



## **System Requirements Specification Version 15.4.0**

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## Foreword

This EIRENE System Requirements Specification version 15.4.0 is released to address the requirements that are relevant to interoperability of the rail system within the European Community, in particular according to the Directive 2008/57/EC. It has been released alongside a new version of the EIRENE Functional Requirements Specification version 7.4.0, with which consistency was assured.

The document incorporates the relevant requirements for introduction of Internet Protocol based new Core Network architecture, Core Network redundancy improvement and Fixed Terminal System interface and the findings of a Working Group managed by the European Railway Agency, with the participation of the UIC, CER, EIM and GSM-R Industry Group, . It includes the ability of using additional frequencies in the 900 MHz band and other public GSM bands. It introduces the enhanced Railway Emergency Call.

The EIRENE System Requirements Specification version 15.4.0 requirements which are relevant for interoperability in Europe are strictly the ones marked in this version with the category (MI), and these should be verified for certification purposes and authorisation for placing into service in Europe. There is no impact for Individual Constituents or Subsystems certification done according to the applicable requirements in EIRENE previous versions. Within the ERA ERTMS/GSM-R CCM process it was agreed that ERA should recommend the referencing of the EIRENE System Requirements Specification version 15.4.0 in the Annex A of the CCS TSI, as a mandatory document.

The EIRENE version numbering structure is as follows:

- First digit (15) is the EIRENE version, and it is aligned with the ERA Baseline for Europe (B0), defined according to the ERA CCM process
- Second digit (4) is aligned to ERA Baseline release 4 (B0 r4), defined according to the ERA CCM process
- Third digit (0) corresponds to an UIC interim version, which shall contain changes that will not refer to (MI) categories

Following this, EIRENE 15.4.0 is aligned with ERA B0 r4.

Please note that, this EIRENE System Requirements Specification version 15.4.0 replaces the former version 15.3. The complete document must be considered in order to ensure an EIRENE compliant GSM-R system.

The current document has been created following the agreements in the MoU signed between ERA and UIC in October 2010

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# Document history

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## List of contents

<b>Important notice</b>	<b>1</b>
<b>Foreword</b>	<b>3</b>
<b>Document history</b>	<b>5</b>
<b>List of abbreviations</b>	<b>16</b>
<b>List of definitions</b>	<b>21</b>
<b>1 Introduction</b>	<b>29</b>
1.1 General	29
1.2 Scope	29
1.3 Applicability	31
1.4 System overview	32
1.5 Structure of the specification	38
<b>2 Network requirements</b>	<b>41</b>
2.1 Introduction	41
2.2 GSM teleservices	41
2.3 GSM bearer services	42
2.4 GSM supplementary services	43
2.5 Railway specific services	44
2.6 Alerting duration	44
2.7 Uplink Reply and Notification Response	44
2.8 Network architecture	45
2.9 Core Network Redundancy	45
2.10 Interfaces to Core Network	46
2.11 Train control application	46
<b>3 Network configuration</b>	<b>47</b>
3.1 Introduction	47
3.2 Coverage	47
3.3 Handover and cell selection	48
3.4 Call setup time requirement	48
3.5 Frequency band and channel arrangements	49
3.6 DTMF tones and signals	50
3.7 Termination of VGCS/VBS calls	50
3.8 Muting and unmuting for VGCS calls	50
3.9 Call Release Causes for Functional Addressing and Location Dependent Addressing	51
<b>4 Mobile equipment core specification</b>	<b>53</b>
4.1 Introduction	53
4.2 Radio interface aspects	55
4.3 Services and facilities	57
4.4 Core MMI requirements	61
4.5 Core environmental requirements	62

4.6	Alerting of a controller	65
4.7	Uplink Reply and Notification Response	67
<b>5</b>	<b>Cab radio</b>	<b>68</b>
5.1	Introduction	68
5.2	System components	68
5.3	Driver call-related functions	69
5.4	MMI functions	71
5.5	Handling of calls	73
5.6	Other Cab radio functions	77
5.7	Environmental and physical	78
5.8	Cab radio interfaces to on-train systems	80
5.9	Train borne recorder	81
5.10	ERTMS/ETCS interface	81
5.11	Public Address interface	81
5.12	UIC Intercom	81
5.13	Driver's Safety Device	81
5.14	Other interfaces	82
5.15	Train Interface Unit (TIU)	82
<b>5A</b>	<b>Handling of calls</b>	<b>84</b>
5A.1	Call arbitration table (MI)	84
5A.2	Call termination of outgoing calls table	90
5A.3	Call termination of incoming calls table	91
<b>6</b>	<b>General purpose radio</b>	<b>93</b>
6.1	Introduction	93
6.2	System components	93
6.3	General purpose radio functions	93
6.4	Environmental and physical	94
<b>7</b>	<b>Operational radio</b>	<b>97</b>
7.1	Introduction	97
7.2	System components	97
7.3	Operational radio functions	97
7.4	Deleted.	99
7.5	Environmental and physical	99
<b>7A</b>	<b>Shunting radio</b>	<b>101</b>
7A.1	Introduction	101
7A.2	System components	101
7A.3	Shunting radio functions	102
7A.4	Environmental and physical	103
<b>8</b>	<b>Controller equipment specifications</b>	<b>105</b>
8.1	General	105
8.2	Termination of VGCS/VBS calls	105

8.3	Muting and unmuting for VGCS calls	105
8.4	Shunting operation	106
8.5	Joining and Re-Joining of Group Calls	106
<b>9</b>	<b>Numbering plan</b>	<b>107</b>
9.1	General	107
9.2	Numbering plan requirements	107
9.3	Numbering plan limitations	109
9.4	Types of numbers	109
9.5	Use of National EIRENE Numbers	110
9.6	Use of International EIRENE Numbers	117
9.7	Use of MSISDN numbers	118
9.8	Use of Short Dialling Codes	118
9.9	Use of group addresses	120
9.10	Access to external networks	120
9.11	Calls from external networks to the GSM-R network	122
9.12	Generic numbering scheme for international calls	122
<b>9A</b>	<b>Function Codes</b>	<b>127</b>
<b>9B</b>	<b>Numbering plan overview</b>	<b>129</b>
<b>10</b>	<b>Subscriber management</b>	<b>131</b>
10.1	Introduction	131
10.2	Allocation of priorities	131
10.3	Access classes	133
10.4	Closed user groups	133
10.5	Network selection	133
10.6	Cell broadcast message identifiers	134
10.7	Security Algorithms	134
<b>11</b>	<b>Functional numbering and location dependent addressing</b>	<b>136</b>
11.1	Introduction	136
11.2	Ground-train addressing	136
11.3	Functional numbering	136
11.4	Re-establishment of functional number correlation	139
11.5	Presentation of functional identities	140
11.6	Inter EIRENE network interfacing	141
11.7	Location dependent addressing	141
11.8	Calls from external networks to the EIRENE network	142
<b>12</b>	<b>Text messaging</b>	<b>144</b>
12.1	Introduction	144
12.2	System requirements	144
<b>13</b>	<b>Railway emergency calls</b>	<b>146</b>
13.1	Introduction	146
13.2	Provision of Railway emergency calls	146

13.3	Initiation of Railway emergency calls	146
13.4	Receipt of Railway emergency calls	147
13.5	Confirmation of Railway emergency calls	147
13.6	Enhancement of Railway emergency calls	148
<b>13A</b>	<b>enhanced Railway emergency calls</b>	<b>149</b>
<b>14</b>	<b>Shunting mode</b>	<b>153</b>
14.1	Introduction	153
14.2	System requirements: Shunting Radio	153
14.3	System requirements: Cab radio	153
14.4	System requirements: Shunting radio and Cab radio	154
14.5	Numbering plan	156
14.6	Control of shunting group membership	157
14.7	Link assurance signal	157
<b>15</b>	<b>Direct mode</b>	<b>168</b>
15.1	Introduction	168
15.2	System requirements	168
<b>16</b>	<b>ETCS data only radio</b>	<b>170</b>
16.1	Introduction	170
16.2	System components	170
16.3	System requirements	171
16.4	Environmental and physical	171
<b>17</b>	<b>Interconnection, Roaming and Border Crossing</b>	<b>174</b>
17.1	Border Crossing	174
<b>A</b>	<b>References</b>	<b>175</b>
A.1	List of normative references	175

## List of abbreviations

3GPP	Third Generation Partnership Project
A-MSC	Anchor MSC
AoC	Advice of Charge
ARFCN	Absolute Radio Frequency Channel Number
ATC	Automatic Train Control
BOIC	Barring of Outgoing International Calls
BSC	Base Station Controller
BSS	Base Station System
BTS	Base Transceiver Station
CCBS	Completion of Calls to Busy Subscribers
CFU	Call Forwarding Unconditional
CHPC	Confirmation of High Priority Calls
CLI	Calling Line Identity
CLIP	Calling Line Identity Presentation
CLIR	Calling Line Identification Restriction
CN	Coach Number
CoLP	Connected Line Identification Presentation
CoLR	Connected Line Identification Restriction
COTS	Commercial Off-the-Shelf
CT	Call Type
CUG	Closed User Group
CW	Call Waiting
DSD	Driver Safety Device
DM	Direct Mode
ECT	Explicit Call Transfer
EDOR	ETCS data only cab radio
EIRENE	European Integrated Railway Radio Enhanced Network
eMLPP	Enhanced Multi-Level Precedence and Pre-emption
EN	Engine Number
ENAN	EIRENE Network Access Number
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
ETSI	European Telecommunications Standards Institute
FA	Functional Addressing
FC	Function Code

