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GPRS/EGPRS requirements for ETCS

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Railway Telecommunications (RT).

Introduction

Railway undertakings are facing the challenge to evolve their networks to support the ETCS operation in high density railway traffic areas. The limited GSM-R spectrum resources put additional pressure on air interface traffic capabilities and as well radio spectrum efficiency. Also, the continuous development of further voice services e.g. GSM-R based shunting communication using circuit switched technology requires increased traffic resource capabilities.

When ETCS is using circuit switched data mode, radio traffic channel capacity utilization is low compared to the requested/assigned bandwidth. Having more than one ETCS session multiplexed to one radio resource using packet switched mode is therefore desirable. Taking into account GSM evolution GPRS/EGPRS bearer services provide packet oriented data transmission that allocates transmission resources on demand and release those resources if no further data are to be exchanged. ETCS message sizes are rather small and the typical message frequency are in the range of several seconds. This allows to multiplex several ETCS sessions to one transmission resource and facilitating use of ETCS level 2 in high density rail traffic areas.

The present document identifies the features required to allow the support of ETCS using GPRS/EGPRS bearer services, in particular the basic ones and those needed to fulfil End-to-End performance requirements.

1 Scope

The present document defines the minimum set of 3GPP GPRS features to support ETCS application and to guarantee QoS required. Two operational cases are applicable in GSM-R networks:

- GSM-R GPRS packet switched bearer service is only utilized by ETCS PS-mode operation - **ETCS only operation**.
- GSM-R GPRS packet switched bearer service is utilized by simultaneous ETCS and other packet data oriented applications - **Simultaneous operation of ETCS and non-ETCS applications**.

Both operational scenarios require basic GPRS features but in case of simultaneous ETCS and non-ETCS operation, ETCS packet data session requires priority over non-ETCS packet data traffic.

The present document is focussing on the relevant references needed for the GSM-R PS-domain. It does not describe the detailed requirements for each of the referred GSM feature.

The minimum requirements on ETSI/3GPP for the use of GSM for application on railway networks are based on the Release 99 version of the Technical Specifications and are described in ETSI EN 301 515 [i.1]. The features serving as the basis for GSM-R PS-domain are described in releases later than Release 99. So the present document is referring to specifications versions later than Release 4 but is not mandating any other functionality than covered by the applicable 3GPP Work Items and referenced in the applicable clauses as listed in clauses 5.1.10 and 5.2.2.

2 References

2.1 Normative 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.

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

[1] ETSI TS 123 002 (V4.8.0): "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Network architecture (3GPP TS 23.002 version 4.8.0 Release 4)".

[2] ETSI TS 123 060 (V4.11.0): "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); General Packet Radio Service (GPRS); Service description; Stage 2 (3GPP TS 23.060 version 4.11.0 Release 4)".

[3] ETSI TS 123 107 (V4.6.0): "Universal Mobile Telecommunications System (UMTS); Quality of Service (QoS) concept and architecture (3GPP TS 23.107 version 4.6.0 Release 4)".

[4] ETSI TS 123 207 (V5.10.0): "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); End-to-end Quality of Service (QoS) concept and architecture (3GPP TS 23.207 version 5.10.0 Release 5)".

[5] ETSI TS 124 008 (V4.17.0): "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Mobile radio interface Layer 3 specification; Core network protocols; Stage 3 (3GPP TS 24.008 version 4.17.0 Release 4)".

[6] ETSI TS 127 007 (V4.7.0): "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; AT command set for User Equipment (UE) (3GPP TS 27.007 version 4.7.0 Release 4)".

[7] ETSI TS 129 002 (V4.18.0): "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Mobile Application Part (MAP) specification (3GPP TS 29.002 version 4.18.0 Release 4)".

[8] ETSI TS 129 060 (V4.11.0): "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); General Packet Radio Service (GPRS); GPRS Tunnelling Protocol (GTP) across the Gn and Gp interface (3GPP TS 29.060 version 4.11.0 Release 4)".

[9] ETSI TS 129 061 (V4.10.1): "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Interworking between the Public Land Mobile Network (PLMN) supporting packet based services and Packet Data Networks (PDN) (3GPP TS 29.061 version 4.10.1 Release 4)".

