

ETSI TS 101 376-3-23 V3.3.1 (2012-12)



**GEO-Mobile Radio Interface Specifications (Release 3);
Third Generation Satellite Packet Radio Service;
Part 3: Network specifications;
Sub-part 23: Radio Access Network;
Overall description - Stage 2;
GMR-1 3G 43.051**

Reference

RTS/SES-00328-3-23

Keywords

3G, earth station, GMPRS, GMR, GPRS, GSM,
GSO, MES, mobile, MSS, radio, satellite

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

Important notice

Individual copies of the present document can be downloaded from:

<http://www.etsi.org>

The present document may be made available in more than one electronic version or in print. In any case of existing or perceived difference in contents between such versions, the reference version is the Portable Document Format (PDF). In case of dispute, the reference shall be the printing on ETSI printers of the PDF version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at

<http://portal.etsi.org/tb/status/status.asp>

If you find errors in the present document, please send your comment to one of the following services:

http://portal.etsi.org/chaicor/ETSI_support.asp

Copyright Notification

No part may be reproduced except as authorized by written permission.
The copyright and the foregoing restriction extend to reproduction in all media.

© European Telecommunications Standards Institute 2012.
All rights reserved.

DECT™, PLUGTESTS™, UMTS™ and the ETSI logo are Trade Marks of ETSI registered for the benefit of its Members.
3GPP™ and LTE™ are Trade Marks of ETSI registered for the benefit of its Members and
of the 3GPP Organizational Partners.

GSM® and the GSM logo are Trade Marks registered and owned by the GSM Association.

Contents

Intellectual Property Rights	6
Foreword.....	6
Introduction	7
1 Scope	9
2 References	9
2.1 Normative references	9
2.2 Informative references.....	11
3 Symbols and abbreviations.....	11
3.1 Symbols.....	11
3.2 Abbreviations	11
4 Satellite GERAN Architecture	13
4.1 Satellite GERAN Reference Architecture	13
4.2 UMTS Architecture applied to Satellite GERAN	13
4.3 Protocol architecture in PS domain	14
4.3.1 General.....	14
4.3.2 User plane	15
4.3.3 Control plane	15
4.4 Protocol architecture in CS domain.....	16
4.5 Iur-g interface.....	16
4.6 Support for MSC/SGSN in pool.....	16
4.7 CS services for Satellite GERAN Iu-mode	16
4.8 User Equipment Specific Behaviour Information (UESBI) in Satellite GERAN Iu mode	17
5 Radio Interface Protocol Architecture.....	17
5.1 Protocol Structure when connecting through Iu	17
5.2 Multiplexing Principles	18
5.2.1 Multiplexing of different types of radio access bearers for one MES.....	18
5.2.2 Multiplexing of user plane data from different core network interfaces.....	19
5.3 <i>Iu</i> vs <i>A/Gb mode</i> selection.....	19
5.3.1 Introduction.....	19
5.3.2 PLMN, cell and mode (re-)selection in Satellite GERAN	20
6 User and Control Plane Protocols	20
6.1 Identifiers in Satellite GERAN.....	20
6.1.1 IMSI, TMSI and P-TMSI.....	20
6.1.2 G-RNTI.....	20
6.1.3 NSAPI, RAB ID and RB ID	20
6.1.4 RB Id, RRB Id, and TFI.....	21
6.1.5 USF.....	21
6.1.6 SAI.....	21
6.1.7 BSC-id	21
6.1.8 LAI for 3G core network	21
6.1.9 RAI for the 3G core network	22
6.1.10 GRA Identity	22
6.1.11 Satellite GERAN internal Cell Identity	22
6.2 Relay	22
6.3 Radio Resource Control (RRC).....	22
6.3.1 RRC Functions.....	22
6.3.2 RRC Connection Levels	23
6.3.3 RRC Connection Modes	24
6.3.4 RRC Connection Mobility	24
6.3.4.1 RRC Connection mobility in RRC-Idle mode	24
6.3.4.2 RRC Connection mobility in RRC-Connected mode.....	24
6.3.5 RRC protocol and messages	24

6.3.6	Support of Radio Bearers in Satellite GERAN	25
6.4	Packet Data Convergence Protocol (PDCP).....	25
6.4.1	Services provided to upper layers	25
6.4.2	Services expected from RLC layer	25
6.4.3	PDCP Functions.....	25
6.4.3.1	Transparent Mode	25
6.4.3.2	Non-Transparent Mode	26
6.5	Radio Link Control (RLC)	26
6.5.1	Services provided to upper layer.....	26
6.5.2	RLC Functions.....	27
6.5.2.1	Transparent Mode	27
6.5.2.2	Non-Transparent Mode	27
6.5.2.2.1	Acknowledged Mode.....	27
6.5.2.2.2	Unacknowledged Mode.....	27
6.6	Medium Access Control (MAC)	27
6.6.1	Services provided to upper layers	28
6.6.2	MAC Functions	28
6.6.2.1	Additional functions for RLC transparent mode.....	28
6.6.2.2	Additional functions for RLC non-transparent mode.....	28
6.6.3	Model of MAC	29
6.6.4	MAC operation	30
6.6.4.1	General	30
6.6.4.1.1	TBF Modes.....	31
6.6.4.2	TBF establishment	31
6.6.4.2.0	General	31
6.6.4.2.1	Uplink resource request from MAC-Idle state	32
6.6.4.3	TBF multiplexing and scheduling	33
6.6.4.3.1	Multiplexing of RLC instances on TBFs.....	33
6.6.4.3.2	Scheduling of TBFs on physical-layer resources	33
6.6.4.4	TBF release	33
6.6.4.5	TBF reallocation	34
6.7	RLC/MAC PDU Formats for different protocol modes	34
6.7.1	Acknowledged RLC mode.....	34
6.7.2	Unacknowledged RLC mode.....	34
6.7.3	Transparent RLC mode.....	34
6.8	Physical Layer (Phy)	34
6.8.1	Definitions	34
6.8.2	Services provided to upper layer.....	35
6.8.2.1	Specific services of the physical layer in the MES	35
6.8.3	Logical Channels	35
6.8.3.1	Traffic channels.....	35
6.8.3.2	Control channels	35
6.8.3.2.1	Broadcast channels.....	35
6.8.3.2.2	Common control type channels	35
6.8.3.2.3	Dedicated control channels.....	36
6.8.3.2.4	Cell Broadcast Channel (CBCH).....	36
6.8.4	Physical Channels	36
6.8.4.1	DCH - Dedicated Physical CHannel	36
6.8.4.2	PDCH - Packet Data physical CHannel	36
6.8.5	Mapping of logical channels onto physical channels.....	36
6.8.5.1	DCH.....	36
6.8.5.2	Void.....	36
6.8.5.3	PDCH.....	36
6.8.6	Physical Layer Functions	36
6.8.7	Channel Coding	37
6.8.8	Void	37
6.9	Flexible Layer One (FLO).....	37
7	Ciphering	37
7.1	Location of ciphering in the Satellite GERAN protocol architecture.....	37
7.2	Inputs to the ciphering algorithm	38
7.2.1	Ciphering Key.....	38

7.2.2	Bearer.....	38
7.2.3	Direction	38
7.2.4	Length.....	38
7.2.5	Parameter Settings	38
8	Integrity protection.....	39
8.1	Integrity protection on RRC messages	39
8.2	Integrity protection on RLC/MAC control messages	39
8.3	Calculation of message authentication code.....	39
9	Mobility Management and Session Management (MM and SM).....	39
10	Void.....	39
Annex A (informative): Radio Access Bearer Realization.....		40
A.1	Conversational Radio Access Bearer	40
A.2	Streaming, Interactive, Background Radio Access Bearers	40
Annex B (informative): RLC/MAC Header format Convention		41
Annex C (informative): RRC States, MAC States and RRC Connection Mobility.....		42
C.1	Void.....	42
C.2	MAC states	42
C.3	Mapping between RRC States and MAC States	42
Annex D (informative): Bibliography		44
History		45

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://ipr.etsi.org>).

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 Technical Committee Satellite Earth Stations and Systems (SES).

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

Version 3.m.n

where:

- the third digit (n) is incremented when editorial only changes have been incorporated in the specification;
- the second digit (m) is incremented for all other types of changes, i.e. technical enhancements, corrections, updates, etc.

The present document is part 3, sub-part 23 of a multi-part deliverable covering the GEO-Mobile Radio Interface Specifications (Release 3); Third Generation Satellite Packet Radio Service, as identified below:

Part 1: "General specifications";

Part 2: "Service specifications";

Part 3: "Network specifications";

Sub-part 1: "Network Functions; GMR-1 03.001";

Sub-part 2: "Network Architecture; GMR-1 03.002";

Sub-part 3: "Numbering, addressing and identification; GMR-1 23.003";

Sub-part 4: "Organization of Subscriber Data; GMR-1 03.008";

Sub-part 5: "Technical realization of Supplementary Services; GMR-1 03.011";

Sub-part 6: "Location Registration and Position Identification Procedures; GMR-1 03.012";

Sub-part 7: "Discontinuous Reception (DRX); GMR-1 03.013";

Sub-part 8: "Support of Dual-Tone Multifrequency Signalling (DTMF); GMR-1 03.014";

Sub-part 9: "Security related Network Functions; GMR-1 03.020";

Sub-part 10: "Functions related to Mobile Earth Station (MES) in idle mode; GMR-1 3G 43.022";

Sub-part 11: "Technical realization of the Short Message Service (SMS) Point-to-Point (PP); GMR-1 03.040";

- Sub-part 12: "Technical realization of the Short Message Service Cell Broadcast (SMSCB); GMR-1 03.041";
- Sub-part 13: "Technical realization of group 3 facsimile using transparent mode of transmission; GMR-1 03.045";
- Sub-part 14: Transmission Planning Aspects of the Speech Service in the GMR-1 system; GMR-1 03.050";
- Sub-part 15: "Line Identification supplementary service - Stage 2; GMR-1 03.081";
- Sub-part 16: "Call Barring (CB) supplementary services - Stage 2; GMR-1 03.088";
- Sub-part 17: "Unstructured Supplementary Service Data (USSD) - Stage 2; GMR-1 03.290";
- Sub-part 18: "Terminal-to-Terminal Call (TtT); GMR-1 03.296";
- Sub-part 19: "Optimal Routing technical realization; GMPRS-1 03.297";
- Sub-part 20: "Technical realization of High-Penetration Alerting; GMR-1 03.298";
- Sub-part 21: "Position Reporting services; Stage 2 Service description; GMR-1 03.299";
- Sub-part 22: "Overall description of the GMPRS radio interface; Stage 2; GMR-1 3G 43.064";
- Sub-part 23: "Radio Access Network; Overall description - Stage 2; GMR-1 3G 43.051";**
- Part 4: "Radio interface protocol specifications";
- Part 5: "Radio interface physical layer specifications";
- Part 6: "Speech coding specifications";
- Part 7: "Terminal adaptor specifications".

Introduction

GMR stands for GEO (Geostationary Earth Orbit) Mobile Radio interface, which is used for Mobile Satellite Services (MSS) utilizing geostationary satellite(s). GMR is derived from the terrestrial digital cellular standard GSM and supports access to GSM core networks.

The present document is part of the GMR Release 3 specifications. Release 3 specifications are identified in the title and can also be identified by the version number:

- Release 1 specifications have a GMR 1 prefix in the title and a version number starting with "1" (V1.x.x).
- Release 2 specifications have a GMPRS 1 prefix in the title and a version number starting with "2" (V2.x.x).
- Release 3 specifications have a GMR-1 3G prefix in the title and a version number starting with "3" (V3.x.x).

The GMR release 1 specifications introduce the GEO Mobile Radio interface specifications for circuit mode Mobile Satellite Services (MSS) utilizing geostationary satellite(s). GMR release 1 is derived from the terrestrial digital cellular standard GSM (phase 2) and it supports access to GSM core networks.

The GMR release 2 specifications add packet mode services to GMR release 1. The GMR release 2 specifications introduce the GEO Mobile Packet Radio Service (GMPRS). GMPRS is derived from the terrestrial digital cellular standard GPRS (included in GSM Phase 2+) and it supports access to GSM/GPRS core networks.

The GMR release 3 specifications evolve packet mode services of GMR release 2 to 3rd generation UMTS compatible services. The GMR release 3 specifications introduce the GEO-Mobile Radio Third Generation (GMR-1 3G) service. Where applicable, GMR-1 3G is derived from the terrestrial digital cellular standard 3GPP and it supports access to 3GPP core networks.

Due to the differences between terrestrial and satellite channels, some modifications to the GSM or 3GPP standard are necessary. Some GSM and 3GPP specifications are directly applicable, whereas others are applicable with modifications. Similarly, some GSM and 3GPP specifications do not apply, while some GMR specifications have no corresponding GSM or 3GPP specification.

Since GMR is derived from GSM and 3GPP, the organization of the GMR specifications closely follows that of GSM or 3GPP as appropriate. The GMR numbers have been designed to correspond to the GSM and 3GPP numbering system. All GMR specifications are allocated a unique GMR number. This GMR number has a different prefix for Release 2 and Release 3 specifications as follows:

- Release 1: GMR n xx.zyy
- Release 2: GMPRS n xx.zyy
- Release 3: GMR-1 3G xx.zyy

where:

- xx.0yy ($z = 0$) is used for GMR specifications that have a corresponding GSM or 3GPP specification. In this case, the numbers xx and yy correspond to the GSM or 3GPP numbering scheme.
- xx.2yy ($z = 2$) is used for GMR specifications that do not correspond to a GSM or 3GPP specification. In this case, only the number xx corresponds to the GSM or 3GPP numbering scheme and the number yy is allocated by GMR.
- n denotes the first ($n = 1$) or second ($n = 2$) family of GMR specifications.