FFFIS	Form Fit Functional Interface Specification
FFFS	Form Fit Functional Specification
FIS	Functional Interface Specification
FN	Functional Number
GCSMSC	Group Call Serving MSC
GCR	Group Call Register
GGSN	Gateway GPRS Support Node
GLN	Group Location Number
GMSC	Gateway MSC
GPS	Global Positioning System
GPRS	General Packet Radio Service
GSM	Global System for Mobile communications
GSM-R	GSM - Railway
HLR	Home Location Register
IC	International Code
IE	Information Element
IEC	International Electrotechnical Commission
IFN	International Functional Number
IMSI	International Mobile Subscriber Identity
IP	Internet protocol
ISDN	Integrated Services Digital Network
ITU	International Telecommunications Union
ITU-T	International Telecommunications Union – Telecommunications
LDA	Location Dependant Addressing
LN	Location Number
MAP	Mobile Application Part
ME	Mobile Equipment
MGW	Media Gateway
MMI	Man-Machine Interface (this term encompasses all Human-Machine Interfaces including the Driver-Machine Interface and the Controller-Machine Interface)
MO/PP	Mobile Originated/Point-to-Point (short message)
MORANE	MOBILE radio for RAILway Networks in Europe
MPTY	Multi ParTY service
MS	Mobile Station
MSC	Mobile services Switching Centre

MSC-S	MSC Server
MSISDN	Mobile Station International ISDN Number
MT	Mobile Termination
MT/PP	Mobile Terminated/Point-to-Point (short message)
MTLN	Maintenance Team Location Number
NFN	National Functional Number
NSS	Network Sub-System
OMC	Operation and Maintenance Centre
OTA	Over the Air
PA	Public Address
PABX	Private Automatic Branch Exchange
PDP	Packet Data Protocol
PFN	Presentation of Functional Numbers
PLMN	Public Land Mobile Network
PTT	Push-To-Talk
QoS	Quality of Service
RAN	Radio Access Network
RANFlex	Radio Network Flexibility
RBC	Radio Block Centre
REC/eREC	Railway Emergency Call / enhanced Railway Emergency Call
R-MSC	Relay MSC
SA	Service Area
SGSN	Serving GPRS Support Node
SIM	Subscriber Identity Module
SIP	Session Initiation Protocol
SMS	Short Message Service
STLN	Shunting Team Location Number
TBD	To Be Determined
TCLN	Train Controller Location Number
TDMA	Time Division Multiple Access
TN	Train Number
TRX	Transceiver
TS	Technical Specification
UA	Unnumbered Acknowledge
UIC	Union Internationale des Chemins de Fer

*List of abbreviations*

UIN	User Identifier Number
Um	GSM air interface
UN	User Number
USSD	Unstructured Supplementary Service Data
UUS1	User-to-User Signalling type 1
VBS	Voice Broadcast Service
VGCS	Voice Group Call Service
VLR	Visitor Location Register

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## List of definitions

### Balise

A passive or active device normally mounted in proximity to the track for communications with passing trains. A standard for passive balises has been devised within the EUROBALISE project.

### Broadcast call

A call made to all members of a pre-defined group within a local geographical area. Only the initiator of the call may talk with all other group members listening only.

### Cab radio

The radio and associated user and other interfaces installed in the cab of a locomotive and for use principally by the locomotive driver.

### Call type

A prefix used to identify the User Number dialled.

### Chief conductor

A member of the train crew with overall responsibility for passenger related Railway activities on-board the train.

### Coach number

A number assigned to an item of rolling stock on a permanent basis. The coach number may form a component of a functional number used to address users/systems on an item of rolling stock.

### Controller

An individual responsible for the conduct of some aspect of train operations (also known as dispatcher). For the purposes of this specification the following functional roles of controllers are defined:

- primary controller;
- secondary controller;
- traffic controller;
- power supply controller.

Dependent upon local circumstances, a number of functional roles can be carried out by a single controller or a single functional role can be carried out by a number of controllers.

#### Direct mode

The term for back-to-back or set-to-set radio communications without the use of any ground infrastructure.

#### Driver safety device

An on-train system which monitors the alertness of the driver and provides warning and alarms to other systems as appropriate.

#### EIRENE network

An EIRENE network is a railway telecommunications network, based on the ETSI GSM standard, which complies with all related mandatory requirements specified in the EIRENE FRS and SRS. An EIRENE network may also include optional features and these shall then be implemented as specified in the EIRENE FRS and SRS. The EIRENE network excludes terminals.

#### EIRENE Network Access Number

A number dialled as an access code to allow use of functional numbers not compliant with [ITU-T E.164].

#### EIRENE system

An EIRENE system is a railway telecommunications system based on the ETSI GSM standard, which complies with all related mandatory requirements as specified in the EIRENE FRS and SRS. An EIRENE system may also include optional features and these shall then be implemented as specified in the EIRENE FRS and SRS. The EIRENE System includes terminals.

#### Engine number

A number assigned to an item of traction stock on a permanent basis. The engine number may form a component of a functional number used to address users/systems on an item of traction stock.

#### ETCS data only radio

The radio equipment dedicated to support the ETCS train control application data transmission requirements. This equipment includes one or several radio transceivers and their enclosure.

## Fiche

A UIC fiche or leaflet is a document adopted by UIC members. Statements within the fiche may comprise specifications which are binding on UIC members ('obligatory' specifications) or optional ('recommended' specifications). The existing track-to-train radio standard is contained within UIC fiche 751-3. It is envisaged that the EIRENE standard will be covered by a new UIC fiche, 951.

## Functional addressing/numbering

A term used to describe the process of addressing a call using a number representing the function a user is performing, rather than a number identifying the user's terminal equipment.

## Functional identity

The full alphanumeric description of the function performed by a called or calling party within the functional numbering scheme, identifying them by function or role rather than by a specific item of radio equipment or user subscription. The functional identity can include characters and/or numbers.

## Functional number

The full number used within the functional addressing scheme to contact an end user/system by function or role rather than by a specific item of radio equipment or user subscription.

## General purpose radio

A standard GSM radio based closely on commercially available units for general use.

## Group call

A call made to all members of a pre-defined group within a local geographical area. Only one member of the group may talk at any instant with all other group members listening only.

## Handover

The process by which connection between the GSM mobile and the GSM network is maintained as the mobile moves from area to area, by passing communication channel control from one base station to another or between different channels in one cell.

### High priority call

High priority calls (critical group calls for drivers in the same area initiated by a driver, critical group calls for station and security staff, trackside maintenance staff and controller groups) are made in exceptional circumstances where the situation requires a higher level of priority than for normal operational calls, but the same call handling regarding alerting and setup. These calls have lower priority than Railway emergency calls.

### High speed line

A section of route forming part of the European High Speed Rail Network and any additional routes specified as such by national administrations.

### Link assurance signal

A form of unidirectional signalling transmitted periodically or constantly from one radio to another to allow the receiving user to detect a break in radio transmission during critical manoeuvres (e.g. during shunting).

### Location dependent addressing

A term used to describe the process of addressing a particular function (typically a controller) based on the current location of the user (typically a train).

### Maintenance settings

Maintenance settings are settings that are not normally accessible by the user in operational modes. These settings will normally be accessible only by authorised maintenance personnel.

### Multi-party call

A voice communication method whereby a number of parties defined by the call initiator may participate in the call. All parties may talk simultaneously. The parties can be connected to different MSCs.

### Multiple driver communications

A term used to describe communications between the drivers of each active cab in a train comprising multiple traction vehicles.

### Operational communications

These are railway communications directly concerned with train movements or train operation. For example controller-driver communications.

Operational radio

A handheld radio suitable for use by people involved in railway operations.

Power supply controller

A controller responsible for the management of the traction power supply.

Primary controller

The location and direction of movement of any particular train permits the unique identification of a Primary Controller. The Primary Controller is currently the co-ordinator of train emergency calls. The Primary Controller is normally responsible for the operation of a designated area of track. The exact responsibilities of the Primary Controller are determined on a national basis.

Radio Block Centre

An ERTMS/ETCS term referring to a centralised safety unit to establish and control train separation using radio as the train to ground communication medium.

Railway Access Code

A prefix used to identify an EIRENE network outside the network the calling party is operating in.

Railway emergency call

A call of the highest priority for warning drivers, controllers and other concerned personnel of a dangerous situation in a pre-defined area. Two types of Railway emergency calls are defined:

- Train emergency calls (for Railway emergencies whilst not involved in Shunting operations).
- Shunting emergency calls (for Railway emergencies whilst involved in Shunting operations).

enhanced Railway emergency call

Unless otherwise specified, Railway emergency call also applies to enhanced Railway emergency call in this document.

eREC provides an additional set of functionalities to enhance the operation of railway emergency calls so as to define these areas to include or exclude joining, crossing and parallel tracks and shunting areas. eREC allows to achieve discrimination of Railway emergency call in order to minimize production loss.

## Roaming

The use of a mobile on any communications network other than the user's home network.

## Routing database

The database that contains the registered relationships between the functional number and the MSISDN.

## Secondary controller

A Secondary Controller is a train controller who holds responsibility for the safe running of trains on a designated area of track (e.g. a signaller). Secondary Controllers require the facility to communicate with trains in all situations in order to perform their function. The split of responsibilities between Primary Controllers and Secondary Controllers is determined on a national basis.