[10] ETSI TS 143 064 (V4.5.0): "Digital cellular telecommunications system (Phase 2+); Overall description of the GPRS radio interface; Stage 2 (3GPP TS 43.064 version 4.5.0 Release 4)".

[11] ETSI TS 144 018 (V4.23.0): "Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 specification; Radio Resource Control (RRC) protocol (3GPP TS 44.018 version 4.23.0 Release 4)".

[12] ETSI TS 144 060 (V4.23.0): "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Mobile Station (MS) - Base Station System (BSS) interface; Radio Link Control / Medium Access Control (RLC/MAC) protocol (3GPP TS 44.060 version 4.23.0 Release 4)".

[13] ETSI TS 144 064 (V4.4.0): "Digital cellular telecommunications system (Phase 2+); Mobile Station - Serving GPRS Support Node (MS-SGSN); Logical Link Control (LLC) Layer Specification (3GPP TS 44.064 version 4.4.0 Release 4)".

[14] ETSI TS 144 065 (V4.3.0): "Digital cellular telecommunications system (Phase 2+); Mobile Station (MS) - Serving GPRS Support Node (SGSN); Subnetwork Dependent Convergence Protocol (SNDCP) (3GPP TS 44.065 version 4.3.0 Release 4)".

[15] ETSI TS 148 018 (V4.7.0): "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Base Station System (BSS) - Serving GPRS Support Node (SGSN); BSS GPRS Protocol (3GPP TS 48.018 version 4.7.0 Release 4)".

[16] ETSI TS 145 001 (V4.5.0): "Digital cellular telecommunications system (Phase 2+); Physical layer on the radio path; General description (3GPP TS 45.001 version 4.5.0 Release 4)".

[17] ETSI TS 145 002 (V4.8.0): "Digital cellular telecommunications system (Phase 2+); Multiplexing and multiple access on the radio path (3GPP TS 45.002 version 4.8.0 Release 4)".

[18] ETSI TS 145 003 (V4.4.0): "Digital cellular telecommunications system (Phase 2+); Channel coding (3GPP TS 45.003 version 4.4.0 Release 4)".

[19] ETSI TS 145 004 (V4.2.0): "Digital cellular telecommunications system (Phase 2+); Modulation (3GPP TS 45.004 version 4.2.0 Release 4)".

[20] ETSI TS 145 005 (V4.19.0): "Digital cellular telecommunications system (Phase 2+); Radio transmission and reception (3GPP TS 45.005 version 4.19.0 Release 4)".

[21] ETSI TS 145 008 (V4.19.0): "Digital cellular telecommunications system (Phase 2+); Radio subsystem link control (3GPP TS 45.008 version 4.19.0 Release 4)".

[22] ETSI TS 145 010 (V4.5.0): "Digital cellular telecommunications system (Phase 2+); Radio subsystem synchronization (3GPP TS 45.010 version 4.5.0 Release 4)".

[23] ETSI TS 148 016 (V4.4.0): "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Base Station System (BSS) - Serving GPRS Support Node (SGSN) Interface; Network Service (3GPP TS 48.016 version 4.4.0 Release 4)".

2.2 Informative 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.

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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 EN 301 515: "Global System for Mobile communication (GSM); Requirements for GSM operation on railways".

3 Definitions and abbreviations

3.1 Definitions

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

ETCS application: comprises the EuroRadio protocol suite

non-ETCS application(s): comprises any other protocol suites than EuroRadio

3.2 Abbreviations

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

ARP	Allocation Retention Priority
BSS	Base Station Subsystem
CS	Coding Schemes
EGPRS	Evolved GPRS
ETCS	European Train Control System
ETSI	European Telecommunication Standardisation Institute
GERAN	GSM / EDGE Radio Access Network
GGSN	Gateway GPRS Support Node
GPRS	General Packet Radio Service
GSM	Global System Mobile
GSM-R	Global System for Mobile communication for Railway application
HARQ	Hybrid Automatic Repeat Request
IP	Internet Protocol
LLC	Logical Link Control
MCS	Modulation Coding Schemes
NACC	Network Assisted Cell Change
NSE	Network Service Entity
PCU	Packet Control Unit
PDP	Packet Data Protocol
PDU	Protocol Data Unit
PFC	Packet Flow Context
PS	Packet Switched
QoS	Quality of Service
RAN	Radio Access Network
RIM	RAN Information Management
RLC	Radio Link Control
SGSN	Serving GPRS Support Node
TBF	Temporary Block Flow

