ETSI TS 143 064 V15.3.0 (2020-04)

TECHNICAL SPECIFICATION

Digital cellular telecommunications system (Phase 2+) (GSM);
General Packet Radio Service (GPRS);
Overall description of the GPRS radio interface;
Stage 2
(3GPP TS 43.064 version 15.3.0 Release 15)

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A GLOBAL INITIATIVE

GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS

Reference
RTS/TSGR-0643064vf30

Keywords
GSM

ETSI

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

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

Siret N° 348 623 562 00017 - NAF 742 C
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1 Scope

The present document provides the overall description for lower-layer functions of the General Packet Radio Service (GPRS and EGPRS)) radio interface (Um).). Within this TS the term GPRS refers to GPRS and EGPRS unless explicitly stated otherwise.

The overall description provides the following information:

- The services offered to higher-layer functions,
- The distribution of required functions into functional groups,
- A definition of the capabilities of each functional group,
- Service primitives for each functional group, including a description of what services and information flows are to be provided, and
- A model of operation for information flows within and between the functions.

The present document is applicable to the following GPRS Um functional layers:

- Radio Link Control functions,
- Medium Access Control functions, and
- Physical Link Control functions.

The present document describes the information transfer and control functions to be used across the radio (Um) interface for communication between the MS and the Network, see Figure 1.

3GPP TS 23.060 [3] describes the overall GPRS logical architecture and the GPRS functional layers above the Radio Link Control and Medium Access Control layer.

3GPP TS 24.007 [5] contains a description in general terms of the structured functions and procedures of this protocol and the relationship of this protocol with other layers and entities.

3GPP TS 44.018 [6] contains the definition of GPRS RLC/MAC procedures when operating on the Common Control Channel (CCCH).

3GPP TS 44.060 [7] contains the definition of RLC/MAC functions when operating on a Packet Data Channel (PDCH).

3GPP TS 44.064 [8] contains functional procedures for the Logical Link Control (LLC) layer above the RLC/MAC.

3GPP TS 45 series defines the Physical Link layer and Physical RF layer.

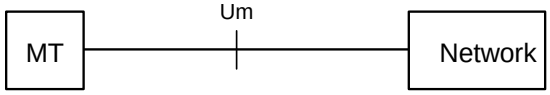

Figure 1: Scope of GPRS Logical Radio Interface Architecture

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- For a specific reference, subsequent revisions do not apply.

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[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 22.060: "General Packet Radio Service (GPRS); Stage 2".

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

[4] 3GPP TS 44.004: "Digital cellular telecommunications system; Layer 1; General requirements".

[5] 3GPP TS 24.007: "Mobile radio interface signalling layer 3 General aspects"

[6] 3GPP TS 44.018: "Mobile radio interface layer 3 specification; Radio Resource Control Protocol"

[7] 3GPP TS 44.060: "Radio Link Control/Medium Access Control (RLC/MAC) protocol".

[8] 3GPP TS 44.064: "General Packet Radio Service (GPRS); Logical Link Control (LLC)".

[9] 3GPP TS 44.065: "General Packet Radio Service (GPRS); Subnetwork Dependent Convergence Protocol (SNDCP)".

[10] 3GPP TS 45.001: "Physical layer on the radio path, General description".

[11] 3GPP TS 45.002: "Multiplexing and multiple access on the radio path".

[12] 3GPP TS 45.003: "Channel coding".

[13] 3GPP TS 45.004: "Modulation".

[14] 3GPP TS 45.005: "Radio transmission and reception".

[15] 3GPP TS 45.008: "Radio subsystem link control".

[16] 3GPP TS 45.010: "Radio subsystem synchronisation".

[17] 3GPP TS 43.246: "Multimedia Broadcast Multicast Service (MBMS) in the GERAN; Stage 2".

[18] 3GPP TS 23.682: "Architecture enhancements to facilitate communications with packet data networks and applications".

[19] 3GPP TS 24.008: "Mobile radio interface Layer 3 specification; Core network protocols; Stage 3".

[20] 3GPP TS 43.020: "Security related network functions".

[21] 3GPP TS 48.018: "BSS GPRS Protocol (BSSGP)".

