS domain.

4.2 Circuit switched (CS) core network domain

4.2.1 Iu mode to Iu mode handover for circuit switched services

For Iu mode to Iu mode Inter-MSC Hand-Over / SRNS relocation the MAP E interface transporting RANAP messages shall be used. Alternatively, in the case of intra-PLMN handover, the GSM to UMTS inter-system handover or SRNS relocation between two MSC-areas may be executed as intra-MSC inter-system handover or SRNS relocation respectively. In such a case this will be performed by utilising a direct SCCP connection between the target RNC located in the target MSC-area and the MSC server already involved in the call.

For handover of circuit-switched services involving the change of CN equipment (only CS-MGW or CS-MGW and MSC-server) the anchor principle shall be applied.

- The first MSC Server involved in a call will become the Anchor MSC Server for this call during and after handover, and will remain in the call until the call is released. Every subsequent handover (Intra and Inter) will be controlled by this MSC Server.

- The first CS-MGW involved in a call will become the Anchor CS-MGW for this call during and after handover , and will remain in the call until the call is released. The Nc interface is anchored in the CS-MGW, the correlation between CS-MGW to PSTN and the CS-MGW to RAN remain fixed until the call is released.

4.2.2 A mode to Iu mode handover for CS services

For A mode to Iu mode inter-system Inter-MSC Hand-Over (GSM to UMTS) the MAP E interface transporting BSSMAP messages shall be used. As a network option, in the case of intra-PLMN inter-system handover from A mode to Iu mode, the handover between two MSC-areas may be executed as:

- intra-MSC handover, if the serving BSS is connected to the Anchor MSC; or

- subsequent intra-MSC handover or subsequent inter-MSC handover back to the Anchor MSC Server, if the serving BSS is connected to an MSC-B. The decision between these two alternatives is implementation and network configuration dependent.

The procedure will be performed by utilising a direct SCCP connection between the target RNC located in the target MSC-area and the Anchor MSC or MSC-B, respectively.

4.2.3 General principles for use of CS-MGW resources

The following principles for use of CS-MGW resources apply:

1. it shall not be necessary to have the CS-MGW co-located with the MSC Server;
2. the CS-MGW resources need not be associated with any particular MSC Server (see note 1);
3. it shall be possible for any MSC Server to request resources of any CS-MGW in the network (see note 1);
4. it shall be possible for an RNC to connect to the CS-MGW indicated by the MSC server;

Note 1: For points 2 and 3 above, issues related to O&M procedures such as where notification of restart of a CS-MGW should be sent to, need to be considered. Extensions to H.248 may be required.

The specification of the Bearer Independent CS CN which uses the CS-MGW is in TS 23.205 [14].

4.2.4 Transcoder location

The transcoders are located in the core network. They may be located in the CS-MGW at the border to the RAN (i.e. the CS-MGW at the Iu interface) or at the CS-MGW at the edge of the core network (e.g. at the edge towards the PSTN/ISDN), TS 23.153 [13].

4.3 Packet Switched (PS) core network domain

The requirements for the GPRS PS domain are in TS 23.060 [2] and for the EPS PS domain in TS 23.401 [27].

4.4 IP Multimedia subsystem (IMS)

The requirements for the IMS are in TS 23.228 [11].

4.5 Cross Core Network Domain Requirements

The specifications shall support the option of IP transport for the MAP and CAP based interfaces

4.6 UTRAN

The requirements for the UTRAN are in the 3GPP 25-series of specifications. An overview can be found in TS 25.401 [18].

4.7 GERAN

The requirements for the GERAN are in TS 43.051 [12]

4.8 E-UTRAN

The requirements for the E-UTRAN are in the 3GPP 36-series of specifications. An overview can be found in TS 36.300 [28].

5 IP addressing

5.1 IP version issues

The EPS/UMTS/GSM architecture shall support IPv4 / IPv6 based on the statements below.

- IP transport between network elements of the IP Connectivity services (between RNC, SGSN, GGSN, eNodeB, MME, S-GW, and P-GW) and IP transport for the CS Domain: both IPv4 and IPv6 are options for IP Connectivity.

- For UEs used for Machine-Type Communications (MTC) IPv6 addressing as described in TS 23.401 [27] and TS 23.060 [2] should be the primary mechanism for IP addressing. IPv4 based addressing is considered a transition solution and is deprecated for MTC used over 3GPP accesses.

For implementation guidelines related to transition and other aspects of IPv4 address usage see Annex B.

- IM CN subsystem elements (UE to CSCF and the other elements e.g. MRF):

  - The architecture should make optimum use of IPv6.

  - 3GPP specifications design the IM CN subsystem elements and interfaces to support both IPv4 and IPv6. In the case the UE supports IPv4, the guidelines and recommendations in TR 23.981 [26] should be followed.

  - The UE may support IPv4 only, IPv6 only or both for the connection to the IM CN subsystem. In the case the UE supports IPv4, the guidelines and recommendations in TR 23.981 [26] should be followed.

  - According to the procedures defined in TS 23.060 [2] and/or TS 23.401 [27], when a UE is assigned an IPv6 prefix, it can change the global IPv6 address it is currently using via the mechanism defined in RFC 4941 [17a], or similar means.

- Access to existing data services (Intranet, Internet,…):

- The UE can access IPv4 and IPv6 based services.

5.2 Interoperability between IPv4 and IPv6 networks

Since the UE can access both IPv4 and IPv6 based services, situations may arise where interworking is needed to interoperate with IPv4 and IPv6 networks. This clause describes three different interworking scenarios: UE is IPv4 and IPv6 capable, IPv6 only UE, and IPv6 UE connected via IPv4 network to an IPv6 device. These scenarios are examples of IPv6 and IPv4 interworking. The scenarios presented below only considered cases of a Transition Gateway (TrGW) for generic services and specialist services may require additional functionally at the application level.

In addition to the following subsections, Annex B describes additional guidelines for interoperability if such function is required (e.g. IMS, MTC).