A GMR system is defined by the combination of a family of GMR specifications and GSM and 3GPP specifications as follows:

- If a GMR specification exists it takes precedence over the corresponding GSM or 3GPP specification (if any). This precedence rule applies to any references in the corresponding GSM or 3GPP specifications.

NOTE: Any references to GSM or 3GPP specifications within the GMR or 3GPP specifications are not subject to this precedence rule. For example, a GMR or 3GPP specification may contain specific references to the corresponding GSM or 3GPP specification.

- If a GMR specification does not exist, the corresponding GSM or 3GPP specification may or may not apply. The applicability of the GSM or 3GPP specifications is defined in TS 101 376-1-2 [7].

The clause numbering and the table numbering and figure numbering in the present document are aligned to the corresponding numbering of TS 143 051 [i.1] as far as possible. In several places, this means that the table numbering and figure numbering is non-continuous in the present document in order to maintain this alignment, the following rules apply:

- A table that uses the same table number replaces the corresponding table in TS 143 051 [i.1];
- A table that uses a different table number is a new additional table.

1 Scope

The present document defines the stage 2 service description for the GMR-1 3rd Generation Satellite Radio Access Network. This 3rd Generation Satellite Radio Access Network is functionally equivalent to a GSM/EDGE Radio Network (GERAN). The term Satellite GERAN is used interchangeably with 3rd Generation Satellite Radio Access Network in the present document.

The present document illustrates how the services requested by a GSM/UMTS Core Network are realized by the 3rd Generation Satellite Radio Access Network.

The main focus of the present document is on functionality related to the Iu interfaces. The aim of the present document is not to describe functionality related to the A and Gb interfaces in details. There is no detailed description of the interfaces towards the core network and only references are given to the appropriate specifications.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <http://docbox.etsi.org/Reference>.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are necessary for the application of the present document.

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 Release 7 or to the latest version of that document in the latest release less than 7.

In the case of a reference to a GMR-1 3G document, a non-specific reference implicitly refers to the latest version of that document in the same Release as the present document.

- [1] ETSI TS 125 410: "Universal Mobile Telecommunications System (UMTS); UTRAN Iu interface: General aspects and principles (3GPP TS 25.410)".
- [2] ETSI TS 125 411: "Universal Mobile Telecommunications System (UMTS); UTRAN Iu interface layer 1 (3GPP TS 25.411)".
- [3] ETSI TS 125 412: "Universal Mobile Telecommunications System (UMTS); UTRAN Iu interface signalling transport (3GPP TS 25.412)".
- [4] ETSI TS 125 413: "Universal Mobile Telecommunications System (UMTS); UTRAN Iu interface Radio Access Network Application Part (RANAP) signalling (3GPP TS 25.413)".
- [5] ETSI TS 125 414: "Universal Mobile Telecommunications System (UMTS); UTRAN Iu interface data transport and transport signalling (3GPP TS 25.414)".
- [6] ETSI TS 125 415: "Universal Mobile Telecommunications System (UMTS); UTRAN Iu interface user plane protocols (3GPP TS 25.415)".
- [7] ETSI TS 101 376-1-2: "GEO-Mobile Radio Interface Specifications (Release 3); Third Generation Satellite Packet Radio Service; Part 1: General specifications; Sub-part 2: Introduction to the GMR-1 family; GMR-1 3G 41.201".
- [8] Void.

- [9] ETSI TS 101 376-1-1: "GEO-Mobile Radio Interface Specifications (Release 2) General Packet Radio Service; Part 1: General specifications; Sub-part 1: Abbreviations and acronyms; GMPRS-1 01.004".

NOTE: This is a reference to a GMR-1 Release 2 specification. See the introduction for more details.

- [10] ETSI TS 101 376-5-1: "GEO-Mobile Radio Interface Specifications (Release 1); Part 5: Radio interface physical layer specifications; Sub-part 1: Physical Layer on the Radio Path: General Description; GMR-1 05.001".

NOTE: This is a reference to a GMR-1 Release 1 specification. See the introduction for more details.

- [11] ETSI TS 101 376-5-2: "GEO-Mobile Radio Interface Specifications (Release 3); Third Generation Satellite Packet Radio Service; Part 5: Radio interface physical layer specifications; Sub-part 2: Multiplexing and Multiple Access; Stage 2 Service Description; GMR-1 3G 45.002".

- [12] ETSI TS 101 376-5-3: "GEO-Mobile Radio Interface Specifications (Release 3); Third Generation Satellite Packet Radio Service; Part 5: Radio interface physical layer specifications; Sub-part 3: Channel Coding; GMR-1 3G 45.003".

- [13] ETSI TS 123 110: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); UMTS Access Stratum Services and Functions (3GPP TS 23.110)".

- [14] ETSI TS 101 376-4-7: "GEO-Mobile Radio Interface Specifications (Release 3); Third Generation Satellite Packet Radio Service; Part 4: Radio interface protocol specifications; Sub-part 7: Mobile Radio Interface Signalling Layer 3 General Aspects; GMR-1 3G 24.007".

- [15] ETSI TS 123 107: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Quality of Service (QoS) concept and architecture (3GPP TS 23.107)".

- [16] ETSI TS 125 323: "Universal Mobile Telecommunications System (UMTS); Packet Data Convergence Protocol (PDCP) specification (3GPP TS 25.323)".

- [17] ETSI TS 133 102: "Universal Mobile Telecommunications System (UMTS); 3G security; Security architecture (3GPP TS 33.102)".

- [18] ETSI TS 101 376-4-12: "GEO-Mobile Radio Interface Specifications (Release 3); Third Generation Satellite Packet Radio Service; Part 4: Radio interface protocol specifications; Sub-part 12: Mobile Earth Station (MES) - Base Station System (BSS) interface; Radio Link Control/Medium Access Control (RLC/MAC) protocol; GMR-1 3G 44.060".

- [19] ETSI TS 101 376-4-13: "GEO-Mobile Radio Interface Specifications (Release 3); Third Generation Satellite Packet Radio Service; Part 4: Radio interface protocol specifications; Sub-part 13: Radio Resource Control (RRC) protocol; Iu Mode; GMR-1 3G 44.118".

- [20] ETSI TS 101 376-4-14: "GEO-Mobile Radio Interface Specifications (Release 3); Third Generation Satellite Packet Radio Service; Part 4: Radio interface protocol specifications; Sub-part 14: Mobile Earth Station (MES) - Base Station System (BSS) interface; Radio Link Control/Medium Access Control (RLC/MAC) protocol; Iu Mode; GMR-1 3G 44.160".

- [21] ETSI TS 101 376-4-8: "GEO-Mobile Radio Interface Specifications (Release 3); Third Generation Satellite Packet Radio Service; Part 4: Radio interface protocol specifications; Sub-part 8: Mobile Radio Interface Layer 3 Specifications; GMR-1 3G 44.008".

- [22] ETSI TS 101 376-3-10: "GEO-Mobile Radio Interface Specifications (Release 3); Third Generation Satellite Packet Radio Service; Part 3: Network specifications; Sub-part 10: Functions related to Mobile Earth Station (MES) in idle mode; GMR-1 3G 43.022".

- [23] ETSI TS 101 376-5-5: "GEO-Mobile Radio Interface Specifications (Release 3); Third Generation Satellite Packet Radio Service; Part 5: Radio interface physical layer specifications; Sub-part 5: Radio Transmission and Reception; GMR-1 3G 45.005".

- [24] ETSI TS 144 018: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 specification; Radio Resource Control (RRC) protocol (3GPP TS 44.018)".
- [25] ETSI TS 124 008: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Mobile radio interface Layer 3 specification; Core network protocols; Stage 3 (3GPP TS 24.008)".
- [26] ETSI TS 123 060: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); General Packet Radio Service (GPRS); Service description; Stage 2 (3GPP TS 23.060)".
- [27] ETSI TS 101 376-5-6: "GEO-Mobile Radio Interface Specifications (Release 3); Third Generation Satellite Packet Radio Service; Part 5: Radio interface physical layer specifications; Sub-part 6: Radio Subsystem Link Control; GMR-1 3G 45.008".
- [28] ETSI TS 101 376-3-3: "GEO-Mobile Radio Interface Specifications (Release 3); Third Generation Satellite Packet Radio Service; Part 3: Network specifications; Sub-part 3: Numbering, addressing and identification; GMR-1 3G 23.003".
- [29] ETSI TS 143 064: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Overall description of the GPRS radio interface; Stage 2 (3GPP TS 43.064)".

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] ETSI TS 143 051: "Digital cellular telecommunications system (Phase 2+); GSM/EDGE Radio Access Network (GERAN) overall description; Stage 2 (3GPP TS 43.051)".
- [i.2] ITU-R Recommendation M.1035: "Framework for the radio interface(s) and radio sub-system functionality for International Mobile Telecommunications-2000 (IMT-2000)".
- [i.3] ETSI TR 121 905: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Vocabulary for 3GPP Specifications (3GPP TR 21.905)".

3 Symbols and abbreviations

3.1 Symbols

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

A	Interface between a Satellite BSS and a 2G MSC
Gb	Interface between a Satellite BSS and a 2G SGSN
GMR-1 3G	Interface between MES and Satellite BSS
Iu-cs	Interface between a Satellite BSS and a 3G MSC
Iu-ps	Interface between a Satellite BSS and a 3G SGSN
Iur-g	Interface between two Satellite BSSs

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TS 101 376-1-1 [9], TR 121 905 [i.3], TS 143 064 [29] and the following apply:

AS	Access Stratum
BCCH	Broadcast Control CHannel
BSS	Base Station Subsystem
CBCH	Cell Broadcast CHannel
CC	Call Control

CN	Core Network
DC	Dedicated Control
DCH	Dedicated physical CHannel
EDGE	Enhanced Data rates for Global Evolution
E-FACCH	Enhanced FACCH
E-TCH	Enhanced TCH
FACCH	Fast Associated Control CHannel
FLO	Flexible Layer One
GC	General Control
GERAN	GSM/EDGE Radio Access Network
GPRS	General Packet Radio Service
GRA	GERAN Registration Area
G-RNTI	GERAN Radio Network Temporary Identity
GSM	Global System for Mobile Communications
IETF	Internet Engineering Task Force
IMSI	International Mobile Subscriber Identity
IP	Internet Protocol
MAC	Medium Access Control
MM	Mobility Management
MES	Mobile Earth Station
NAS	Non Access Stratum
NSAPI	Network layer SAPI
Nt	Notification
O-TCH	Octal TCH
PBCCH	Packet BCCH
PDCH	Packet Data physical CHannel
PDCP	Packet Data Convergence Protocol
PDP	Packet Data Protocol
PDTCH	Packet Data TCH
PDU	Packet Data Unit
PLMN	Public Land Mobile Network
P-TMSI	Packet TMSI
QoS	Quality of Service
RAB	Radio Access Bearer
RANAP	Radio Access Network Application Part
RB	Radio Bearer
RLC	Radio Link Control
RNSAP	Radio Network Subsystem Application Part
ROHC	RObust Header Compression
RRC	Radio Resource Control
RTP	Real Time Protocol
SAP	Service Access Point
SAPI	Service Access Point Identifier
Satellite BSS	Satellite Base Station Subsystem
SDU	Service Data Unit
Satellite GERAN	Satellite GSM/EDGE Radio Access Network
S-RNTI	Serving Radio Network Temporary Identity
TB	Transport Block
TBF	Temporary Block Flow
TCH	Traffic CHannel
TCP	Transmission Control Protocol
TLLI	Temporary Logical Link Identifier
TMSI	Temporary Mobile Subscriber Identity
UDP	User Datagram Protocol
UESBI	UE Specific Behaviour Information
UMTS	Universal Mobile Telecommunication System
USF	Uplink State Flag
UTRAN	UMTS Terrestrial Radio Access Network

4 Satellite GERAN Architecture

4.1 Satellite GERAN Reference Architecture

The reference architecture of the Satellite GERAN is illustrated in figure 1.

The Satellite GERAN connects via Iu-PS interfaces to the core network. Any combination comprising one, two or three of these 3 interfaces is possible. Two Satellite Base Station Subsystems (Satellite BSS) may be connected to each other with an Iur-g interface. A Satellite BSS and an RNC may also be connected via an Iur-g interface.

The mobile earth station shall operate using **only the Iu mode**.

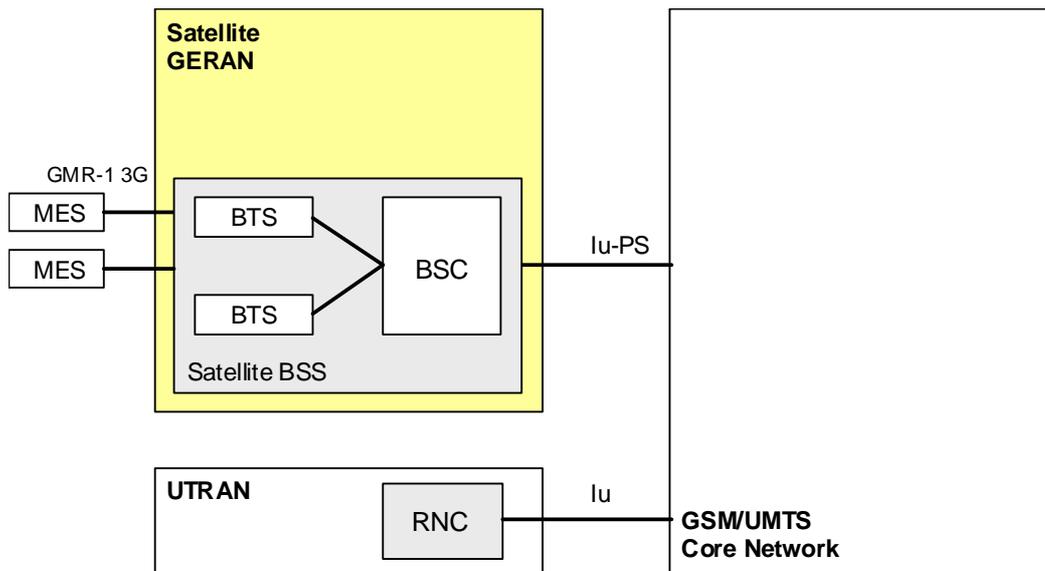


Figure 1: 3rd Generation Satellite Radio Access Network reference architecture

The functional split within a Satellite BSS is implementation-dependent.