## Shunting emergency call

A Railway emergency call used to instruct shunting teams to cease shunting movements immediately.

## Shunting mode

Shunting mode is the operational mode of mobile terminals, where the train emergency call 299 and the group call "all drivers in same area" 200 are deactivated on the SIM and at least the shunting emergency call 599 is activated.

## Shunting radio

A handheld radio suitable for use by people involved in railway operations including shunting operations.

## Shunting team

A group of people manoeuvring trains in order to change their composition. Communications for shunting are particularly critical when a driver at the front of a train is pushing it backwards towards buffers or other potential obstructions. In this case a lookout is often required to report progress to the driver.

## Stock number

A number assigned to an item of traction or rolling stock on a permanent basis. A stock number may form a component of a functional number used to address users/systems on an item of traction or rolling stock.

### Support communications

These are railway communications which are not directly concerned with train movements or train operation. For example such communications might involve the passage of catering, maintenance or timetable information.

### Trackside environment

The Trackside environment consists of rail yards and track sections, where the following extreme environmental conditions are observed:

- Very low and high temperatures
- Rapid temperature variations;
- Heavy snowfall;
- Heavy rain;
- Strong winds;
- Very strong occasional water splashes and water jets (e.g. from the roof of coaches);
- High incidence of fine dust particles, especially iron particles;
- Very high ambient noise level
- High variation of illumination (from darkness to direct sunlight).

### Traffic controller

A controller who has responsibility for the scheduling of trains and the 'flow' of trains over the network. For example, traffic control personnel are responsible for such activities as holding connecting services and minimising disruption to the timetable. The traffic control function has no formal safety responsibility.

### Train control system (TCS)

The process by which the movement of a train is influenced without any action by the driver. For the purposes of this specification, reference to the train control system also encompasses automatic train protection, automatic train operation and in-cab signalling.

### Train controller

A controller who has responsibility for the safe movement of trains.

### Train mode

Train mode is the operational mode of mobile terminals, where at least the train emergency call 299 and the group call "all drivers in same area" 200 are activated on the SIM and the shunting emergency call 599 is de-activated.

### Train number

A number given to a train by operational staff for a particular journey. A train number may form a component of functional number used to address users/systems on a train.

### Tromboning

Tromboning may occur when a call is placed to a roaming mobile in the same country as the call originator. Tromboning is the term given to the routing of a call via the mobile's home country and back. This is obviously undesirable.

### User number

The entry in a routing database. It consists of two parts: the User Identifier Number and the Functional Code.

# **1 Introduction**

## **1.1 General**

1.1.1 This specification has been developed within UIC Project EIRENE. It specifies a digital radio standard for the European railways applicable worldwide. It forms part of the specification for technical interoperability. (I)

## **1.2 Scope**

1.2.1 The EIRENE System Requirements Specification defines a radio system satisfying the mobile communications requirements of the applicable worldwide [EIRENE FRS]. It encompasses ground-train voice and data communications, together with the ground-based mobile communications needs of trackside workers, station and depot staff and railway administrative and managerial personnel. (I)

1.2.2 Figure 1-1 shows how the EIRENE system is covered in this specification, by associating each element of the system with its corresponding section number(s). References specifying the main interfaces are also cited, and are detailed more extensively in Appendix A. (I)

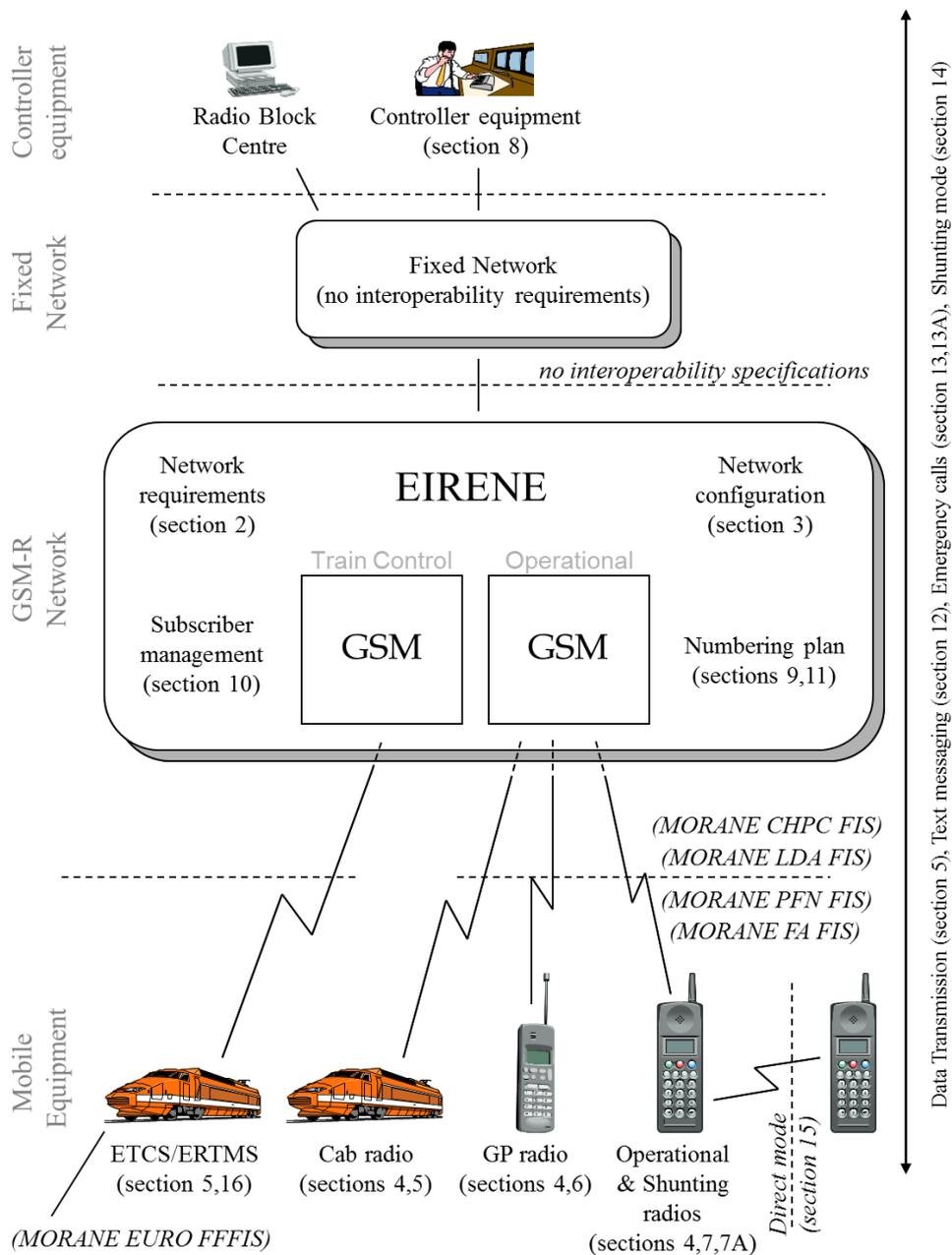


Figure 1-1: Layout of EIRENE specifications and details of interfaces

1.2.3 The application of this specification will ensure interoperability for trains and staff crossing national or other borders between systems. It also intends to provide manufacturing economies of scale wherever practical. (I)

### 1.3 Applicability

- 1.3.1 The EIRENE System Requirements Specification defines the set of requirements which a railway radio system shall comply with in order to ensure interoperability between national railways. (I)
- 1.3.2 The EIRENE Functional Requirements Specification [EIRENE FRS] specifies the functional requirements for EIRENE. (I)
- 1.3.3 The specification distinguishes between requirements affecting a railway's network infrastructure, onto which mobiles will roam, and the requirements concerning mobiles which may be used in any EIRENE compliant network. (I)
- 1.3.4 The statements made in the specification are assigned to one of three categories: (I)
- **Mandatory for Interoperability** (indicated by '(MI)' at the end of the paragraph). These are the requirements, **with respect to the authorisation in the EU according to the TSI**, that are considered in the European Directives to be relevant for interoperability as **fulfilling the essential requirements for the Control-Command and Signalling subsystem** related to safety and technical compatibility which must be met by the rail system, the subsystems, and the interoperability constituents, including interfaces according to the corresponding conditions set out in Annex III of the Directive 2008/57/EC. It is mandatory that each railway subsystem in the EU meets these requirements on lines under the scope of the Directive to ensure technical compatibility between Member States and safe integration between train and track.
  - **Mandatory for the System** (indicated by '(M)' at the end of the paragraph). These requirements must be complied with together with the "Mandatory for Interoperability (MI)" requirements in order to deliver an EIRENE compliant system. The M requirements ensure additional level of system technical integration and compliance to existing standards; they allow that the technical characteristics of the network and fixed terminal system are compatible with each other and with those on board the trains to be used on the rail system.
  - **Optional** (indicated by '(O)' at the end of the paragraph). These requirements allow the selection (or non-selection) of a set of requirements on a national basis and shall not be used as a precondition for the acceptance of roaming mobile equipment on GSM-R networks. When an option is selected, the method defined in the SRS and FRS by which such features are implemented becomes mandatory (M), both to provide a consistent service and to present a recognised and agreed standard to manufacturers in order to obtain economies of scale in development and manufacture.
  - **Information** (indicated by '(I)' at the end of the paragraph). These are statements intended to provide explanatory notes.
  - Note: NA is used to indicate that a particular service is not applicable and will therefore not need to be provided.