4 General requirements

4.1 ETCS application characteristics

GPRS and EGPRS are the available packet switched bearer services based on GSM, and are applicable for GSM-R too. These bearer services are to be considered for the transport of the ETCS application and in addition, certain features are required to adapt to the ETCS characteristics and to prioritize the ETCS application against other non-ETCS applications while sharing the radio and network resources.

ETCS application is safety related and therefore requires reactive processing and highly reliable transport along the transmission path. One of the GPRS main principles is that radio transmission resources are allocated based on the demand principle and released after a short guard time if no further data are to be transmitted. The message periodicity (inter arrival frequency of application user data packets) between the involved communication entities inside the ETCS application can vary between one and several seconds (see example in Figure 1). This can result in the release of allocated transmission resources too early which causes additional ETCS user data transfer delay.

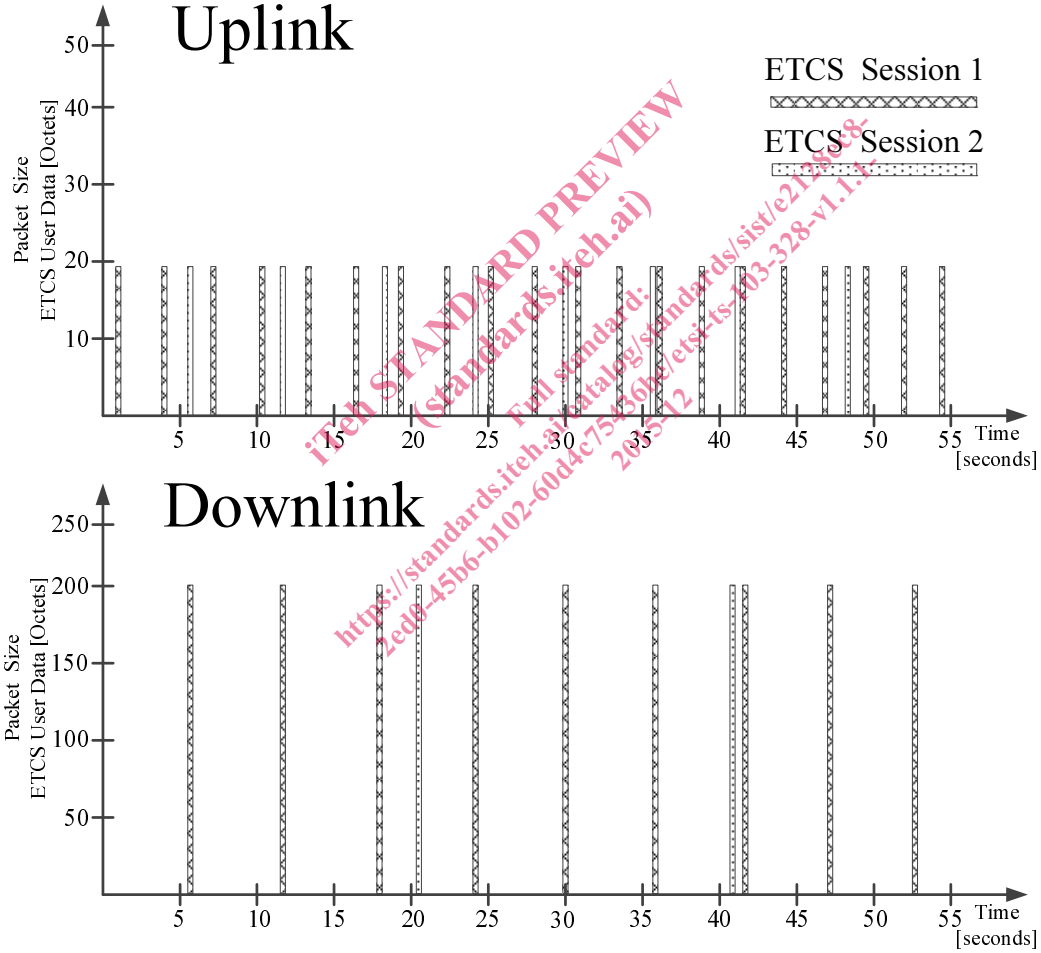

Figure 1: Example Inter-Transmission and arrival intervals in ETCS

4.2 Coexistence between ETCS and non-ETCS applications

ETCS application can be the only service using GPRS/EGPRS bearer or together with other non-ETCS applications (simultaneous operation of ETCS/non-ETCS applications). Latter scenario requires a strict separation of the different traffic types using different QoS profile parameters as part of the subscription and the processing of the QoS parameters within the radio access domain and core network domain.

In particular, the radio access domain has to prioritize the ETCS traffic over the non-ETCS traffic if those are operated simultaneously. In addition to the prioritization of ETCS traffic in both traffic scenarios, guaranteed transmission bandwidth should be provided to fulfil the QoS requirements.

4.3 Reference 3GPP Release

All GSM GPRS features that are referenced in the present document shall be implemented to fulfil in minimum 3GPP Release 4 GERAN, based on A/Gb mode operation.

Specific timer and counter specification of the normative references shall be supported, except the subsequent chapters indicating specific values for the operation of ETCS.

4.4 Applicability

The present document shall only apply to Mobile Terminals of an ETCS Data Only Radio.

5 Bearer services and features for ETCS operation