4.2 UMTS Architecture applied to Satellite GERAN

This clause describes the Satellite GERAN architecture when it connects to the core network through an Iu interface. The assumed UMTS architecture as outlined in TS 123 110 [13]. Figure 2 shows the UMTS architecture applied to the Satellite GERAN in terms of its entities Mobile Earth Station, Satellite GERAN and Core Network. The respective reference points GMR-1 3G (Radio Interface) and Iu (CN-RAN reference) are shown. The figure illustrates furthermore the high-level functional grouping into the Access Stratum and the Non-Access Stratum.

The Access Stratum offers services through the following Service Access Points (SAP) to the Non-Access Stratum:

- General Control (GC) SAPs;
- Notification (Nt) SAPs; and
- Dedicated Control (DC) SAPs.

The SAPs are marked with circles in figure 2.

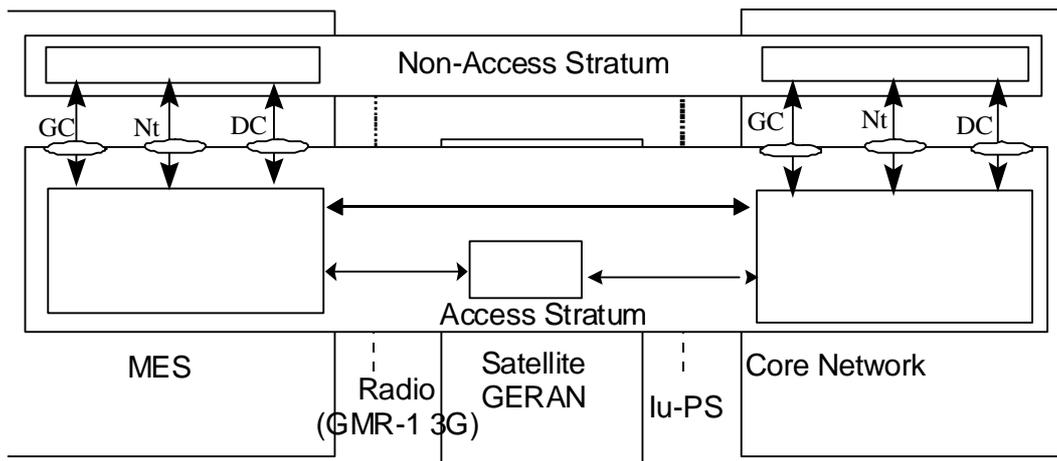


Figure 2: UMTS Architecture applied to Satellite GERAN

This model can be further refined to distinguish the end AS entities, which provide the services to higher layers, from the local entities, which provide services over respectively the GMR-1 3G and the Iu reference point. Figure 3 presents the refined model.

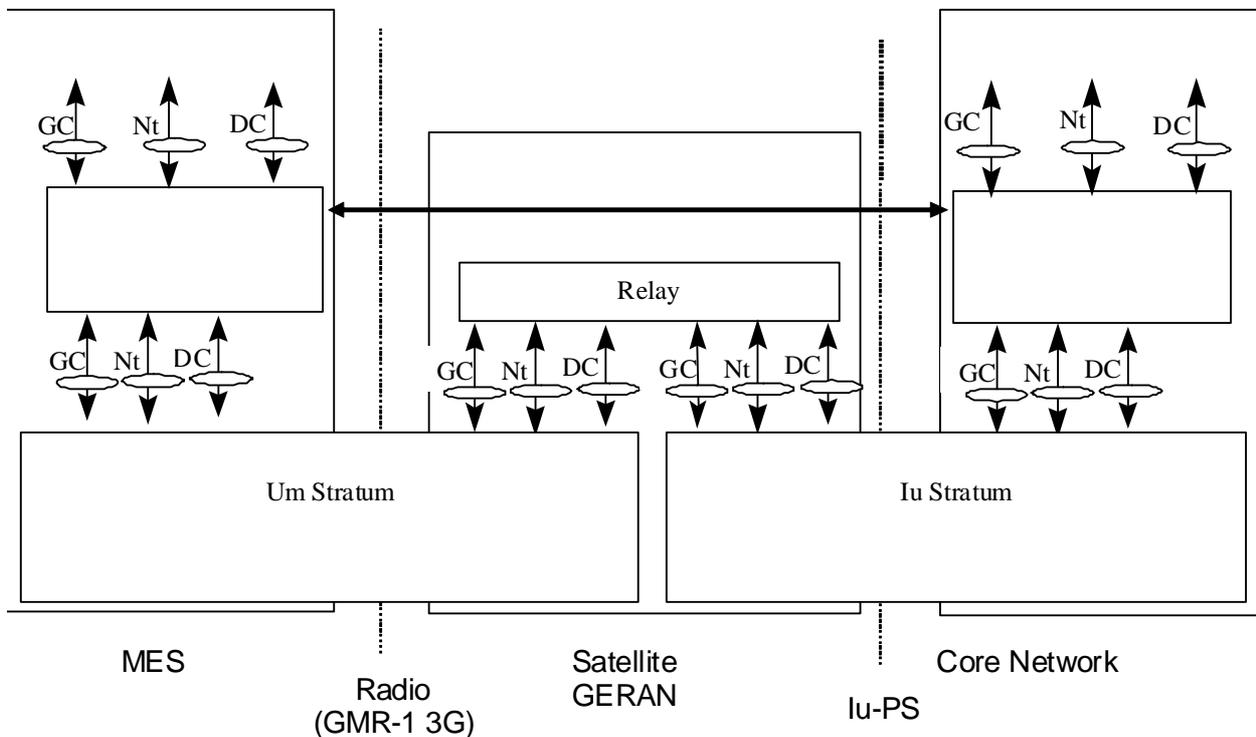


Figure 3: Assumed Satellite GERAN Model

4.3 Protocol architecture in PS domain

4.3.1 General

Specifications and more detailed descriptions of the Iu-ps interface protocols and architecture can be found in TS 125 410 to TS 125 415 [1], [2], [3], [4], [5] and [6].

The GMR-1 3G radio interface protocols are described in clauses 5 and 6.

4.3.2 User plane

Figure 4 shows the user plane for Satellite GERAN connected to a packet switched core network domain. For reference, GPRS and UMTS protocol stacks when connected to the packet switched core network domain are described in TS 123 060 [26].

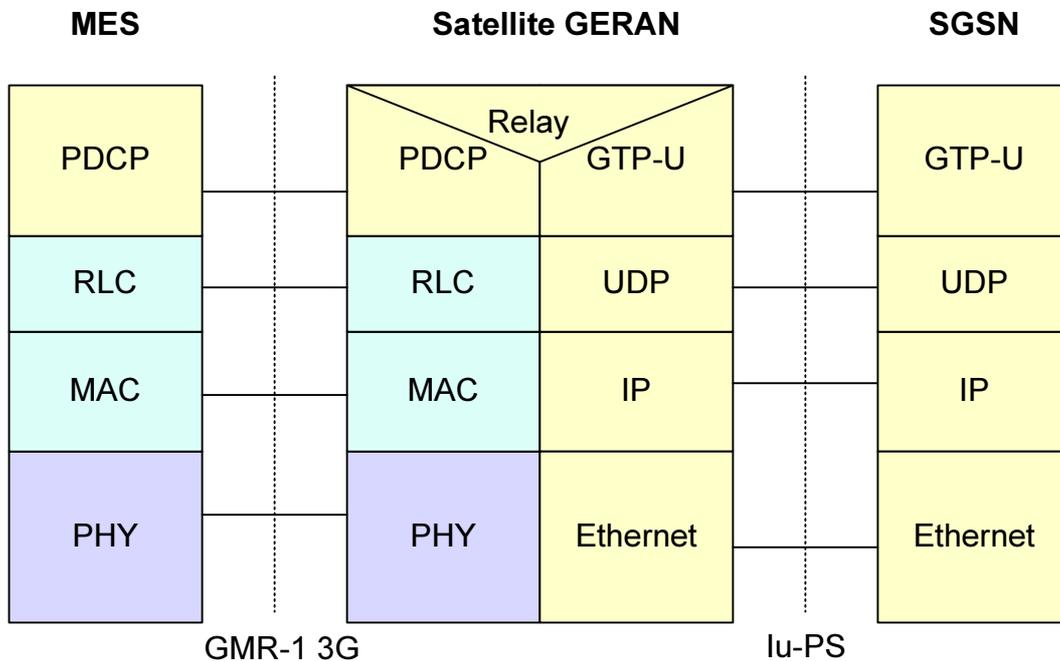


Figure 4: User Plane protocols towards Packet Switched Core Network domain

The Iu-ps protocol stack is inherited from UMTS specifications (see TS 125 410 to TS 125 415 [1], [2], [3], [4], [5] and [6]).

4.3.3 Control plane

Figure 5 shows a high level view of the control plane for Satellite GERAN when connected to a packet switched core network domain.

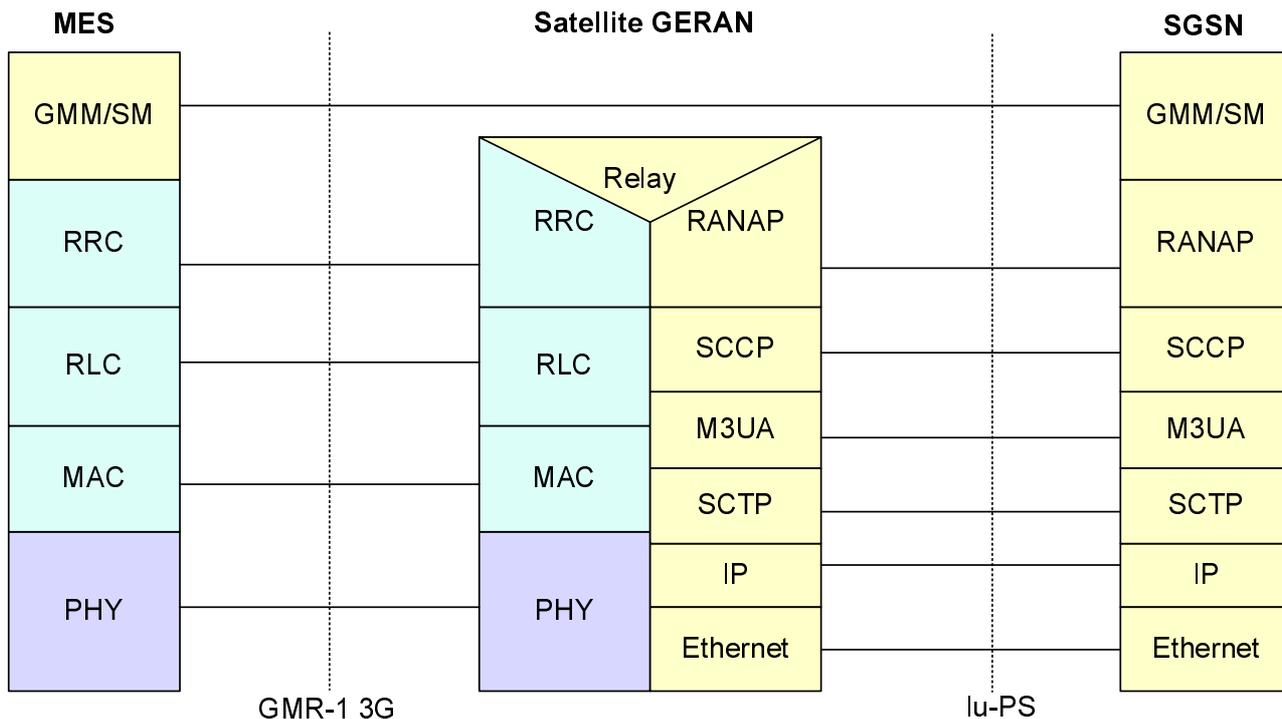


Figure 5: Control Plane protocols towards Packet Switched Core Network domain

NOTE: The Iu-ps protocol stack is inherited from UMTS specifications (see TS 125 410 to TS 125 415 [1], [2], [3], [4], [5] and [6]).

4.4 Protocol architecture in CS domain

Not supported in GMR-1 3G.

Figure 6: Void

Figure 7: Void

4.5 Iur-g interface

Not supported in GMR-1 3G.

Figure 8: Void

Figure 9: Void

4.6 Support for MSC/SGSN in pool

Not supported in GMR-1 3G.

4.7 CS services for Satellite GERAN Iu-mode

Not supported in GMR-1 3G.

4.8 User Equipment Specific Behaviour Information (UESBI) in Satellite GERAN Iu mode

Not supported in GMR-1 3G.

5 Radio Interface Protocol Architecture

Clause 5.1 describes the protocol architecture when connecting through an Iu interface to the CN.

5.1 Protocol Structure when connecting through Iu

The radio interface is layered into three protocol layers:

- the physical layer (Layer 1);
- the data link layer (Layer 2);
- the network layer (Layer 3).