## **1.4 System overview**

### **1.4.1 Extent of specification**

1.4.1.1 The system is based on the ETSI GSM standard. To meet additional functionality and performance requirements, this standard is to be supplemented by: (I)

- the following GSM services:
- voice broadcast service;
- voice group call service;
- enhanced multi-level precedence and pre-emption;
- General Packet Radio Service (GPRS);
- Asynchronous and transparent data services at 2.4, 4.8 and 9.6 kbps;
- railway specific applications:
- exchange of number and location information between train and ground to support functional and location dependent addressing;
- emergency calls;
- shunting mode;
- multiple driver communications;
- direct mode facility for set-to-set operation;
- railway specific features, network parameters and standards:
- link assurance signal;
- calling and connected line presentation of functional identities;
- cab radio, man-machine and other interfaces;
- environmental specifications;
- controller position functional specifications;
- system configuration (numbering plans, priority levels, subscriber details, closed user groups, etc).

1.4.1.2 The scope of the specification is shown in figure 1-2, showing the hierarchy of the GSM, and railway features to be implemented. (I)

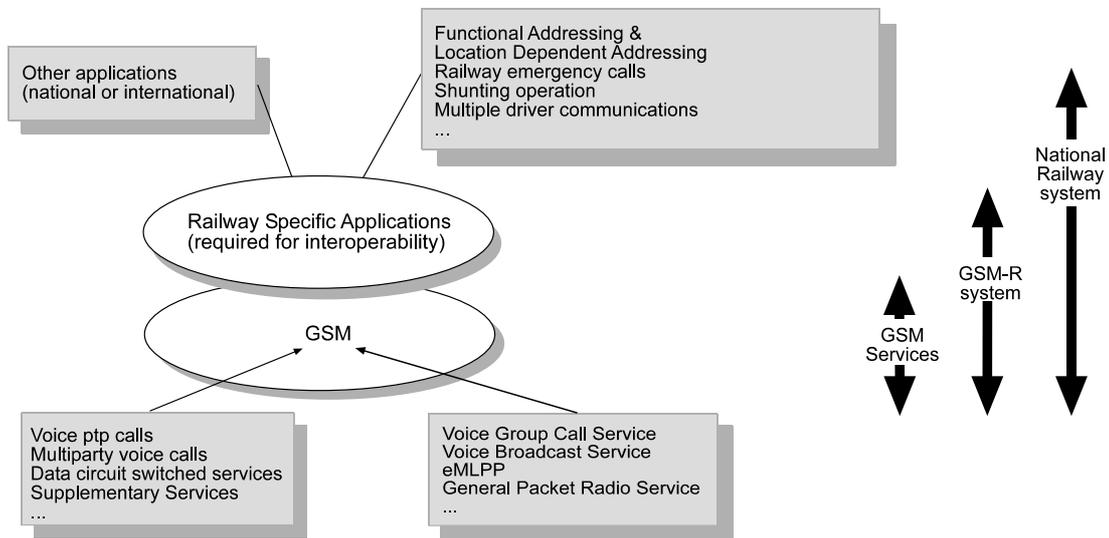


Figure 1-2: Scope of the GSM-R system with reference to functionality provided by GSM

- 1.4.1.3 A list of ETSI and 3GPP specifications is provided in the normative references section of this document. (I)
- 1.4.1.4 Compliance to the list of normative documents is mandatory for all of the GSM services necessary to provide the functionality specified in the [EIRENE FRS]. (M)
- 1.4.1.5 Later releases of these specifications may be used, providing that the system is backwards-compatible with the versions listed. (I)

**1.4.2 Outline architecture**

- 1.4.2.1 The system is based on the GSM architecture which is summarised in figure 1-3. (I)

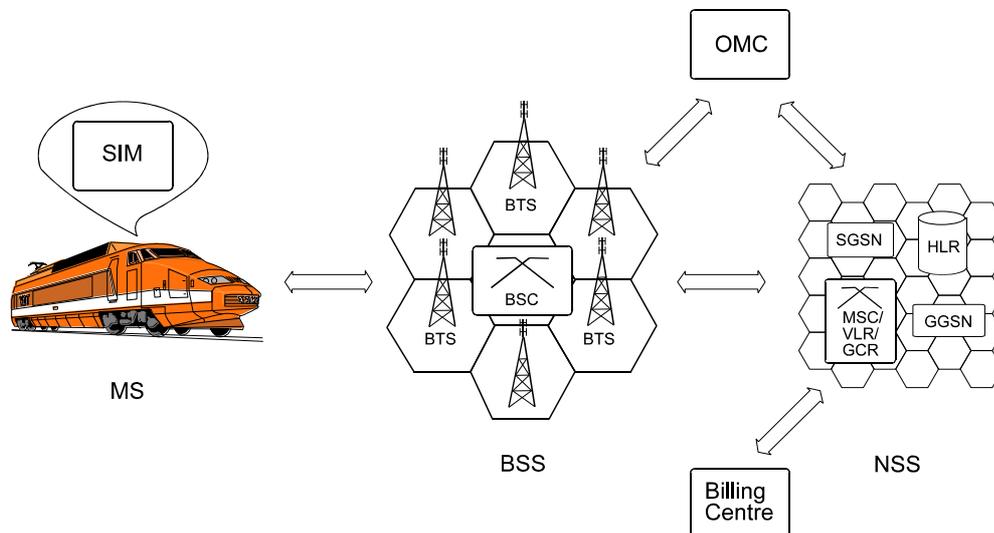


Figure 1-3: GSM architecture overview

#### 1.4.2.2 The system comprises the following elements: (I)

- Base station sub-systems (BSSs) of base station controllers (BSCs) controlling base transceiver stations (BTSs) each containing a number of transceivers (TRXs).
- Network sub-systems (NSSs) interfacing to the BSS via the GSM 'A' interface. The NSS contains mobile services switching centres (MSCs) with primary responsibility for call control. The MSC is supported by a visitor location register (VLR) containing temporary details of subscribers active within the MSC area, a group call register (GCR) containing attributes of voice group and broadcast call configurations for the related MSC area and home location registers (HLRs) holding subscriber details on a permanent basis.

Whenever the terms MSC, GMSC, A-MSC or R-MSC are used in the specification, they refer to the relevant MSC functionalities that can be implemented in two different architectures as described in [TS 103 066]:

- ETSI GSM Release 99 (R99) includes MSC or multiple MSCs
- 3GPP Release 4 (Rel-4) includes single or multiple MSC Server(s) coupled with Media Gateway(s).

A BSC can be connected to multiple MSCs (RANFlex) in order to increase the system availability, e.g. to overcome MSC disaster situations.

- The network also comprises General Packet Radio Service (GPRS) infrastructure elements supporting the respective packet radio services. The serving GPRS support node (SGSN) is a location register function storing subscription information and location information for each subscriber registered in that node. It interfaces to the BSS via the Gb interface and to the MSC/VLR via the Gs interface and to the HLR via the Gr interface. The gateway GPRS support node (GGSN) is a location register function storing subscription information and routing information (needed to tunnel packet data traffic destined for a GPRS MS to the SGSN where the MS is registered) for each subscriber for which the GGSN has at least one PDP context active. It interfaces to the SGSN via the Gn interface, to the HLR via the Gx interface, to external packet data networks via the Gi interface and to other GSM/GPRS networks via the Gp interface.
  - Mobile equipment (ME) interfacing to the BSS via the air (Um) interface.
  - Subscriber Identity Modules (SIMs) containing information specific to single subscribers. A standardised interface links mobile equipment to SIM cards. A SIM and ME combined are termed a mobile station (MS).
  - Operation and Maintenance Centre (OMC) for managing the network.
  - Billing Centre.
- 1.4.2.3 Signalling within the NSS and between NSSs is carried out according to signalling system number 7, SS7, making specific use of the mobile application part (MAP) of that standard. (I)
- 1.4.2.4 Railway networks may implement a short message service centre to be interfaced to the GSM network in order to support railway specific messaging applications. (I)
- 1.4.2.5 A railway GSM network is also likely to have external interfaces to: (I)
- private railway fixed networks;
  - public operator networks;
  - controller equipment;
  - specialised railway systems (e.g. train control systems).
- 1.4.2.6 EIRENE will provide the radio bearer for ERTMS/ETCS. The EURORADIO layers are responsible for ensuring the overall safety of the transmission link between train-borne and trackside ERTMS/ETCS applications. (I)
- 1.4.2.7 In addition to a GSM capability, a direct mode capability may be provided for railway mobiles for set-to-set operation. (I)
- 1.4.2.8 Standardised interface protocols are to be provided to allow applications external to EIRENE to access EIRENE bearer services. (I)
- 1.4.2.9 Applications may include: (I)
- public address;

- intercom;
- driver safety device;
- train borne recorder.