5.1 Basic features

5.1.0 General

The features that are listed in this clause are considered for ETCS operation.

5.1.1 Network - Bearer Service capabilities

The GSM-R network shall support all mandatory GPRS bearer services capabilities according to [1], [2], [3], [10], [11], [12], [16], [17], [18], [19], [20], [21] and [22] in the radio access domain (BSS) and according to [1], [2], [3], [4], [5], [7], [8], [9], [10], [13], [14], [15] and [23] in the packet core network domain.

In addition, EGPRS bearer services shall be supported by the network to enhance the bandwidth across the air interface.

EGPRS bearer services should comprise the enhancements i.e. HARQ including Incremental Redundancy that are available in acknowledged RLC operation mode according to ETSI TS 144 060 [12].

GSM-R packet domain shall support interworking according to ETSI TS 129 061 [9] with networks based on the Internet Protocol. The operation of ETCS requires an End-to-End QoS transmission resources management. Thus, it is necessary to interwork with external IP bearer services beyond the GSM-R packet domain reference point. For that reason, the GGSN shall support the DiffServ edge functionality according to ETSI TS 123 207 [4] which can be used for external bearer service QoS management.

The radio access network (BSS) shall support GPRS/EGPRS bearer services up to an absolute speed of 500 kph accepting certain limitations of the robustness i.e. level of forward error correction.

5.1.2 Mobile - Bearer Service capabilities

The Mobile Stations to be used for ETCS operation shall provide GPRS and EGPRS bearer service capabilities which comply to [1], [2], [3], [5], [6], [10], [11], [12], [13], [14], [16], [17], [18], [19] and [20].

GPRS/EGPRS bearer services shall be operated by the Mobile Station up to an absolute speed of 500 kph accepting certain limitations of the robustness i.e. level of forward error correction.

5.1.3 Quality of Service Management

In order to allow basic QoS management, Mobile Stations and the Network shall support 3GPP QoS concept and architecture according to ETSI TS 123 107 [3]. The relevant network entities and the Mobile Stations shall be able to process non-Guaranteed Bitrate traffic classes, Interactive and Background, between the specified reference points in ETSI TS 123 060 [2] including the associated parameters.

5.1.4 Multislot Operation

GPRS and EGPRS bearer services offers Multislot operation. Possible Multislot configuration/classes shall be implemented according to ETSI TS 145 002 [17].