Layer 2 is split into the following sublayers: Radio Link Control (RLC), Medium Access Control (MAC) protocol and Packet Data Convergence Protocol (PDCP). RLC/MAC is used as layer 2 in the control plane below RRC, except for operation on the BCCH, where DL is used.

The protocol architecture is divided into Control (C-) and User (U-) planes. The RLC and MAC protocols and the physical layer carry data from both C- and U-plane. PDCP exists in the U-plane only.

In the C-plane, Layer 3 is partitioned into sublayers where the lowest sublayer, denoted as Radio Resource Control (RRC), interfaces with layer 2 and terminates in the Satellite GERAN. The next sublayer provides "Duplication avoidance" functionality as specified in TS 101 376-4-7 [14]. It terminates in the CN but is part of the Access Stratum; it provides the Access Stratum Services to higher layers. The higher layer signalling such as Mobility Management (MM) and Call Control (CC) are assumed to belong to the non-access stratum, and therefore not in the scope of 3GPP TSG Satellite GERAN. On the general level, the protocol architecture is similar to the current ITU-R protocol architecture, ITU-R Recommendation M.1035 [i.2].

Figure 10 shows the radio interface protocol architecture. Each block in figure 10 represents an instance of the respective protocol. Service Access Points (SAP) for peer-to-peer communication are marked with circles at the interface between sublayers. The SAP between MAC and the physical layer provides the logical channels when Flexible Layer One is not used, and transport channels when Flexible Layer One is used. In the C-plane, the interface between "Duplication avoidance" and higher Layer 3 sublayers (CC, MM) is defined by the General Control (GC), Notification (Nt) and Dedicated Control (DC) SAPs. A description of these SAPs can be found in TS 123 110 [13].

Also shown in the figure are connections between RRC and MAC as well as RRC and L1 providing local inter-layer control services. An equivalent control interface exists between RRC and the RLC sublayer, between RRC and the PDCP sublayer. These interfaces allow the RRC to control the configuration of the lower layers. For this purpose separate Control SAPs are defined between RRC and each lower layer (PDCP, RLC, MAC, and L1).

The Satellite GERAN can be requested by the CN to prevent loss of data according to the quality of service requirements (see TS 123 107 [15]) of the bearer in question (i.e. independently of the handovers on the radio interface), as long as an inter-Satellite BSS handover does not take place. This is a basic requirement to be fulfilled by the Satellite GERAN retransmission functionality as provided by the RLC sublayer. However, in case of the inter-Satellite BSS handover, the prevention of the loss of data may not be guaranteed autonomously by the Satellite GERAN but relies on "Duplication avoidance" functions in the CN.

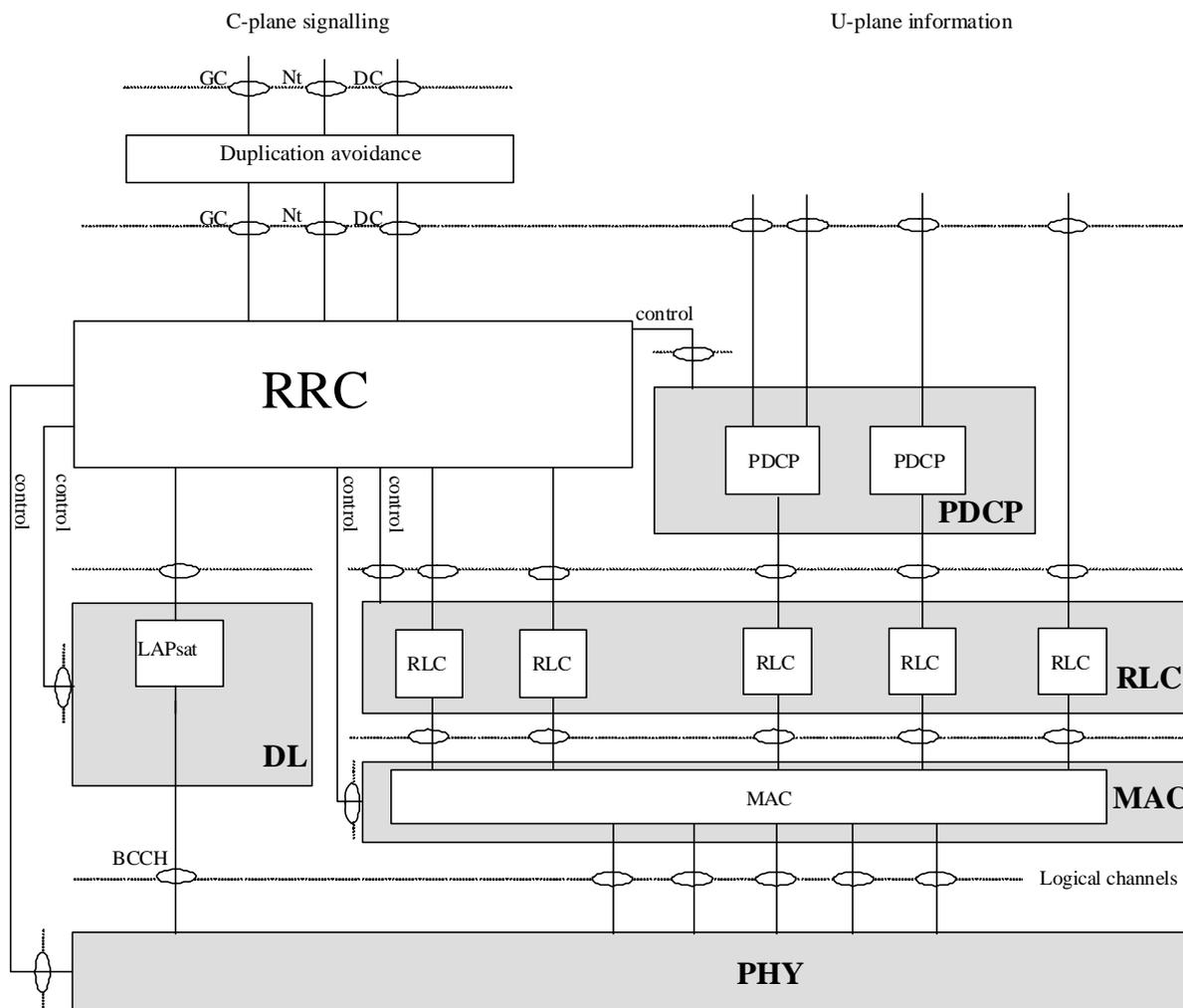


Figure 10: Radio Interface protocol architecture

Figure 10 reflects the radio interface protocol architecture when connecting to the Iu interface and the Flexible Layer One is not used.

Figure 11: Void

5.2 Multiplexing Principles

5.2.1 Multiplexing of different types of radio access bearers for one MES

Satellite GERAN can allocate multiple dedicated and shared physical channels to a mobile earth station. The allocation shall be consistent with the mobile earth station's capability (see TS 101 376-5-2 [11]).

Different types of Radio Access Bearer Services can be multiplexed for one MES using functionality of the MAC and/or the physical layers on one or more shared and/or dedicated physical channels. One radio bearer can be mapped to shared physical channel in the downlink and either a shared or dedicated physical channels in the uplink.

5.2.2 Multiplexing of user plane data from different core network interfaces

Only Iu-PS interface is supported by Satellite GERAN. Figure 12 shows the multiplexing principles on the network side of user plane data coming from the core network interface.

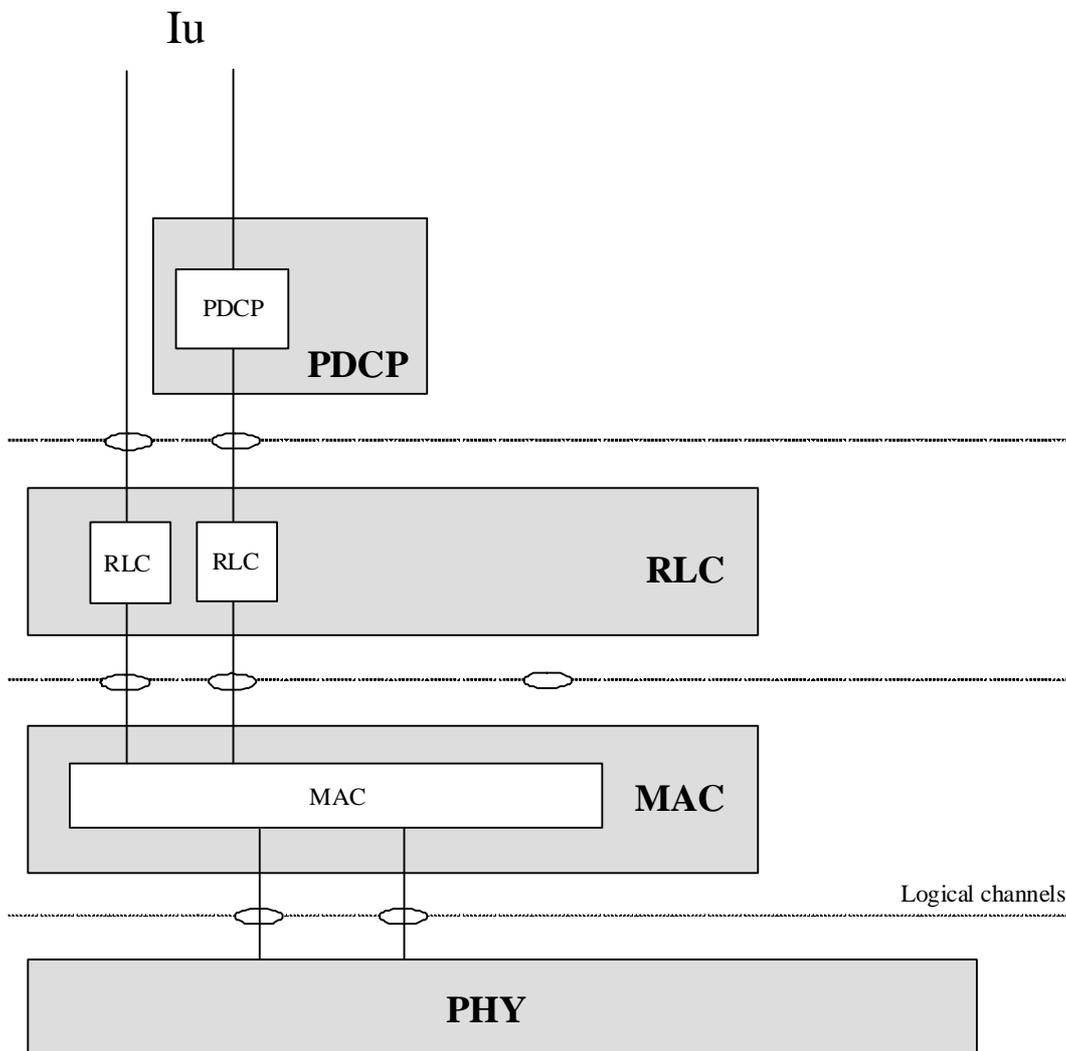


Figure 12: Multiplexing principles on the network side of user plane

5.3 Iu vs A/Gb mode selection

5.3.1 Introduction

A Satellite GERAN cell supports Iu mode only.

The support of each mode of operation by a Satellite GERAN cell is indicated in the broadcast system information messages, see clause 6.3.1.

Similarly, the mode(s) of operation a mobile earth station supports is indicated in information concerning radio aspects of the mobile earth station, made available to the radio access network, see TS 124 008 [25] Iu mode support may also be indicated implicitly at radio access by the mobile earth station. A mobile earth station can only operate either in A/Gb mode or in Iu mode at a given time.

5.3.2 PLMN, cell and mode (re-)selection in Satellite GERAN

The procedures for PLMN selection apply independently of the mode(s) supported by the cells belonging to the available PLMNs.

The procedures for cell re-selection defined in *A/Gb mode* apply also in *Iu mode*. The cell re-selection may be under the control of the network or the mobile earth station, see TS 101 376-4-12 [18].

In case cell re-selection is under control of the mobile earth station, cell re-selection shall only be based on radio criteria and not on which mode is supported by the neighbour cells, see TS 101 376-5-6 [27]. The *Iu mode* shall be selected in the target cell if supported by both the cell and the mobile earth station unless otherwise ordered by the network.

NOTE 1: The above text outlines the default mechanism of mode of operation selection and does not prohibit the introduction of a more flexible solution, which avoids unnecessary mode of operation changes, at a later stage.

In case cell re-selection is under control of the network, the mode to apply in the target cell is provided by the network.

NOTE 2: When a mobile earth station is allocated dedicated physical sub-channels, the maintenance of the radio resources is handled via handover procedures by the network. Irrespective of the mode of operation in the current cell, the network will select the mode of operation to apply in the target cell.

Once the mode of operation has been chosen in the new cell, the relevant procedures to *A/Gb* or *Iu mode* apply. Procedures will be defined in *A/Gb* or *Iu mode* to allow for changing mode without changing cell.

6 User and Control Plane Protocols

This clause provides an overview on the user and control plane protocols of Satellite GERAN. For detailed description of each of the layer, please refer to the corresponding specification (see below).

6.1 Identifiers in Satellite GERAN

The identities listed below shall be used for an MES connected, via Satellite GERAN through an Iu interface, to the CN.

6.1.1 IMSI, TMSI and P-TMSI

The International Mobile Subscriber Identity (IMSI), Temporary Mobile Subscriber Identity (TMSI) and Packet Temporary Mobile Subscriber Identity (P-TMSI) are defined in TS 101 376-3-3 [28].

6.1.2 G-RNTI

A Satellite GERAN Radio Network Temporary Identity (G-RNTI) shall be allocated to a mobile earth station by the Satellite BSS when an RRC connection is established between this mobile earth station and the Satellite GERAN. It identifies the MES within Satellite GERAN and may be used the same way TLLI is currently used over the radio interface in *A/Gb mode*. The G-RNTI is defined in TS 101 376-4-13 [19]. It is 32 bits in length and contains the serving BSC identity (SBSC-id) and the MES identity (S-RNTI) which is unique within the satellite spotbeams being handled by the Serving BSC.