### 1.4.3 Railway specific services and facilities

1.4.3.1 To meet the specific railway requirements, a number of additional features are required some of which have been incorporated in the GSM Standard. The main aspects are summarised in the following paragraphs. (I)

1.4.3.2 **Frequency:** Equipment is to be capable of operation (see figure 1-4) in a sub-band, or combination of sub-bands, of the R-GSM band. The R-GSM band includes the UIC frequency band and the Extended GSM (E-GSM) band which includes the Public GSM (P-GSM) band. (I)

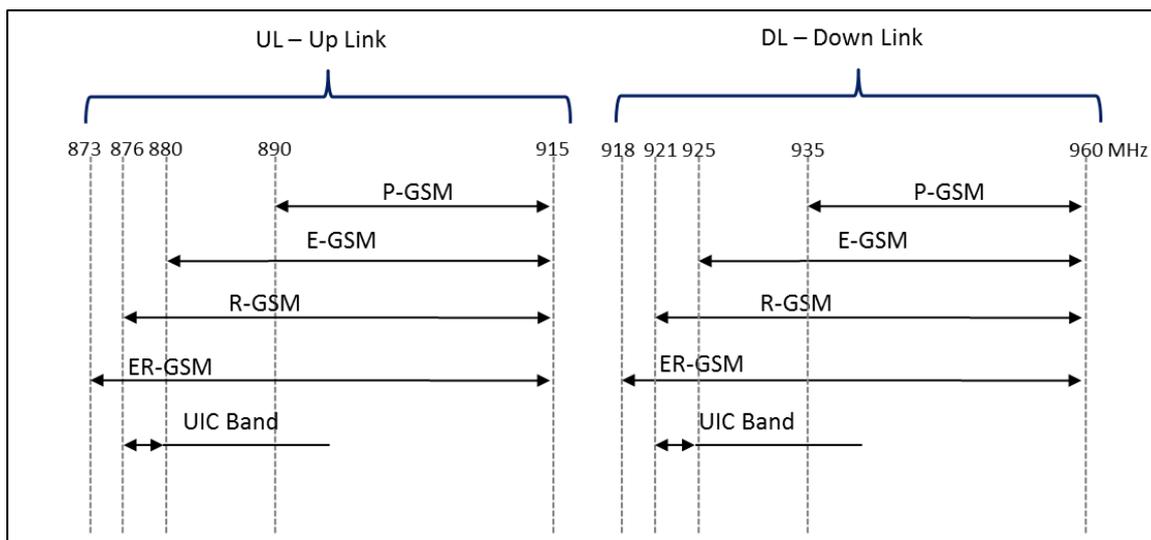


Figure 1-4

	Sub-Bands	Frequencies (MHz)
R-GSM band	UIC frequency band	876-880/921-925
	Extended GSM (E-GSM) band	880-915/925-960
	Public GSM (P-GSM) band	890-915/935-960

Table 1-A

- 1.4.3.2i For applications of EIRENE Systems which are not relevant to interoperability of the rail system within the European Community, in particular according to the Directive 2008/57/EC, the frequencies given in clause 1.4.3.2 need not necessarily be supported. Alternative frequencies may be employed according to local spectrum availability and allocation. The frequencies employed may be in the ER-GSM band or the frequency bands allocated for GSM as defined in [EN301 515, index [35]]. (I)
- 1.4.3.3 **Voice broadcast and group call facilities:** All mobile equipment (ME) except ETCS data only radio are to support these services as defined in the relevant GSM specifications. The services will mainly be used to: (I)
- broadcast messages from controllers to certain groups of trains in a controller area;
  - broadcast messages from trains or shunting team members to controllers or other mobiles in a defined area;
  - conduct group calls between train drivers and controllers over pre-defined areas;
  - conduct group calls between trackside workers, shunting team members, station staff and similar groups, typically over local areas.
- 1.4.3.4 **Enhanced multi-level precedence and pre-emption:** This GSM specification is to be implemented in order to achieve the high performance requirements necessary for emergency group calls. It is also necessary to meet different grades of service requirements for different types of communications traffic on the system (e.g. safety (e.g. train control system), operational and administrative communications). (I)
- 1.4.3.5 **Functional numbering:** Many railway staff need to be addressed by functional rather than personal numbers. The functional numbers may change on a regular basis. The principal example is that of train drivers, who need to be addressed by train numbers which change with each journey. To overcome this difficulty a translation facility will be provided to allow calls to functional numbers to be forwarded to the most appropriate personal number at that time. Thus calls made to a train number are forwarded by the network to the appropriate driver or locomotive for that train at that time. (I)
- 1.4.3.6 A follow-me service will be implemented in the EIRENE network using the GSM Unstructured Supplementary Service Data (USSD) facility to allow users to establish and terminate the forwarding of calls from a functional number to their personal number. (I)
- 1.4.3.7 **Location dependent addressing:** Train drivers need to be able to contact controllers and other staff at the push of a single button. As the train moves through different areas, controllers are liable to change. As a consequence it is necessary to provide a means of addressing calls from a train to certain functions based on the location of the train. (I)
- 1.4.3.8 The only source of location information available within the GSM network is the cell that the train is in. However, there are a number of external sources from which more accurate location information may be derived: (I)

- on-train location systems;
- trackside balises;
- information from ground based systems.

1.4.3.9 Within EIRENE, the primary means of determining the location of a train for the purpose of location dependent addressing will be based on the cell dependent routing. This may be supplemented with additional information from external systems to provide a greater degree of accuracy. (I)

1.4.3.10 **Direct mode:** Railway mobiles may support a direct communications mode whereby a mobile can communicate with all other railway mobiles in a local area without the use of GSM infrastructure. Such a mode is required for use where: (I)

- no GSM infrastructure is provided;
- GSM infrastructure equipment has failed.

## 1.5 Structure of the specification

1.5.1 The specification is divided into the following separate sections: (I)

1. Introduction;
2. Network requirements;
3. Network configuration;
4. Mobile equipment core specification;
5. Cab radio;
6. General purpose radio;
7. Operational radio;
- 7A. Shunting radio;
8. Controller equipment specifications;
9. Numbering plan;
10. Subscriber management;
11. Functional numbering and location dependent addressing;
12. Text messaging;
13. Railway emergency calls;
- 13A. enhanced Railway emergency calls;
14. Shunting mode;
15. Direct mode;
16. ETCS data only radio;

## 17. Interconnection, Roaming and Border Crossing

## A. References.

- 1.5.2 Section 2 lists the services and facilities which are to be supported by GSM-R networks. Section 3 provides requirements and recommendations concerning the configuration, planning and implementation of networks. (I)
- 1.5.3 Sections 4, 5, 6, 7, 7A and 16 are concerned with mobile equipment. Section 4 provides specifications applicable to all GSM-R mobiles. Sections 5, 6, 7, 7A and 16 detail the additional requirements for Cab radio, General purpose radio, Operational radio, Shunting radio and ETCS data only radio equipment respectively. Note that for the handheld version of the General purpose radio, commercial standards apply. (I)
- 1.5.4 Section 8 covers controller equipment. Section 9 is concerned with a numbering plan for the variety of functional numbers which are required. Section 10 details the handling of other information, such as priority, closed user groups and encryption algorithms, which must be applied consistently in all networks. (I)
- 1.5.5 Section 11 specifies functional and location dependent addressing. Section 12 refers to the possible use of pre-defined text messages (not required for interoperability). (I)
- 1.5.6 Sections 13 to 15 and 17 describe the implementation of emergency calls, shunting mode, direct mode and Interconnection, Roaming and Border Crossing. (I)
- 1.5.7 References for all sections are included in appendix A. (I)

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## 2 Network requirements

### 2.1 Introduction

2.1.1 The network services necessary to meet the range of UIC requirements are detailed below. These services are to be considered as a minimum set for implementation within each GSM-R network. Railways may implement additional network services as desired. (I)

### 2.2 GSM teleservices

2.2.1 The GSM teleservices [EN 301 515, Index [24]] to be supported are indicated in table 2-1.

Category	Teleservice	Requirement	Notes
1 Speech transmission	11 Telephony	MI	
	12 Emergency calls	M	For '112' calls and not necessarily railway operational emergencies.
2 Short message service	21 Short message MT/PP	O	Service may be used for the passage of text messages.
	22 Short message MO/PP	O	
	23 Short message cell broadcast	O	
6 Facsimile transmission	61 Alternate speech and fax group 3	O	
	62 Automatic fax group 3	O	
9 Voice Group service*	91 Voice Group Call Service (VGCS)	MI	
	92 Voice Broadcast Service (VBS)	M	

MT/PP - Mobile Terminated/Point-to-Point

MO/PP - Mobile Originated/Point-to-Point

\* Voice Group service specifications contain implementation options. The options required for interoperability are as stated in [ASCI OPTIONS]