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3 Abbreviations, symbols and definitions

3.1 Abbreviations

In addition to abbreviations in 3GPP TR 21.905 [1] and 3GPP TS 22.060 [2] the following abbreviations apply:

ARQ	Automatic Repeat reQuest
BCS	Block Check Sequence
BEC	Backward Error Correction
BH	Block Header
BTTI	Basic Transmission Time Interval
CC	Coverage Class
CCN	Cell Change Notification
CFCCH	Compact Frequency Correction Channel
CPAGCH	Compact Packet Access Grant Channel

CPBCCH	Compact Packet Broadcast Control Channel
CPCCCH	Compact Packet Common Control Channel
CPPCH	Compact Packet Paging Channel
CPRACH	Compact Packet Random Access Channel
CSCH	Compact Synchronization Channel
CS-*i*	GPRS Coding Scheme *i*
CU	Cell Update
DAS-*i*	EGPRS2 Downlink level A modulation and coding Scheme *i*
DBS-*i*	EGPRS2 Downlink level B modulation and coding Scheme *i*
DLMC	Downlink Multi Carrier
DTM	Dual Transfer Mode
eDRX	Extended Discontinuous Reception
EC	Extended Coverage
EGPRS	Enhanced GPRS
EGPRS2	Enhanced GPRS phase 2
EC-GSM-IoT	Extended Coverage GSM for Internet of Things
EC SI	EC-GSM-IoT System Information
ESAB	Extended Synchronization Access Burst
EDAB	Extended Dual slot Access Burst
eTFI	Extended Temporary Flow Identity
FANR	Fast Ack/Nack Reporting
FBI	Final Block Indicator
FH	Frame Header
GGSN	Gateway GPRS Support Node
HCS	Header Check Sequence
HSR	Higher Symbol Rate
IR	Incremental Redundancy
LLC	Logical Link Control
MAC	Medium Access Control
MBMS	Multimedia Broadcast/Multicast Service
MCS-*i*	EGPRS Modulation and Coding Scheme *i*
MPRACH	MBMS Packet Random Access Channel
NSS	Network and Switching Subsystem
PACCH	Packet Associate Control Channel
PAGCH	Packet Access Grant Channel
PAN	Piggy-backed Ack/Nack
PBCCH	Packet Broadcast Control Channel
PC	Power Control
PCCCH	Packet Common Control Channel
PCS	PAN Check Sequence
PDCH	Packet Data Channel
PDTCH	Packet Data Traffic Channel
PDU	Protocol Data Unit
PEO	Power Efficient Operation
PFC	Packet Flow Context
PFI	Packet Flow Indentifier
PL	Physical Link
PPCH	Packet Paging Channel
PRACH	Packet Random Access Channel
PSI	Packet System Information
PSM	Power Saving Mode
PTCCH	Packet Timing Advance Control Channel
p-t-m	point-to-multipoint
RLC	Radio Link Control
RTTI	Reduced Transmission Time Interval
SGSN	Serving GPRS Support Node
SNDC	Subnetwork Dependent Convergence
TA	Timing Advance
TBF	Temporary Block Flow
TFI	Temporary Flow Identity
TTI	Transmission Time Interval
UAS-*i*	EGPRS2 Uplink level A modulation and coding Scheme *i*

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UBS-*i* EGPRS2 Uplink level B modulation and coding Scheme *i*
USF Uplink State Flag

3.2 Symbols

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

Gb Interface between an SGSN and a BSC.
Um Interface between MS and GPRS fixed network part. The Um interface is the GPRS network interface for providing packet data services over the radio to the MS.

3.2a Restrictions

Independently of what is stated elsewhere in this and other 3GPP specifications, mobile station support for PBCCH and PCCCH is optional for A/Gb-mode of operation. The network shall never enable PBCCH and PCCCH.

3.2b Definitions

Blind Physical Layer Transmissions: Repetitions performed on physical layer by blindly, without feedback from the receiving end, transmitting multiple instances of the same block. To maximize the processing gain at the receiver, phase coherency at the transmitter between blind transmissions transmitted within the same TDMA frame is required, see 3GPP TS 45.005 [14].

Coverage Class: A predetermined number of blind physical layer transmissions used by Extended Coverage logical channels, EC-channels, to be able to support a certain level of extended coverage. The number of blind physical layer transmissions may differ between logical channels for the same coverage class. A Coverage Class defines a maximum coverage limit supported in EC operation, see 3GPP TS 45.005 [14]. Four Coverage Classes are defined.

EC operation: An EC-GSM-IoT capable MS in a cell supporting EC-GSM-IoT may enable EC operation, in which case CS domain services are disabled. When EC operation is enabled the MS uses FCCH and EC-SCH for synchronization purposes, EC-BCCH for acquisition of EC System Information (EC SI), EC-CCCH for monitoring EC-PCH in idle mode, EC-CCCH for packet access procedures, or, if indicated by the network CCCH, and enables relaxed mobility related requirements. In packet transfer mode the MS is assigned EC-PDTCH(s) and an associated EC-PACCH in EC TBF operation mode.

Extended coverage: Coverage level exceeding the reference sensitivity and reference interference performance of GPRS/EGPRS, see 3GPP TS 45.005 [14].