6.1.3 NSAPI, RAB ID and RB ID

The UMTS definitions and mapping amongst NSAPI, RAB ID and RB ID defined in TS 123 060 [26] shall be used for Satellite GERAN.

The Network layer Service Access Point Identifier (NSAPI) and IMSI are used for network layer routing. In the MES, NSAPI identifies the PDP-SAP. In the SGSN and GGSN, NSAPI identifies the PDP context associated with an MM context.

In communication with Satellite BSS across the Iu-ps and GMR-1 3G interfaces, the RAB ID is used to identify the radio access bearer and shall be identical to the NSAPI value. In the Satellite BSS, the RAB ID identifies the Satellite BSS RAB context. The RAB ID shall uniquely identify the RAB for a specific CN domain and a particular MES.

For supporting spectrally efficient voice service the satellite GERAN establishes two radio bearers to realize a RAB. For all other services the Satellite GERAN establishes exactly one radio bearer to realize each RAB. Within the MES and the Satellite GERAN, the RB ID shall uniquely identify the radio bearer for a particular MES.

6.1.4 RB Id, RRB Id, and TFI

An RB Id (Radio Bearer Identity) identifies an RB (Radio Bearer). An RB Id has one of 32 possible values. Signalling radio bearers use RB Ids 0 to 4; user radio bearers use the rest. RB Ids are assigned at RB establishment and remain assigned until the radio bearer or the RRC connection is released.

An RRB Id (Reduced Radio Bearer Identity) identifies a TBF on DACCH. An RRB Id has one of 8 possible values. For such TBFs carrying SRBs, RRB Ids are implicitly assigned when the DCH is assigned. For such TBFs carrying URBs, the mapping between RB Id and RRB Id is given at RB setup.

A TFI (Temporary Flow Identity) identifies a TBF (Temporary Block Flow) on PDTCHs. A TFI has one of 32 possible values. For PDCHs, when a TBF is established, one unique TFI is assigned across all PDCHs that carry the TBF. Uplink and downlink TFIs are independent, i.e. assignment of a TFI in one direction does not constrain the TFI used in the other direction. The Satellite GERAN establishes the association between RB Id and TFI when the TBF is established.

A TBF on one or more TCHs is the only user of the TCHs; hence, no specific MAC-layer identifier is needed.

6.1.5 USF

For a TBF on one or more PDTCHs, USF (Uplink State Flag) is sent in the downlink and identifies which TBF may use the next block (or blocks) on the uplink PDCH. The USF is 5 bits or 8 bits depending on the type of PDCH used.

The Satellite GERAN establishes the association between TFI and USFs when the TBF is established.

6.1.6 SAI

The SAI (Service Area Identifier) identifies a Service Area that consists of one or more Satellite GERAN and UTRAN cells. It is defined in TS 124 008 [25]. The SAI is unique within the PLMN. The SAI is used over the Iu interface for mechanism such as inter-system handover, location services, charging etc.

The SAI is constructed as follows:

$$\text{SAI} = \text{MCC} + \text{MNC} + \text{LAC} + \text{SAC}$$

6.1.7 BSC-id

Each BSC that supports the Iu interface will be allocated a BSC-id (Base Station Control Identifier). The BSC-id is constructed the same way as the RNC-id, which is defined in TS 124 008 [25]. The BSC-id and the RNC-id are allocated from the same addressing space and are unique within the PLMN. The BSC-id together with the PLMN-id is used for addressing BSCs over the Iur-g and the Iu interface.

6.1.8 LAI for 3G core network

In GMR-1 3G a satellite spotbeam is equivalent to a GSM/EDGE cell. Excluding the radio aspects, a satellite spotbeam and GSM/EDGE cell are functionally equivalent. The term cell and spotbeam are used interchangeably. Due to the large geographical area served by a satellite spotbeam, a spotbeam is also equivalent to GSM/EDGE location area. The LAI is unique within the PLMN.

NOTE: In GMR-1 3G a location area consists of a single cell, where the cell is a unique satellite spotbeam.

The LAI is constructed as follows:

$$\text{LAI} = \text{MCC} + \text{MNC} + \text{LAC}$$

6.1.9 RAI for the 3G core network

The RAI is unique within the LAI. The RAI is constructed as follows:

$$\text{RAI} = \text{LAI} + \text{RAC}$$

6.1.10 GRA Identity

A Satellite GERAN Registration Area (GRA) is identified by the GRA Identity. In GMR-1 3G each GRA is identical to a Location Area. Due to the equivalence of Location Area and GRA, GRA Identities are not explicitly broadcast in the cell. See TS 101 376-4-8 [21]. GRA Identity is the same as the LAC.

6.1.11 Satellite GERAN internal Cell Identity

A Satellite GERAN cell identity (GC-id) will be used to address cells (spotbeams) in Satellite GERAN. The GC-id consists of the physical spot beam identifier. Physical spot beam identifier is unique within a satellite.

6.2 Relay

The relay function of Satellite GERAN is implementation dependent.

6.3 Radio Resource Control (RRC)

RRC is a layer 3 control plane protocol for radio resource management.

6.3.1 RRC Functions

The Radio Resource Control (RRC) layer handles the control plane signalling of Layer 3 between the MESs and the Satellite GERAN. The RRC performs the following functions:

- **Broadcast of information provided by the non-access stratum (Core Network):** The RRC layer performs system information broadcasting from the network to all MESs. The system information is normally repeated on a regular basis. The RRC layer performs the scheduling, segmentation and repetition when such broadcasting is carried on BCCH. This function supports broadcast of higher layer (above RRC) information. This information may be cell specific or not. As an example RRC may broadcast Core Network location service area information related to some specific cells.
- **Broadcast of information related to the access stratum (Satellite GERAN):** The RRC layer performs system information broadcasting from the network to all MESs. The system information is normally repeated on a regular basis. The RRC layer performs the scheduling, segmentation and repetition when such broadcasting is carried on BCCH. This function supports broadcast of typically cell-specific information.
- **Establishment, re-establishment, maintenance and release of an RRC connection between the MES and the Satellite GERAN:** The establishment of an RRC connection is initiated by a request from higher layers at the MES side to establish the first Signalling Connection for the MES. The establishment of an RRC connection includes an optional cell re-selection, an admission control, and a layer 2 signalling link establishment. The release of an RRC connection can be initiated by a request from higher layers to release the last Signalling Connection for the MES or by the RRC layer itself in case of RRC connection failure. In case of connection loss, the MES requests re-establishment of the RRC connection. In case of RRC connection failure, RRC releases resources associated with the RRC connection.

- **Establishment, reconfiguration and release of Radio Bearers:** The RRC layer can, on request from higher layers, perform the establishment, reconfiguration and release of Radio Bearers in the user plane. A number of Radio Bearers can be established to an MES at the same time. At establishment and reconfiguration, the RRC layer performs admission control and selects parameters describing the Radio Bearer processing in layer 2 and layer 1, based on information from higher layers.
- **Assignment, reconfiguration and release of radio resources for the RRC connection:** Depending on the RRC and MAC states, the RRC layer may handle the assignment of radio resources needed for the RRC connection including needs from both the control and user planes. The RRC layer may reconfigure radio resources during an established RRC connection. RRC indicates to the MES resource allocations for purposes of inter system handovers.
- **RRC connection mobility functions:** The RRC layer performs evaluation, decision and execution related to RRC connection mobility during an established RRC connection, such as handover, preparation of handover to UTRAN or other systems, cell re-selection and cell/GRA update procedures, based on e.g. measurements done by the MES.
- **Release of signalling connections:** The RRC layer provides the necessary functions for the Satellite GERAN or the MES to request the release of a signalling connection.
- **Paging/notification:** The RRC layer can broadcast paging information from the network to selected MESs on CCCH. Higher layers on the network side can request paging and notification. The RRC layer can also initiate paging during an established RRC connection.
- **Listening to BCCH:** The RRC layer may need to listen to the BCCH of the serving cell for working out whether Iu mode is supported in this cell. The RRC layer listens to the BCCH of neighbouring cells for neighbour cell measurements; the RRC layer also receives paging information on the CCCH.
- **Routing of higher layer PDUs:** This function performs at the MES side routing of higher layer PDUs to the correct higher layer entity, at the Satellite GERAN side to the correct RANAP entity.
- **Control of requested QoS:** This function shall ensure that the QoS requested for the Radio Bearers can be met. This includes the allocation of a sufficient number of radio resources.
- **MES measurement reporting and control of the reporting:** The measurements performed by the MES are controlled by the RRC layer including both GMR-1 3G air interface and other systems. The RRC layer is responsible for sending information that control the MES measurement reporting.
- **Power control:** The RRC layer controls parameters for normal power control, enhanced power control and fast power control.
- **Control of ciphering:** The RRC layer provides procedures for setting of ciphering (on/off) between the MES and Satellite GERAN.
- **Integrity protection:** This function controls integrity protection and performs integrity protection those RRC messages that are considered sensitive and/or contain sensitive information.
- **Support for Location Services:** Signalling between MES and Satellite GERAN to support positioning of an MES.
- **Timing advance control:** The RRC controls the operation of timing advance on shared and dedicated physical channels.

6.3.2 RRC Connection Levels

The different levels of RRC connection between MES and Satellite GERAN are listed below:

- No signalling connection exists:
The MES has no relation to Satellite GERAN, only to CN. For data transfer, a signalling connection has to be established.
- A signalling connection exists:
There is an RRC connection between the MES and Satellite GERAN. The MES position is known at Satellite GERAN Registration Area (GRA) level. (Note that in GMR-1 3G Satellite Spotbeam = Cell = Location Area).

6.3.3 RRC Connection Modes

Two modes of operation are currently defined for the MES, RRC-Idle mode and RRC-Connected mode.

After power on, the MES in RRC-Idle mode may transmit a request to establish an RRC connection with the Satellite GERAN. In RRC-Idle mode the MES is identified by non-access stratum identities such as IMSI, TMSI and P-TMSI. In addition, the Satellite GERAN has no own information about the individual MESs in RRC-Idle mode, and can only address e.g. all MESs in a cell or all MESs monitoring a specific paging occasion.

The RRC-Connected mode is entered when the RRC connection is established between the MES and the Satellite GERAN. The MES is assigned a radio network temporary identity (G-RNTI) to be used as MES identity. MES is identified within a Satellite GERAN with the G-RNTI.

Three states are defined in RRC-Connected mode: RRC-Cell_Shared state, RRC-Cell_Dedicated state and RRC-GRA_PCH state.

In RRC-Cell_Shared state, no dedicated physical channel is allocated to the MES and the position of the MES is known by Satellite GERAN on cell (satellite spotbeam) level.

In RRC-Cell_Dedicated state, the MES is assigned one or more dedicated physical channels in the uplink and downlink, which it can use anytime. Furthermore, the MES may be assigned one or more shared physical channels. The position of the MES is known by Satellite GERAN on cell (satellite spotbeam) level.

In RRC-GRA_PCH state, no physical channel is allocated to the MES. No uplink activity is possible. The location of the MES is also known on cell (satellite spotbeam) level. (Note that in GMR-1 3G Satellite Spotbeam = Satellite GERAN Registration area = Location Area = Cell).

The behaviour of the MES in each of these states is defined in TS 101 376-4-13 [19].

The MES leaves the RRC-connected mode and returns to RRC-idle mode when the RRC connection is released or at RRC connection failure.

6.3.4 RRC Connection Mobility

6.3.4.1 RRC Connection mobility in RRC-Idle mode

When the mobile earth station is in RRC-Idle mode, the CN knows the location of the mobile earth station at RA or LA level depending on the CN domain. There is no knowledge of the MES location within the Satellite BSS and paging is required to trigger an RRC connection establishment prior to any transfer with the MES. Such establishment moves the MES to RRC-Connected mode.

6.3.4.2 RRC Connection mobility in RRC-Connected mode

Handover procedures are used by the Satellite GERAN to control the mobility of the mobile earth station in RRC-Cell_Dedicated state. Such procedures are used to completely modify the channels allocated to the mobile earth station, e.g. when the cell (spotbeam) is changed.

The Satellite GERAN is in charge of tracking the location of the mobile earth station, at spotbeam level, when in RRC-Cell_Dedicated or RRC-Cell_Shared state or RRC-GRA_PCH state. In such case, the CN to which a signalling connection is established knows the location of the mobile earth station at the Satellite BSS level. Cell Update and GRA update procedures are defined to let the serving Satellite BSS know about any cell or GRA change.

6.3.5 RRC protocol and messages

The RRC protocol and the related RRC messages are defined in TS 144 018 [24].

6.3.6 Support of Radio Bearers in Satellite GERAN

The RRC layer is responsible for setting up radio bearers in the U-plane and the C-plane.

User Plane Radio Bearers are set-up when a Radio Access Bearer is required to be set-up by the Core Network.

Control Plane Radio Bearers are established when an RRC connection is set-up by a Mobile earth station. They comprise a set of five Signalling Radio Bearers:

- RB 0. In GMR-1 3G RB0 is not used, however RB Id = 0 is reserved.
- RB 1. In GMR-1 3G RB1 is not used, however RB Id = 1 is reserved.
- RB 2 shall be used for all messages sent using RLC acknowledged mode (RLC-AM). In GMR-1 3G RB2 is also used for RRC messages carrying higher layer (NAS) signalling.
- RB 3 and optionally RB 4. Services provided by RB3 and RB4 are provided by RB2. RB Id = 3 and RB Id = 4 are reserved.