Table 2-1: GSM teleservices to be supported

## 2.3 GSM bearer services

2.3.1 The GSM bearer services [EN 301 515, Index [23]] to be supported are listed in table 2-2.

Bearer service	Requirement	Notes
20. Asynchronous General Bearer Service	O	
21. Asynchronous 300 bps T	O	
21. Asynchronous 300 bps NT	O	
22. Asynchronous 1.2 kbps T	O	
22. Asynchronous 1.2 kbps NT	O	
23. Asynchronous 1200/75 bps T	O	
23. Asynchronous 1200/75 bps NT	O	
24. Asynchronous 2.4 kbps T	MI	E.g. V.21, V.22, V.22 bis, V.23, V.32 access
24. Asynchronous 2.4 kbps NT	O	
25. Asynchronous 4.8 kbps T	MI	Connection to standard ISDN fixed networks
25. Asynchronous 4.8 kbps NT	O	
26. Asynchronous 9.6 kbps T	MI	
26. Asynchronous 9.6 kbps NT	O	
30. Synchronous General Bearer Service	O	
31. Synchronous 1.2 kbps T	O	
31. Synchronous 1.2 kbps NT	O	
32. Synchronous 2.4 kbps T	O	
32. Synchronous 2.4 kbps NT	O	
33. Synchronous 4.8 kbps T	O	
33. Synchronous 4.8 kbps NT	O	
34. Synchronous 9.6 kbps T	O	
34. Synchronous 9.6 kbps NT	O	
40. General PAD Access Bearer Service	O	
41. PAD access 300 bps T	O	
41. PAD access 300 bps NT	O	
42. PAD access 1.2 kbps T	O	
42. PAD access 1.2 kbps NT	O	
43. PAD access 1200/75 bps T	O	
43. PAD access 1200/75 bps NT	O	
44. PAD access 2.4 kbps T	O	
44. PAD access 2.4 kbps NT	O	
45. PAD access 4.8 kbps T	O	
45. PAD access 4.8 kbps NT	O	
46. PAD access 9.6 kbps T	O	
46. PAD access 9.6 kbps NT	O	
61. Alternate speech/data	O	
70. GPRS	O	
81. Speech followed by data	O	

T - Transparent; NT - Non-transparent

Table 2-2: GSM bearer services to be supported

2.3.2 The Adaptive Multi-Rate (AMR) CODEC is not suitable for voice group calls or for voice broadcast calls. (I)

## 2.4 GSM supplementary services

2.4.1 The GSM supplementary services [EN 301 515] and [SUPP SERVICES] to be supported and their applicability are listed in table 2-3.

Supplementary service	Requirement	Notes
Calling Line Identification Presentation (CLIP)	MI	Note 1
Calling Line Identification Restriction (CLIR)	O	
Connected Line Identification Presentation (CoLP)	MI	Note 1
Connected Line Identification Restriction (CoLR)	O	
Call Forwarding Unconditional (CFU)	MI	Note 2
Call Forwarding on Mobile Subscriber Busy (CFB)	MI	Note 3
Call Forwarding on No Reply (CFNRy)	O	
Call forwarding on Mobile Subscriber Not Reachable (CFNRc)	O	
Call waiting (CW)	MI	
Call hold (HOLD)	MI	
Multi Party Service (MPTY)	MI	
Closed User Group (CUG)	O	
Advice of Charge (Information) (AoCI)	O	
Advice of Charge (Charging) (AoCC)	O	
Barring of All Outgoing Calls (BAOC)	O	
Barring of Outgoing International Calls (BOIC)	O	
BOIC except those to Home PLMN Country (BOIC-exHC)	M	
Barring of All Incoming Calls (BAIC)	O	
Barring of Incoming Calls when Roaming Outside the Home PLMN Country (BIC-Roam)	M	
Unstructured Supplementary Service Data (USSD)	MI	
Follow Me	MI	
Sub-addressing*	MI	
Enhanced Multi-Level Precedence and Pre-emption (eMLPP)	MI	
Explicit Call Transfer (ECT)	O	
Completion of Calls to Busy Subscribers (CCBS)	O	
User-to-User Signalling 1 (UUS1)	MI	Note 4

Note 1 - Provide additional safety check for driver-controller communications

Note 2 - Can be used for train number conversion (see section 11)

Note 3 - To be used for call forwarding where there are multiple radios in the cab

Note 4 - Used for the transfer of functional numbers (sender and receiver) and railway emergency call confirmation messages

\* Sub-addressing is not a GSM supplementary service but for convenience is listed in the above table

Table 2-3: GSM supplementary services to be supported

## 2.5 Railway specific services

2.5.1 The railway specific services to be supported are listed in table 2-4.

Railway service	Requirement	Notes
Functional addressing (section 11)	MI	
Location dependent addressing (section 11)	MI	
Shunting mode (section 14)	MI	
Multiple driver communications (section 5)	MI	
Railway Emergency calls (section 13)	MI	
enhanced Railway Emergency Calls (section 13A)	O	

Table 2-4: Railway specific services to be supported

## 2.6 Alerting duration

2.6.1 The call waiting service (CW) permits a party A to be notified of an incoming call from party C whilst the traffic channel is not available for the incoming call and party A is engaged in an active call with party B. However call waiting does not operate during the prior set up of the call between the parties A and B (including alerting if used). Therefore the alerting duration has to be as short as possible in order to minimize the risk for the party A of missing notification of an incoming call from party C with a higher eMLPP priority. Taking into account technical and operational aspects, it is recommended to set the relevant timer(s) in the network in such a way that the maximum alerting duration is limited to 60s. (I)

## 2.7 Uplink Reply and Notification Response

2.7.1 "Uplink Reply" and "Notification Response" are procedures for VGCS and VBS to optimize the usage of radio resources and can be used depending on the Group Call Reference number (Group Call Area, Group Identity), e.g. for national local applications.

2.7.2 "Uplink Reply" and "Notification Response" procedures may be applied in an EIRENE network. (O)

2.7.3 "Uplink Reply" and "Notification Response" procedures shall not be applied in an EIRENE network for any function required for interoperability (e.g. REC and call to drivers in the area). (MI)

2.7.4 "Uplink Reply" and "Notification Response" procedures shall not be applied in an EIRENE network for a determined Group Call Reference number if not all EIRENE mobile stations of this VGCS or VBS call support them. (M)

- 2.7.5 If the procedures “Uplink Reply” and “Notification Response” are applied they shall be in accordance with [EN301 515, Index [4]] for VGCS and with [EN 301 515,Index [5]] for VBS. (M)
- 2.7.6 If the Uplink Reply procedure is applied, the EIRENE network can obtain knowledge on whether EIRENE mobile stations are listening in a cell by sending an uplink access request (perform uplink reply procedure) in an uplink free message on the VGCS / VBS call channel downlink when no talking service subscriber is present in the cell. (I)
- 2.7.7 If no uplink access bursts are received by the EIRENE network from any mobile, the EIRENE network can decide to release the VGCS / VBS call channel in that cell and then provide notifications containing no channel description. (I)
- 2.7.8 The EIRENE network shall establish a VGCS / VBS call channel in a cell and inform the EIRENE mobile station on the channel position if it receives a notification response from an EIRENE mobile station moving to this cell with notifications containing no channel description. (M)

## **2.8 Network architecture**

- 2.8.1 The architecture of the core network shall be based on ETSI Release 99 specifications. (M)
- 2.8.1i The core network implemented using the ETSI Release 99 architecture shall comply with [EN 301 515] and [TS 102 281]. (M)
- 2.8.2 The architecture of the core network could be based on ETSI Release 4 specifications. (O)
- 2.8.2i If the core network is implemented using the ETSI Release 4 architecture, it shall comply with [EN 301 515], [TS 102 281] and [TS 103 066]. (M)
- 2.8.3 The non-core part of the network shall be based on ETSI Release 99 specifications. It shall comply with [EN 301 515] and [TS 102 281]. (M)

## **2.9 Core Network Redundancy**

- 2.9.1 In order to increase the system availability, RANFlex can be used. RANFlex introduces redundancy of MSCs while VGCS/VBS requires a specific hierarchy for service and traffic plane control. So for interworking of RANFlex and VGCS/VBS further enhancements are necessary.(I)
- 2.9.2 In order to achieve full interworking between RANFlex and VGCS/VBS including redundancy for VGCS/VBS, the feature GSM-R Core Network Redundancy can be implemented. (O)

2.9.3 If the feature GSM-R Core Network Redundancy based on RANFlex is implemented, it shall comply with [ETSI TS 103 147]. (M)

## **2.10 Interfaces to Core Network**

2.10.1 The GSM-R Core Network interfaces to controller equipment. (I)

2.10.2 If this GSM-R Core Network interface is IP based using SIP, it shall comply with the requirements described in Chapter 8. (M)

## **2.11 Train control application**

2.11.1 Where ERTMS/ETCS level 2 or 3 is implemented, the Quality of Service requirements as specified in document [SUBSET 093] and the test specification [ERTMS/GSM-R QoS Test Specification] are applicable. (I)

2.11.2 Where ERTMS/ETCS level 2 or 3 is implemented, the Interface requirements as specified in document [MORANE EURO FFFIS] are applicable. (MI)

## 3 Network configuration

### 3.1 Introduction

- 3.1.1 EIRENE mobiles are specified to conform to a common minimum standard of performance. It is the responsibility of national railways to design their EIRENE networks to provide the required level of service to EIRENE compliant mobiles. (I)
- 3.1.2 This section draws together specifications and information related to the planning of an EIRENE network and provides guidance on target performance levels. Additional information on communication requirements for the ERTMS/ETCS application is provided in [ERTMS COMMS]. (I)