Fixed Uplink Allocation: Static allocation of resources in the uplink over one or more TTIs, using one or more PDCH, that does not make use of USF based allocation (see 3GPP TS 44.018 [6] and 3GPP TS 44.060 [7]).

Power Efficient Operation: A PEO capable MS that has successfully negotiated the use of eDRX or PSM (see 3GPP TS 23.060 [3]) may enable PEO in a cell that supports PEO in which case it enables the use of relaxed mobility related requirements (see 3GPP TS 45.008 [15]) and the use of the ‘PEO One Phase Access Request'. A cell that supports PEO supports the use of relaxed mobility related requirements and EGPRS PACKET CHANNEL REQUEST messages indicating ‘PEO One Phase Access Request'.

Relaxed mobility related requirements: A relaxed set of MS requirements related to mobility, used when Power Efficient Operation (PEO) or EC operation is enabled. The requirements are relaxed compared to the ones applicable for a MS that has not enabled PEO or EC operation, and include e.g. reduced monitoring of neighbour cells, reduced monitoring of System Information and less frequent triggering of measurements for cell reselection.

3.3 Network and mobile station capabilities

3.3.1 General

In addition to GPRS specific definitions which can be found in 3GPP TS 22.060 [2] and 3GPP TS 23.060 [3] the following apply.

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When referring to radio resources (i.e. physical channels) provided by the network to the mobile station, the term "assignment" refers to granting of resources on a semi-static basis, whereas "allocation" refers to the dynamically changing permission to use those resources that have been "assigned" to it and are shared with other users. An exception applies when granting resources using Fixed Uplink Allocation where only the term "allocation" is used. In this case, resources are assigned and allocated by the same message.

Multislot Capability: the capability of the mobile station to support Multislot Configurations.

Multislot Class: a value which implicitly determines the Multislot Capability of the mobile station.

Multislot Configuration: the set of receive and transmit timeslots assigned to the MS.

3.3.2 EGPRS mobile station

An EGPRS mobile station is a GPRS mobile station with additional capabilities for new radio access protocol features and new modulation and coding schemes. An EGPRS mobile station shall comply with GPRS requirements and the additional requirements defined for an EGPRS mobile station. The support of EGPRS is optional for the mobile station and the network.

An EGPRS mobile station may additionally indicate support for EGPRS2 in uplink and/or downlink direction. In this case an EGPRS mobile station supports additional modulation and coding schemes, and may also support higher symbol rate, see sub-clause 3.3.6. The support of EGPRS2 is optional for the mobile station and the network.

An EGPRS mobile station may additionally indicate the support of Reduced Latency. In this case an EGPRS mobile station may be assigned a TBF with FANR activated either in BTTI configuration or in RTTI configuration, see sub-clause 3.3.5. The support of Reduced Latency is optional for the mobile station and the network.

3.3.3 Dual Transfer Mode

In dual transfer mode, the mobile station is assigned resources providing an RR connection and one or more Temporary Block Flows on one or more physical channels. This feature is optional for the mobile station and the network. It is only applicable for a mobile station supporting GPRS, EGPRS or EGPRS2. Dual transfer mode is a subset of class A mode of operation, which is only possible if there is radio resource assignment co-ordination in the network.

3.3.4 Downlink dual carrier configuration

In a downlink dual carrier configuration, one or more PDCHs are assigned to a single MS on each of two different radio frequency channels on either the uplink or downlink, or both. On the downlink, radio blocks may be allocated on both radio frequency channels in any radio block period. On the uplink, radio blocks shall not be allocated on both radio frequency channels in any given radio block period.

NOTE: A radio frequency channel in this context is defined by the frequency parameter(s) ARFCN for a non-hopping radio frequency channel or MA, MAIO and HSN for a hopping radio frequency channel.

A downlink dual carrier configuration shall support multislot configurations either for packet switched connections or dual transfer mode. For a Dual Transfer Mode capable MS which supports Downlink Dual Carrier, support of Downlink Dual Carrier configurations for Dual Transfer Mode is optional.

Downlink dual carrier is not supported in GPRS mode.

3.3.5 Reduced Latency TBF

A TBF applying Reduced Latency shall operate according to all EGPRS/EGPRS2 requirements, unless otherwise stated, with the Fast Ack/Nack Reporting procedure (see sub-clause 3.3.5.1). In addition, a TBF applying Reduced Latency is characterized by either RTTI configuration or BTTI configuration (see sub-clause 3.3.5.2).

3.3.5.1 Fast Ack/Nack Reporting procedure

The Fast Ack/Nack reporting procedure (FANR) refers to the possibility to include, in a radio block for data transfer sent in one direction, piggy-backed ack/nack information relative to a TBF with FANR activated in the other direction.

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