Association of RBs 1 to 4 and logical channels is provided by the MAC protocol.

6.4 Packet Data Convergence Protocol (PDCP)

This clause provides an overview on services and functions provided by the Packet Data Convergence Protocol (PDCP). A detailed description of the PDCP is given in TS 125 323 [16].

6.4.1 Services provided to upper layers

The following services are provided by PDCP to upper layers:

- PDCP SDU delivery.

6.4.2 Services expected from RLC layer

- Data transfer in acknowledged mode.
- Data transfer in unacknowledged mode.
- Data transfer in transparent mode.
- Segmentation and reassembly.
- In-Sequence delivery.

6.4.3 PDCP Functions

For clarity reason, two PDCP modes are defined in the present document: transparent and non-transparent. The transparent and non-transparent modes relate respectively to the PDCP-no-header PDU and the PDCP-data PDU cases described in TS 125 323 [16].

The functions performed by the PDCP are dependent on the PDCP mode used.

6.4.3.1 Transparent Mode

The name "transparent" means that the PDCP layer does not change the incoming Service Data Units (SDU), i.e. no header is added and possible TCP/IP or RTP/UDP/IP headers in the data are left untouched.

The functions of the transparent mode of PDCP are:

- Transfer of user data.
- Relocation of PDCP buffer.

- PDCP SDU buffering.

6.4.3.2 Non-Transparent Mode

The functions of the non-transparent mode of PDCP are:

- Header adaptation of the IP data streams.
- Transfer of user data.
- PDCP SDU buffering.
- Relocation support appropriate to applicable QoS requirements.
- If adopted for UTRAN, multiplexing of radio bearers onto RLC entities.

Different header adaptation mechanisms may be used by the PDCP:

- **Header compression:** Transport and network level headers (e.g. RTP/UDP/IP) are compressed in such a way that the decompressed headers are semantically identical to the original uncompressed headers. The IETF ROHC WG is responsible for standardising header compression schemes. Header compression is suited for standard internet applications that are not designed to work only with Satellite GERAN and especially for multimedia applications therefore the scheme will be used with generic realtime multimedia bearers.
- **Header removal:** Transport and network level headers (e.g. RTP/UDP/IP) are completely removed. Based on information submitted at call setup and based on information derived from lower layer (link and physical), the receiving entity can regenerate the headers. The primary application of header removal is the optimized speech bearer, and the regenerated header may not always be semantically identical to the original header.
- **No header adaptation:** Transport and network-level headers (e.g. RTP/UDP/IP) are forwarded.

6.5 Radio Link Control (RLC)

This clause provides an overview on services and functions provided by the Radio Link Control (RLC). A detailed description of the RLC is given in TS 101 376-4-12 [18] and TS 101 376-4-14 [20].

6.5.1 Services provided to upper layer

- **Transparent data transfer:** This service transmits higher layer PDUs without altering them nor adding any RLC protocol information.
- **Acknowledged data transfer:** This service transmits higher layer PDUs and guarantees delivery to the peer entity.
- **Unacknowledged data transfer:** This service transmits higher layer PDUs without guaranteeing delivery to the peer entity.
- **Notification of unrecoverable errors:** RLC notifies the upper layer of errors that cannot be resolved by RLC itself by normal exception handling procedures.
- **Notification of discard:** RLC notifies the upper layer of the higher layer PDUs (RLC SDUs) it discards.
- **A local suspend/resume function:** RLC operation may be suspended/resumed if requested by RRC. This service is used when the ciphering parameters need to be changed.
- **A stop/continue function:** RLC operation may be stopped/continued if requested by RRC. This service is used at Serving Satellite BSS relocation in order to synchronise the PDCP entities in the MES and Satellite BSS to realise a loss-less relocation.
- **A reset function.**

There is a single Radio Bearer per RLC instance.

6.5.2 RLC Functions

6.5.2.1 Transparent Mode

RLC has no functionality when operating in transparent mode. The incoming SDUs are transferred to the MAC layer without being altered. No upper layer protocol information is removed. No RLC protocol information is added. All necessary signalling is made out of band.

6.5.2.2 Non-Transparent Mode

In non-transparent mode, the RLC is responsible for ciphering user data blocks (RLC PDUs). This function prevents unauthorized acquisition of data.

6.5.2.2.1 Acknowledged Mode

RLC has support for the following functions in acknowledged mode. For a detailed description, see TS 101 376-4-12 [18] and TS 101 376-4-14 [20].

- **Segmentation** of upper layer PDUs into RLC data blocks.
- **Concatenation** of upper layer PDUs into RLC data blocks.
- **Padding** to fill out an RLC data block.
- **Backward Error Correction (BEC)** procedures enabling the selective retransmission of RLC data blocks.
- **Discard** of RLC SDUs not yet segmented into RLC PDUs, according to the delay requirements of the associated Radio Bearer.
- **Reassembly** of RLC data blocks into upper layer PDUs.
- **In-sequence delivery** of upper layer PDUs.
- **Link Adaptation.**
- **Ciphering.**

6.5.2.2.2 Unacknowledged Mode

RLC has support for the following functions in unacknowledged mode. For a detailed description, see TS 101 376-4-12 [18] and TS 101 376-4-14 [20]. No backward error correction procedure is supported in this mode.

- **Segmentation** of upper layer PDUs into RLC data blocks.
- **Concatenation** of upper layer PDUs into RLC data blocks.
- **Padding** to fill out an RLC data block.
- **Reassembly** of RLC data blocks into upper layer PDUs.
- **Sequence number check** to detect lost RLC blocks.
- **In-order delivery** of upper layer PDUs.
- **Link Adaptation.**
- **Ciphering.**

6.6 Medium Access Control (MAC)

This clause provides an overview on services and functions provided by the Medium Access Control (MAC). A detailed description of the MAC is given in TS 101 376-4-12 [18] and TS 101 376-4-14 [20].

6.6.1 Services provided to upper layers

The MAC layer allows the transmission over the physical layer of upper layer PDUs from one mobile earth station when operating on a dedicated physical channel, or one or more mobile earth stations when operating on a shared physical channel. The MAC layer handles the access to and multiplexing onto the physical channels.

- **Data transfer:** This service provides unacknowledged transfer of MAC SDUs between peer MAC entities. This service does not provide any data segmentation. Therefore, segmentation/reassembly function should be achieved by upper layer.

6.6.2 MAC Functions

The functions of MAC include:

- **Configuring the mapping between logical channels and basic physical subchannels.** The MAC is responsible for configuring the mapping of logical channel(s) onto the appropriate basic physical subchannel(s).
- **Defining logical channels to be used for each radio bearer service.** This function includes mapping of signalling radio bearers onto logical channels.
- **Assignment, reconfiguration and release of shared radio resources for a TBF.** The MAC layer may handle the assignment of radio resources on PDCH(s) needed for a TBF including needs from both the control and user plane. The MAC layer may reconfigure radio resources of a TBF on PDCH(s).
- **MES measurement reporting and control of the reporting.** The MAC layer is responsible for sending information that control the MES measurement reporting when using PBCCH or PACCH channels. The MAC layer also performs the reporting of the measurements from the MES to the network using PACCH.
- **Broadcasting/listening of/to PBCCH and PCCCH.** The MAC layer broadcasts/listens (to) the PBCCH of the serving cell for the sending/decoding of packet system information messages. The MAC layer also sends paging information on the PCCCH and monitors the paging occasions according to the DRX cycle. Within the Mobile earth station, the MAC layer notifies the RRC layer when receiving a paging message; within the network, it is responsible for aggregating and sending paging messages addressed to one or more Mobile earth stations when received from the RRC layer.
- **Timing advance control.** The MAC layer controls the operation of timing advance on shared physical channels.

6.6.2.1 Additional functions for RLC transparent mode

When MAC offers services to an RLC entity in transparent mode, the following function is also supported.

- **Ciphering.** The MAC is responsible for ciphering user data blocks (MAC SDUs).

6.6.2.2 Additional functions for RLC non-transparent mode

When MAC offers services to an RLC entity in non-transparent mode, the following functions are supported in addition to those listed in clause 6.6.2:

- **Ciphering.** The MAC layer is responsible for ciphering layer 2 control blocks (RLC/MAC PDUs).
- **Identification of different traffic flows of one or more MESs on the basic physical channels.** Inband identification is needed to address a flow to an MES in the downlink or identify a flow from an MES in the uplink.
- **Multiplexing/demultiplexing of higher layer PDUs.** This function includes priority handling between data flows of one or more mobile earth stations, e.g. by attributes of Radio Bearer services.
- **Multiplexing/demultiplexing user and control plane data to/from the physical layer.** The MAC layer is responsible for multiplexing/demultiplexing RLC data blocks and RLC/MAC control blocks.

- **Scheduling of RLC/MAC data and control PDUs delivered to the physical layer on shared physical channels.** This includes USF and RRBP field monitoring for uplink transfer and sharing radio resources on the downlink.
- **Splitting/recombining.** This includes splitting/recombining of the RLC/MAC PDU flow belonging to one or more TBF(s) onto/from several shared logical channels. This function does not apply for RLC/MAC control blocks.

6.6.3 Model of MAC

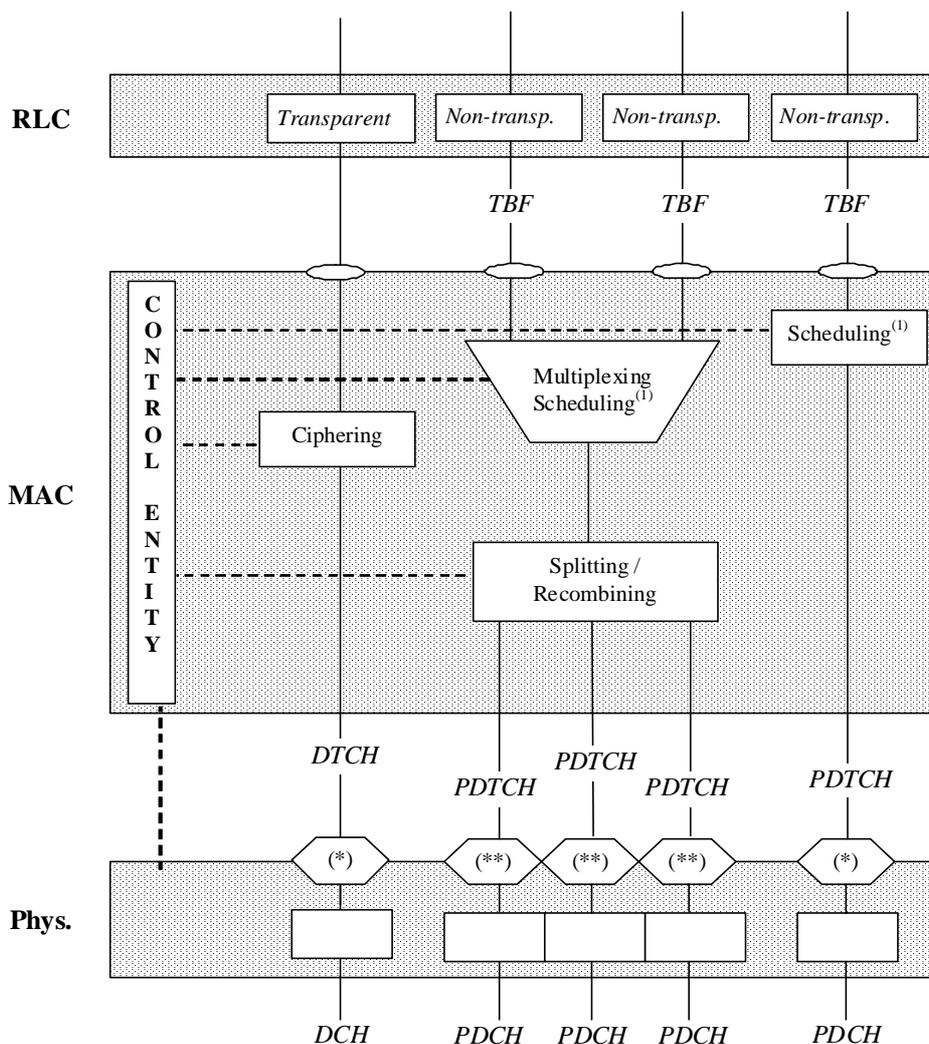
The model presented in this clause does not mandate how to implement the MAC layer.

In this model, the functions of MAC are controlled by a MAC control entity and a MAC common control entity.

The MAC control entity is specific to an MES. It is controlled by RRC; at RB establishment, the MAC control entity sets-up the functions needed to support the Radio Bearer. The MAC control entity can be in one of four states MAC-Idle state, MAC-Shared state, MAC-Dedicated state or MAC-DTM state, as defined in clause C.2. The MAC functions listed in the above clauses do not apply in every MAC state.

There is one and only one MAC control entity on the MES side. On the network side, there is one MAC control entity per MES. Additionally, there is one MAC common control entity per cell, which is responsible for the control of common channels and procedures.

Figure 13 shows an example of MAC model to realise a set of Radio Bearers on the MES side (user plane only). It shows the MAC Control Entity for that MES, together with some MAC functions that are used in this case.



(*): Such a SAP is created, re-configured and released by RRC
 (**): Such a SAP is created, re-configured and released by MAC
 (1): The scheduling function in this figure includes multiplexing user and control plane data and appending a MAC (possibly combined RLC/MAC) header to the MAC SDU.

—— User plane data
 - - - - Control plane data

Figure 13: Example of MAC functions for one user (MES side - user plane)

6.6.4 MAC operation

6.6.4.1 General

The MAC layer uses TBFs (Temporary Block Flows) to offer data transport between peer RLC instances. The MAC layer supports transport of data between multiple peer RLC instances established in a single MES and the Satellite GERAN.