### 3.2 Coverage

- 3.2.1 For network planning, the coverage level is defined as the field strength at the antenna on the roof of a train (nominally a height of 4m above the track). An isotropic antenna with a gain of 0dBi is assumed. This criterion will be met with a certain probability in the coverage area. (The target coverage power level is dependent on the statistical fluctuations caused by the actual propagation conditions.) (I)
- 3.2.1i The values concerning coverage and speed-limitations listed in § 3.2.2 to §3.2.3 are applicable for ER-GSM band frequencies. For other frequencies listed in §4.2.1i, the equivalent power budget taking into account attenuation conditions and power classes as defined in 4.2.4 is to be considered. (I)
- 3.2.2 The following minimum values shall apply: (MI)
- coverage probability of 95% based on a coverage level of 38.5 dB $\mu$ V/m (-98 dBm) for voice and non-safety critical data;
  - coverage probability of 95% based on a coverage level of 41.5 dB $\mu$ V/m (-95 dBm) on lines with ETCS levels 2/3 for speeds lower than or equal to 220km/h.
- 3.2.3 The following minimum values shall apply: (MI)
- coverage probability of 95% based on a coverage level of 44.5 dB $\mu$ V/m (-92 dBm) on lines with ETCS levels 2/3 for speeds above 280km/h;
  - coverage probability of 95% based on a coverage level between 41.5 dB $\mu$ V/m and 44.5 dB $\mu$ V/m (-95 dBm and -92 dBm) on lines with ETCS levels 2/3 for speeds above 220km/h and lower than or equal to 280km/h.
- 3.2.4 The EIRENE mobile installation shall be designed to operate in a network meeting the criteria in 3.2.2 and 3.2.3. (MI)

- 3.2.5 The specified coverage probability means that with a probability value of at least 95% in each location interval (length: 100m) the measured coverage level shall be greater than or equal to the figures stated above. The coverage levels specified above consider a maximum total loss of 6 dB between antenna and receiver inputs (including a margin of e.g. 3dB for ageing). This value is defined in order to ensure that the level at the input of the receiver will never be lower than the reference sensitivity level of the receiver. The relevant clauses according to the appropriate frequency band defined in [EN 301 515, Index [35]] should apply. It is possible to compensate losses higher than 3 dB between antenna and receiver inputs by using an antenna with the corresponding gain above the assumed value of 0dBi (I).
- 3.2.6 The values for ETCS levels 2/3 concerning coverage and speed-limitations are to be validated and, if necessary, reviewed after the first operational implementation of ETCS. (I)

### **3.3 Handover and cell selection**

- 3.3.1 The handover success rate should be at least 99.5% over train routes under design load conditions (as given in [EN 301 515, Index [30]]). (O)
- 3.3.2 To avoid the necessity for large cell overlaps to accommodate high speed train operations, optimisation of the handover process for such trains is considered necessary. Suitable algorithms will be tested and refined as necessary during the trials process. (I)
- 3.3.3 The proposed events for measurement of the start and stop of the handover execution at the mobile are: (I)
- receipt of 'handover command';
  - receipt of 'UA' after 'physical info' on new channel.
- 3.3.4 There is a quality of service requirement for handover executions (e.g. a break of 10s would clearly be unacceptable to the user). 300ms represents our current best estimate of the QoS figure, although this will need to be confirmed through user trials. (I)
- 3.3.5 An additional option is available to reduce the handover break period, namely the use of the synchronous handover capability to reduce the break period to about 150ms. Synchronous handover requires the BTS transmissions in different cells to be synchronised by the system. Each authority can decide whether it wishes to use synchronised BTSs. (I)

### **3.4 Call setup time requirement**

- 3.4.1 Call setup time requirement is dependent upon the eMLPP priority of a call [EN 301 515, Index [27]]. The required priority level for each call type is given in section 10.2. (I)

- 3.4.2 Call setup times as defined in the EIRENE FRS shall be achieved with authentication and ciphering procedures enabled. (MI)
- 3.4.2i Authentication may be delayed if necessary to achieve the required call setup times. (I)
- 3.4.3 In order to achieve these times the passage of the call through any networks external to GSM (e.g. from the GSM MSC to a controller linked by an ISDN connection) must take less than 250ms. (I)
- 3.4.4 Achievement of fast call setup times requires information in the setup message to be compressed. A maximum of 12 digits may be sent as mobile originator-to-dispatcher information. (I)

### 3.5 Frequency band and channel arrangements

- 3.5.1 For applications of EIRENE Systems which are relevant to interoperability of the rail system within the European Community, in particular according to the Directive 2008/57/EC, the network shall operate in a sub-band, or combination of sub-bands, of the R-GSM band as defined in [EN 301 515, Index [35]] according to the table 3-A below: (I)

	Sub-Bands	Frequencies (MHz)	
R-GSM band	UIC frequency band	876-880/921-925	(MI)
	Extended GSM (E-GSM) band	880-915/925-960	(M)
	Public GSM (P-GSM) band	890-915/935-960	(M)

Table 3-A

- 3.5.2 The UIC frequency band for GSM-R is defined in [CEPT 25-09], [1999/569/EC] and [ECC(02)05]: (I)
- 876 – 880 MHz (mobile station transmit); paired with
  - 921 – 925 MHz (base station transmit).
- 3.5.3 The carrier frequency is designated by the absolute radio frequency channel number (ARFCN), and is defined in [EN 301 515, Index [35]]. For carriers in the UIC frequency band the following convention shall be used, where  $F_l(n)$  is the frequency value of the carrier ARFCN  $n$  in the lower band, and  $F_u(n)$  the corresponding frequency value in the upper band: (I)
- $F_l(n) = 890 + 0.2 \cdot (n - 1024)$   $955 \leq n \leq 973$
  - $F_u(n) = F_l(n) + 45$

Frequencies are in MHz.

3.5.4 For applications of EIRENE Systems which are not relevant to interoperability of the rail system within the European Community, in particular according to the Directive 2008/57/EC, the frequencies given in clause 3.5.1 need not be supported. Alternative frequencies may be employed according to local spectrum availability and allocation. The frequencies employed may be in the ER-GSM band or the frequency bands allocated for GSM as defined in [EN301 515, index [35]]. (I)

### **3.6 DTMF tones and signals**

3.6.1 The minimum duration of a DTMF tone and the length of pause between tones generated by the network (DTMF sender) and needed for the DTMF digit recognition in the network (DTMF receiver) are specified in [DTMF SIGNALLING]. (I)

### **3.7 Termination of VGCS/VBS calls**

3.7.1 An entitled controller may terminate a VGCS/VBS call based on DTMF signalling [EN 301 515, Index [4] & [5]]. (I)

3.7.2 The network shall terminate the ongoing VGCS/VBS call if it receives the 3-digit sequence "\*\*\*\*" transmitted via DTMF signals. (M)

3.7.3 In order to minimise the discomfort caused by the DTMF tone added in the voice channel, the duration of the tone generated by the fixed line dispatcher shall be  $70\text{ms} \pm 5\text{ms}$ , and there shall be a minimum gap of 65ms between each tone. (M)

### **3.8 Muting and unmuting for VGCS calls**

3.8.1 The muting and unmuting for VGCS shall be in line with [EN 301 515, Index [4]]. (M)

3.8.2 The network shall send the SET-PARAMETER message with the attribute "D-ATT = T"<sup>1</sup> [EN 301 515, Index [6]] to the mobile station of the talking subscriber if it receives the 3-digit sequence "###" transmitted via DTMF from a controller terminal. However, receiving the 3-digit sequence "###" from any additional controller terminal while the controller mentioned above is still talking shall not result in sending another SET-PARAMETER message with the attribute "D-ATT = T". (M)

3.8.3 When the network has detected the 3-digit DTMF sequence "###" from a controller terminal and if the controller was not previously talking it should indicate its recognition by playing a single DTMF grant tone "#" of duration of  $100\text{ms} \pm 5\text{ms}$  to be sent to that controller terminal only. (O)

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<sup>1</sup> On receiving this message, the mobile of the current talking subscriber will stop muting the down-link, thus allowing the subscriber to hear the controller's voice.

- 3.8.4 The network shall send the SET-PARAMETER message with the attribute "D-ATT = F"<sup>2</sup> [EN 301 515, Index [6]] to the mobile of the talking subscriber only if it has received the 3-digit sequence "\*\*\*" transmitted via DTMF from all the talking controllers<sup>3</sup>. (M)
- 3.8.5 The duration of each tone (see 3.8.2 and 3.8.4) added in the voice channel, shall be 70ms  $\pm$  5ms, and there shall be a minimum gap of 65ms between each tone. (M)
- 3.9 Call Release Causes for Functional Addressing and Location Dependent Addressing**
- 3.9.1 Format, encoding, semantics and handling of call release cause information elements/parameters are specified in [ITU-T Q.850]. (I)
- 3.9.2 In the event of a call release, a call release cause information element/parameter shall be generated by the GSM-R network identifying the call release event. (M)
- 3.9.3 Table 3-1 contains the call release causes which shall be used for the services functional addressing and location dependent addressing. (M)

Call Release Cause Number	Call Release Cause	Caused by
1	Unallocated (unassigned) number	No registration for the FN
		No data fill for a short dialling code
28	Invalid number format (address incomplete)	Incorrect number format dialled (e.g. wrong length for a call type)
21	Call rejected	Access matrix blocks (caller not authorised)

Table 3-1: Call Release Causes

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<sup>2</sup> On receiving this message, the mobile of the current talking subscriber will resume muting the down-link, thus preventing the subscriber from hearing their own echo.

<sup>3</sup> This indicates that all of the controllers have indicated that they no longer wish to speak (for example, by releasing their PTT buttons).

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## 4 Mobile equipment core specification

### 4.1 Introduction

4.1.1 To ensure interoperability, all EIRENE mobiles are specified with a common level of basic services, facilities and features. This section of the specification gives details of these core requirements, while sections 5-7A and 16 detail requirements specific to each of the radio types. (I)

4.1.2 The logical architecture of an EIRENE Cab Radio or handheld mobile station is shown in figure 4-1. The architecture consists of the following elements: (I)

- a) **GSM Mobile Termination (GSM-MT)**: comprising GSM mobile equipment and SIM;
- b) **Direct Mode Mobile Termination (DM-MT)**: for direct mode communications;
- c) **EIRENE applications**: standardised features outside GSM: dependent on radio type;
- d) **Man Machine Interface (MMI)**: dependent on radio type.