A TBF provides unidirectional data transport on one or more physical channels of the same type (either PDCH or DCH). RRC may reconfigure a TBF from using one or more PDCHs to using one or more DCHs (and vice versa). More than one TBF may be allocated to a single MES in any direction. A TBF may transport data for the following combination of RLC instances:

- A single RLC instance carrying data for a URB.
- A single RLC instance carrying data for an SRB.

- A single RLC instance carrying data for a URB or an SRB, and using TBF stealing, one or more RLC instances each carrying data for an SRB for which no specific TBF is currently established. This combination is only supported by TBFs on PDCH.

Multiple TBFs are supported on all logical channels except DTCH and common control channels.

Any MES operating in *Iu mode* supports multiple TBFs in uplink and downlink. MESs supports 8 uplink TBFs and 8 downlink TBFs.

6.6.4.1.1 TBF Modes

The TBF mode depends on the type of logical channels used to transport RLC and MAC PDUs.

- A normal TBF mode operates on PACCH and PDTCH.
- A DCCH TBF mode operates on DACCH.
- A TCH TBF mode operates on DTCH.

A TBF associated with a URB may operate in either normal TBF mode, DCCH TBF mode or TCH TBF mode.

A TBF associated with a SRB may operate in either normal TBF mode or DCCH TBF mode.

In GMR-1 3G, the physical channels used in downlink and uplink directions can be different. Depending on the type of physical channels used, a MES may be allocated TBFs that operate in combination of normal TBF, DCCH and TCH TBFs modes. This is summarized in table 1.

Table 1: TBF modes

Downlink Physical Channel	Uplink Physical Channel	SRB	URB
DCH	DCH	DACCH TBF mode in downlink and uplink	DACCH TBF mode for non-voice traffic in uplink and downlink TCH TBF mode for voice traffic in uplink and downlink
PDCH	DCH	Normal TBF mode in downlink DACCH TBF mode in uplink	Normal TBF mode in downlink for voice and non-voice traffic. DACCH TBF mode in uplink for non-voice traffic. TCH mode in uplink for voice traffic.
PDCH	PDCH	Normal TBF mode in downlink Normal mode in uplink	Normal TBF mode in downlink for voice and non-voice traffic. Normal TBF mode in uplink for non voice traffic. TCHTBF mode in uplink for voice traffic.
NOTE: Normal TBF is to be used to carry voice traffic in downlink direction only. The normal TBF header used for carrying voice is specified in TS 101 376-4-14 [20].			

6.6.4.2 TBF establishment

6.6.4.2.0 General

Uplink TBFs on PDCHs are established as follows:

- An MES issues a MAC-layer request followed by the Satellite GERAN returning a MAC-layer assignment. This is used when the MES is in *MAC-Idle state*, *MAC-Shared state*, *MAC-Dedicated* or *MAC-DTM state*. This explicitly establishes SRB 2.
- The Satellite GERAN sends an RRC-layer message that sets up or reconfigures RBs on a PDCH. This is used when the MES is in *MAC-Shared state*, *MAC-Dedicated state*, or *MAC-DTM state*.

Uplink TBFs on DCHs are established as follows:

- An MES issues a MAC-layer request followed by the Satellite GERAN returning a MAC-layer dedicated assignment. This explicitly establishes SRB 2. This is used when the MES is in *MAC-Idle state*.
- The Satellite GERAN sends an RRC-layer message that sets up or reconfigures radio bearers on a DCH. It may also explicitly establish TBFs and USFs for URBs. This is used when the MES is in *MAC-Shared state*, *MAC-Dedicated state*, or *MAC-DTM state*.

Downlink TBFs on PDCHs are established as follows:

- The Satellite GERAN sends a MAC-layer request for paging the MES. The MES then issues a MAC-layer request in response to the paging request. The Satellite GERAN then returns a MAC-layer assignment explicitly establishing SRB2. This is used when the MES is in *MAC-Idle state*.
- The Satellite GERAN sends a MAC-layer assignment. This is used when the MES is in *MAC-Shared state*, or *MAC-DTM state*.
- The Satellite GERAN sends an RRC-layer message that sets up or reconfigures RBs on a PDCH. This is used when the MES is in *MAC-Shared state*, *MAC-Dedicated state*, or *MAC-DTM state*.

Downlink TBFs on DCHs are established as follows:

- The Satellite GERAN sends a MAC-layer request for paging the MES. The MES then issues a MAC-layer request in response to the paging request. The Satellite GERAN then returns a MAC-layer assignment explicitly establishing SRB2. This is used when the MES is in *MAC-Idle state*.
- The Satellite GERAN sends an RRC-layer message that sets up or reconfigures RBs on a DCH. It may also explicitly establish TBFs for URBs. This is used when the MES is in *MAC-Shared state*, *MAC-Dedicated state*, or *MAC-DTM state*.

6.6.4.2.1 Uplink resource request from MAC-Idle state

6.6.4.2.1.1 Mobile Originated Transmission

When the mobile earth station is in MAC-Idle state and requests the establishment of a TBF or dedicated resource, an RLC/MAC control message (CHANNEL REQUEST TYPE 3 or PACKET CHANNEL REQUEST TYPE 2 message) is sent on the RACH or PRACH. Conditions when to use RACH or PRACH is specified in TS 101 376-4-12 [18].

In CHANNEL REQUEST TYPE 3 message, the mobile earth station indicates one establishment cause from the following list:

- RRC connection request.
- RRC periodic GRA update.
- RRC GRA Update/Change in GRA.
- RRC Cell Update.
- Position Verification.
- User Data Transfer (FFS).

In PACKET CHANNEL REQUEST TYPE 2 message, the mobile earth station indicates one establishment cause from the following list:

- RRC periodic GRA update.
- RRC Cell Update.
- Handover Access.
- Uplink Resource Request.
- Initial Correction (FFS).

6.6.4.2.1.2 Mobile Terminated Transmission

For mobile terminated transmission, when a paging request message containing a paging cause is sent to the mobile earth station, the mobile earth station requests resources on the RACH or PRACH.

On RACH the following causes are used depending on the RRC connection mode:

- RRC connection request (in RRC Idle mode).
- RRC Cell Update (in RRC connected mode).

On PRACH the following cause is used

- RRC Cell Update.

NOTE: PRACH is not used if the MES is in RRC-Idle.

6.6.4.3 TBF multiplexing and scheduling

6.6.4.3.1 Multiplexing of RLC instances on TBFs

Void

NOTE: TBF stealing mechanism is for further study in GMR-1 3G.

6.6.4.3.2 Scheduling of TBFs on physical-layer resources

TBFs are scheduled on a radio-block basis according to their QoS attributes.

An established uplink TBF is scheduled as follows:

- On a PDCH, the MES sends data for the TBF that corresponds to the received USF or UUG. If no TBF corresponds to the received USF or UUG, the MES does not send. UUG operation is specified in TS 101 376-4-12 [18].
- On a DCH, burst stealing (DACCH) and DTX rules determine which TBFs are scheduled as specified in TS 101 376-4-14 [20].

An established downlink TBF is scheduled by the Satellite GERAN.

6.6.4.4 TBF release

An uplink TBF is released as follows:

- The Satellite GERAN initiates release of a normal mode TBF by sending a PACKET UPLINK ACK/NACK with the *final ack indicator* set to 1.
- The Satellite GERAN initiates release of a DACCH mode TBF by sending a PACKET DCH UPLINK ACK/NACK with the *final ack indicator* set to 1.
- The Satellite GERAN releases a TCH mode TBF by releasing the DCH using RRC procedures.

A downlink TBF is released as follows:

- The Satellite GERAN initiates release of a normal mode TBF by sending a data block with *final block indicator* set to 1. The MES acknowledges the release.
- The Satellite GERAN initiates release of a DACCH mode TBF by sending a data block with *final block indicator* set to 1. The MES acknowledges the release.
- The Satellite GERAN releases a TCH mode TBF by releasing the DCH using RRC procedures.

6.6.4.5 TBF reallocation

Considering the mobile earth station's multislot capabilities, Satellite GERAN may reallocate one or more of a mobile earth station's TBFs:

- To a different radio frequency.
- To different timeslots (the same number, more, or fewer).
- To use a different TFI for a given TBF.
- To use different USFs for a given uplink TBF.

When only PDCHs are allocated, Satellite GERAN MAC or Satellite GERAN RRC signals the reallocation.

When at least one DCH is allocated, Satellite GERAN RRC signals the reallocation.

6.7 RLC/MAC PDU Formats for different protocol modes

6.7.1 Acknowledged RLC mode

The RLC/MAC headers are specified in TS 101 376-4-12 [18] and TS 101 376-4-14 [20].

6.7.2 Unacknowledged RLC mode

The RLC/MAC headers are specified in TS 101 376-4-12 [18] and TS 101 376-4-14 [20].

6.7.3 Transparent RLC mode

The transparent mode is used for example to transmit voice in Satellite GERAN. Since RLC is used in transparent mode, no RLC/MAC header has to be added except when PDCH is used in downlink. The RLC/MAC header used to carry voice traffic is specified in TS 101 376-4-14 [20].

6.8 Physical Layer (Phy)

The physical layer (layer 1) is the lowest layer in the OSI Reference Model and it supports all functions required for the transmission of bit streams on the physical medium. This clause provides an overview on services and functions provided by the Physical Layer.

6.8.1 Definitions

A **physical channel** uses a combination of frequency and time division multiplexing and is defined as a sequence of radio frequency channels and time slots. The complete definition of a particular physical channel consists of a description in the frequency domain, and a description in the time domain (see TS 101 376-5-2 [11]).

A **logical channel** is defined by the type of data which is transferred and characterized by parameters such as channel coding and interleaving. It can be uni-directional or bi-directional (see TS 101 376-5-2 [11]).

EXAMPLE: PDTCH/U, TCH/FS, FACCH/F.

6.8.2 Services provided to upper layer

The physical layer interfaces the Medium Access Control (MAC) sub-layer of Layer 2 and the Radio Resource Control (RRC) sub-layer of Layer 3. Through Service Access Points (SAP), the physical layer offers services described below:

- **Access capabilities:** the physical layer offers logical channels and the transmission services associated to higher layers. Logical channels are multiplexed either in a fixed predefined manner (multiframe structure) or dynamically by the MAC on basic physical subchannels. Basic physical subchannels are the units scheduled on the radio medium. Some are reserved by the network for common use (e.g. for use by a combination of PCCCH and PBCCH), others are assigned to dedicated connections with MESs (dedicated basic physical subchannels), or are assigned to a shared usage between MESs (shared physical channels).
- **Error detection:** the physical layer offers an error protected transmission service, it includes error detection functions and to a lower level, error correction functions. Erroneous received frames may be notified to upper layer and, depending on the need of the upper layer, offered to it. The probability of one or more errors in a physical block transferred by the physical layer is defined in TS 101 376-5-5 [23]. Due to non specified methods of quality detection, the probability of residual errors in transferred blocks may vary between implementations.

6.8.2.1 Specific services of the physical layer in the MES

- Measurement of the signal strength of neighbouring base stations. Measurements are transferred to layer 3.
- Measurement of the signal quality of the physical channel used. Measurements are transferred to the MAC layer for reporting to the base station.
- Cell/PLMN selection in idle mode or in packet mode. In idle mode or in packet mode, the physical layer selects the best cell with its BCCH in close co-operation with layer 3, meeting requirements for PLMN selection specified in TS 101 376-3-10 [22].

6.8.3 Logical Channels

6.8.3.1 Traffic channels

Traffic channels of type DTCH are intended to carry encoded speech on dedicated physical channel.

Packet Data Traffic Channels (PDTCH) are intended to carry user data on shared physical channels. PDTCH are used to carry encoded speech when downlink physical resources are mapped to a PDCH.

6.8.3.2 Control channels

Control channels carry signalling or synchronization data. Four categories of control channels are defined: broadcast, common, dedicated control channels and cell broadcast channels. Specific channels within these categories are defined in the following clauses.

6.8.3.2.1 Broadcast channels

Satellite GERAN shall reuse GMR-1 broadcast channels. Any addition shall be made in a backwards compatible manner.

6.8.3.2.2 Common control type channels

Satellite GERAN common control type channels shall be based on GMR-1 common control type channels. Any addition shall be made in a backwards compatible manner.

6.8.3.2.3 Dedicated control channels

On a dedicated physical channel:

- i) The Dedicated Associated Control Channel (DACCH): The DACCH can be unidirectional or bidirectional. The DACCH shall be used to transport signalling and non-voice traffic. The DACCH may be mapped to the same physical channel (frequency and time slot) as the DTCH. Differentiation between DACCH and DTCH is a function of physical layer. One or more DACCH can be allocated to a MES.

On a shared physical channel:

- i) The Packet Associated Control Channel (PACCH): The PACCH is bi-directional. PACCH/U is used for the uplink and PACCH/D for the downlink.

6.8.3.2.4 Cell Broadcast Channel (CBCH)

CBCH is not supported in GMR-1 3G.

6.8.4 Physical Channels

A physical channel can either be dedicated (DCH) or shared (PDCH).

In GMR-1 3G, the physical channels used in downlink and uplink directions can be different. The allowed combinations are:

Downlink	Uplink
DCH	DCH
PDCH	DCH
PDCH	PDCH

6.8.4.1 DCH - Dedicated Physical CHannel

A DCH is for only one user and it always has an associated DACCH.

6.8.4.2 PDCH - Packet Data physical CHannel

A PDCH is for one or more users.

6.8.5 Mapping of logical channels onto physical channels

6.8.5.1 DCH

The following channel combinations are possible for a DCH:

- i) DTCH+DACCH

6.8.5.2 Void

6.8.5.3 PDCH

The following channel combinations are possible for a PDCH:

- i) PDTCH+PACCH

6.8.6 Physical Layer Functions

An overview of the functions which create the services of the physical layer can be found in TS 101 376-5-1 [10].

6.8.7 Channel Coding

Details of channel coding can be found in TS 101 376-5-3 [12].

6.8.8 Void

6.9 Flexible Layer One (FLO)

FLO is not supported in GMR-1 3G.

7 Ciphering

The ciphering architecture is specified in TS 133 102 [17] and is identical to that of UTRAN (f8). The ciphering principle with input parameters to the algorithm is illustrated in figure 14.

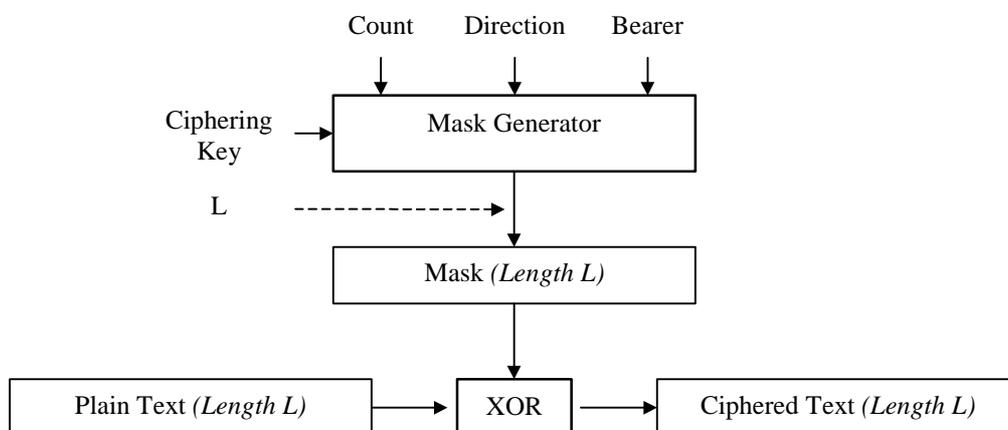


Figure 14: Ciphering Principle

Ciphering shall be applied after contention resolution has been performed provided the MES is under coverage of its serving Satellite BSS.

7.1 Location of ciphering in the Satellite GERAN protocol architecture

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

- In case of non-transparent RLC mode (acknowledged or unacknowledged), ciphering is performed in the RLC sub-layer for layer 2 user data blocks only. Layer 2 signalling is ciphered in the MAC sub-layer.
- In case of transparent RLC mode, ciphering is performed in the MAC sub-layer.

According to this model, ciphering when applied is performed in the Satellite BSS and the MES, and the context needed for ciphering (input parameters) is only known in Satellite BSS and the MES.

7.2 Inputs to the ciphering algorithm

7.2.1 Ciphering Key

The ciphering key is 128 bit long.

The ciphering key is established between the MME and Satellite BSS during the authentication phase. In the two-key solution, the CS-domain user-plane bearers are ciphered with the most recent cipher key agreed between the user and the MSC (CK-CS). The PS-domain user-plane bearers are ciphered with the most recent cipher key agreed between the user and the SGSN (CK-PS).

The signalling radio bearers are used for transfer of signalling data for services delivered by both CS and PS service domains. These signalling radio bearers are ciphered using the CK of the service domain for which the most recent security mode negotiation took place. This may require that the cipher key of an (already ciphered) ongoing signalling connection has to be changed, when a new connection is established with another service domain, or when a security mode negotiation follows a re-authentication during an ongoing connection.

To ensure performing the right ciphering function at the RLC and MAC layers, three conditions shall be met:

- A user-plane Radio Bearer is either from CS-domain or PS-domain, but not from both.
- RRC maps a given user-plane Radio Bearer to a given domain in order to derive the correct key to utilise for each RB.
- The RLC and MAC layers receive the Radio Bearer IDs and CKs they should use from RRC.

7.2.2 Bearer

This parameter indicates the radio bearer identity (when available), which shall be unique within a RRC connection. It is used as input parameter to the ciphering algorithm to ensure that the same ciphering mask is not applied to two or more parallel Radio Bearers having the same ciphering key and count. Each Radio Bearer is ciphered independently.

In case no radio bearer identity is available (layer 2 signalling), the data id shall be equal to a unique value.

To ensure that the same ciphering mask is not applied to layer 2 signalling (no RBid available) and layer 2 user data (RBid available), RBid indicator is used in the count parameter to inform whether RBid is available or not.

7.2.3 Direction

This parameter indicates the direction of transmission (uplink/downlink).

7.2.4 Length

This parameter indicates the length of the mask to be generated by the algorithm (this length is equal to that of the data to be ciphered). It is not an input to the mask generator.

7.2.5 Parameter Settings

Parameters to the ciphering algorithm are specified in TS 101 376-4-14 [20].

8 Integrity protection

8.1 Integrity protection on RRC messages

Integrity protection with a 32-bit MAC-I shall be performed on all RRC messages, with the exceptions defined in TS 101 376-4-13 [19].

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

Only PS service domain is supported in GMR-1 3G.

8.2 Integrity protection on RLC/MAC control messages

RLC/MAC control messages are not integrity protected.

8.3 Calculation of message authentication code

The MES shall calculate the message authentication code in accordance with TS 133 102 [17]. The construction of the input parameter MESSAGE (see TS 133 102 [17]) for the integrity algorithm is specified in TS 101 376-4-13 [19].

9 Mobility Management and Session Management (MM and SM)

See TS 124 008 [25].

10 Void

Annex A (informative): Radio Access Bearer Realization

This annex describes how the different protocols of the Satellite GERAN User Plane protocol stack are configured to provide the desired radio access bearer classes (conversational, streaming, interactive and background). Only the traffic over Iu-ps interface is considered.

A.1 Conversational Radio Access Bearer

Void

A.2 Streaming, Interactive, Background Radio Access Bearers

Void

Annex B (informative): RLC/MAC Header format Convention

RLC/MAC headers are specified in TS 101 376-4-12 [18] and TS 101 376-4-14 [20].

Annex C (informative): RRC States, MAC States and RRC Connection Mobility

C.1 Void

C.2 MAC states

This clause describes the MAC state model for Satellite GERAN in *Iu mode*. The model shows the MAC state for the MAC control entity of an MES and not for individual radio bearers.

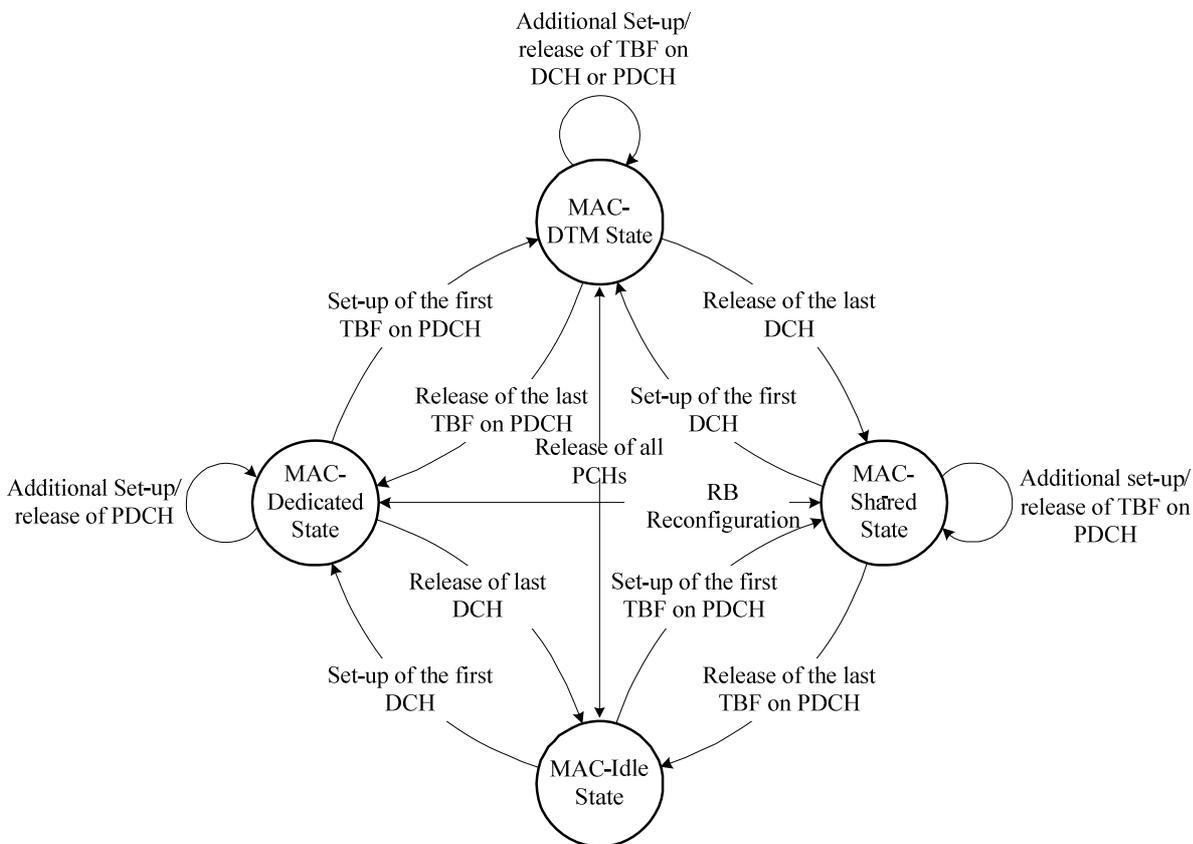


Figure C.1: States of the MAC Control Entity

Transitions among various states are specified in TS 101 376-4-14 [20].

C.3 Mapping between RRC States and MAC States

Table C.1 describes the mapping between Satellite GERAN RRC and MAC states and possible channel combinations. RRC always handles the allocation of DCH and it also controls which PDCHs MAC is allowed to use. MAC always allocates PDTCHs when using PDCHs. Table C.1 shows which protocol is responsible for the different procedures in different scenarios.

Table C.1: Mapping between RRC and MAC states

Currently Allocated channel(s)		Allocation of new resources		Current Control Plane States	
DCH	PDCH	DCH	PDCH	MAC State	RRC State
1 (or more)	-	RRC	RRC	Dedicated	Cell_Dedicated
1 (or more)	1 (or more)		MAC	DTM	Cell_Shared
	1 (or more)			Shared	
-	-	NA	NA	Idle	GRA_PCH
-	-	NA			RRC-Idle Mode
-	-				

Annex D (informative): Bibliography

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

3GPP TS 48.016: "3rd Generation Partnership Project; General Packet Radio Service (GPRS); Base Station System (BSS) - Serving GPRS Support Node (SGSN) interface; Network Service".

3GPP TS 48.018: "3rd Generation Partnership Project; General Packet Radio Service (GPRS); Base Station System (BSS) - Serving GPRS Support Node (SGSN); BSS GPRS Protocol (BSSGP)".

3GPP TS 48.001: "3rd Generation Partnership Project; Base Station System - Mobile Services Switching Centre (BSS-MSC) Interface General Aspects".

3GPP TS 48.002: "3rd Generation Partnership Project; Base Station System - Mobile Services Switching Centre (BSS-MSC) Interface - Interface Principles".

3GPP TS 48.004: "3rd Generation Partnership Project; Base Station System - Mobile Services Switching Centre (BSS-MSC) Interface Layer 1 Specification".

3GPP TS 48.006: "3rd Generation Partnership Project; Signalling Transport Mechanism Specification for the Base Station System - Mobile Services Switching Centre (BSS-MSC) Interface".

3GPP TS 48.008: "3rd Generation Partnership Project; Mobile Switching Centre - Base Station system (MSC-BSS) Interface Layer 3 Specification".

3GPP TS 48.063: "3rd Generation Partnership Project; Inband Tandem Free Operation (TFO) of Speech Codecs; Service Description; Stage 3".

3GPP TS 25.420: "3rd Generation Partnership Project; UTRAN Iur Interface: General Aspects and principles".

3GPP TS 25.421: "3rd Generation Partnership Project; UTRAN Iur Interface Layer 1".

3GPP TS 25.422: "3rd Generation Partnership Project; UTRAN Iur Interface signalling transport".

3GPP TS 25.423: "3rd Generation Partnership Project; UTRAN Iur Interface RNSAP signalling".

3GPP TS 24.022: "3rd Generation Partnership Project; Radio Link Protocol (RLP) for Circuit Switched Bearer and Teleservices".

3GPP TS 44.060: "3rd Generation Partnership Project; Radio Link Control / Medium Access Control (RLC/MAC) protocol".

3GPP TS 23.221: "3rd Generation Partnership Project; Architectural requirements (Release 5)".

3GPP TS 23.236: "3rd Generation Partnership Project; Intra Domain Connection of RAN Nodes to Multiple CN Nodes".

3GPP TS 23.195: "3rd Generation Partnership Project; Provision of User Equipment Specific Behaviour Information (UESBI) to network entities".

3GPP TS 23.034: "3rd Generation Partnership Project; High Speed Circuit Switched Data (HSCSD); Stage 2".

ITU-T Recommendation I.130: "Method for the characterization of telecommunication services supported by an ISDN and network capabilities of an ISDN".

ITU-T Recommendation Q.65: "The unified functional methodology for the characterization of services and network capabilities including alternative object-oriented techniques".

3GPP TS 23.153: "3rd Generation Partnership Project; Out of Band Transcoder Control".

3GPP TR 45.902: "3rd Generation Partnership Project; Flexible Layer One".

History

Document history		
V3.1.1	July 2009	Publication
V3.2.1	February 2011	Publication
V3.3.1	December 2012	Publication