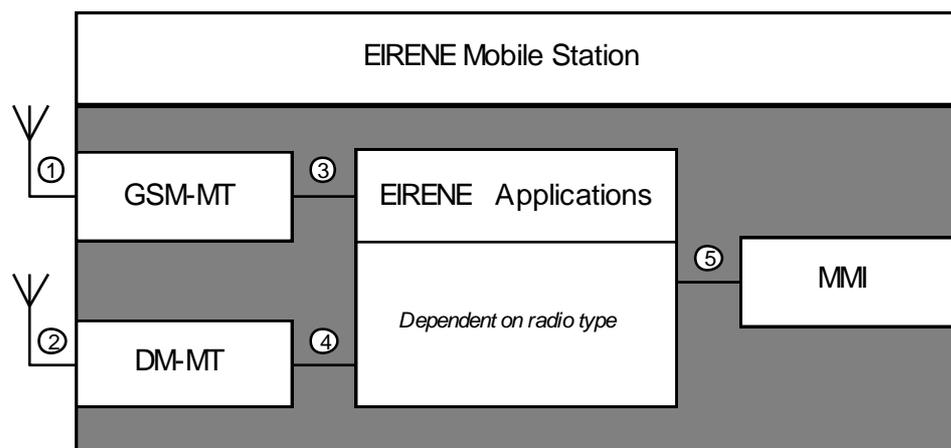


Figure 4-1: Logical mobile radio architecture and interfaces

4.1.2i The logical architecture of an ETCS data only radio is shown in figure 4-1i. The architecture consists of the following elements: (I)

- a) GSM Mobile Terminations (GSM-MT): comprising one or more GSM mobile equipment and SIM;
- b) GSM bearer services;
- c) Air interface  $U_m$  (1);
- d) ETCS data interface  $I_{GSM}$  (2);
- e) There should be no MMI, maintenance indications may be provided.

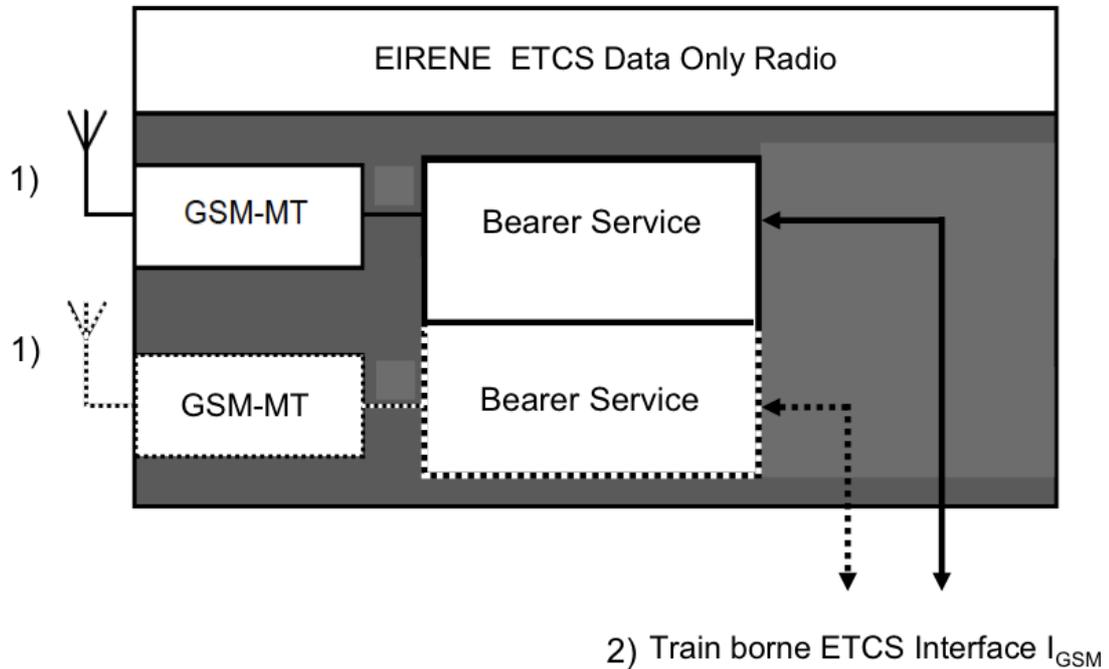


Figure 4-1i: Logical ETCS data only radio architecture and interfaces

- 4.1.3 The logical architecture comprises a number of interfaces between the different EIRENE-MS elements as described in 4.1.3.1 – 4.1.3.7 (I).
- 4.1.3.1 **GSM-MT air interface** is mandatory for interoperability and shall conform with GSM specifications; (MI)
- 4.1.3.2 **DM-MT air interface** is applicable for Direct Mode and is optional. However, where implemented, the requirements concerning this interface are mandatory for interoperability; (O)
- 4.1.3.3 **GSM-MT - EIRENE Applications interface** is specified to allow an option for separate procurement of GSM-MT and EIRENE Application equipment for the Cab radio (see [MORANE FFFIS MTI]); (O)
- 4.1.3.4 **DM-MT - EIRENE Applications interface** is specified to allow an option for separate procurement of DM-MT and EIRENE Application equipment for the Cab radio; (O)
- 4.1.3.5 **EIRENE Applications - MMI interface** is not specified; (O)
- 4.1.3.6 **Train-borne ETCS interface (IGSM)** is specified to allow connection to the ETCS train-borne system; (O)
- 4.1.3.7 **Bearer service** is mandatory for circuit switched mode of ETCS data only radio operation. (MI)

- 4.1.4 This specification defines five distinct mobile radio types according to the type of role they will perform and the environment they will operate in, as follows: (I)
- a) Cab radio - for use by the driver of a train;
  - b) General purpose radio - for general use by railway personnel;
  - c) Operational radio - for use by railway personnel involved in train operations such as trackside maintenance;
  - d) Shunting radio - for use by railway personnel involved in train operations such as shunting;
  - e) ETCS data only radio – for data communication between ETCS trackside equipment and ETCS train borne equipment.
- 4.1.4i It is possible that the General purpose, Operational and Shunting radios may have a number of physical implementations to meet railway requirements (e.g. handheld and vehicle mounted). (I)
- 4.1.5 All SIM cards used in EIRENE mobiles shall comply with the requirements of the MORANE FFFIS for GSM-R SIM Cards [MORANE SIM]. (MI)
- 4.1.6 To ensure interoperability and flexible operation the EIRENE mobile shall use network and subscriber specific information from the specific Elementary Files of GSM-R SIM card rather than have it hard coded in the mobile software. The usage of Elementary Files shall be as defined in MORANE FFFIS for GSM-R SIM Cards [MORANE SIM] (M).

## 4.2 Radio interface aspects

- 4.2.1 For applications of EIRENE Systems which are relevant to interoperability of the rail system within the European Community, in particular according to the Directive 2008/57/EC, all mobiles, except ETCS data only radio for which 16.3.5 and 16.3.6 apply, shall be capable of operation in any sub-band, or combination of sub-bands, of the R-GSM band which includes the frequency bands listed in Table 4-1: (I)

	<b>Sub-Bands</b>	<b>Frequencies (MHz)</b>	
R-GSM band	UIC frequency band	876-880/921-925	(MI)
	Extended GSM (E-GSM) band	880-915/925-960	(M)
	Public GSM (P-GSM) band	890-915/935-960	(M)

*Table 4-1: Frequency bands*

- 4.2.1i This may be achieved for example by a filtering function external or internal to the Mobile Equipment. If the E-GSM or P-GSM bands are to be supported, it is allowed to switch the filtering function on or off. (I)

- 4.2.1ii For applications of EIRENE Systems which are not relevant to interoperability of the rail system within the European Community, in particular according to the Directive 2008/57/EC, the frequencies given in clause 4.2.1 need not be supported. Alternative frequencies may be employed according to local spectrum availability and allocation. The frequencies employed may be in the ER-GSM band or the frequency bands allocated for GSM as defined in [EN301 515, index [35]]. (I)
- 4.2.2 The mobile radio antenna installation on vehicles shall be designed so as to ensure that mobiles operate in networks which conform to the design criteria defined in section 3. (MI)
- 4.2.3 For frequency bands listed in Table 4-1, mobile radios shall be of the following power classes:

<b>Radio type</b>	<b>Power class</b>	<b>Power (W)</b>	
Cab radio	2	8	(MI)
General purpose radio	4*	2*	(M)
Operational radio	4*	2*	(M)
Shunting radio	4*	2*	(M)
ETCS data only radio	2	8	(MI)

\* Vehicle-based versions of the General purpose, Operational and Shunting radios may be used to provide 8W mobile radios.

*Table 4-2: Definition of power classes for each radio type*

4.2.4 For applications of EIRENE Systems which are not relevant to interoperability of the rail system within the European Community, in particular according to the Directive 2008/57/EC, the power class values given in clause 4.2.3 need not be supported. The relevant clauses according to the appropriate frequency band as listed in ETSI TS 100 910 v 8.20.0 should apply. (I)

### **4.3 Services and facilities**

4.3.1 The following GSM teleservices, identified in section 2, are to be supported for each type of mobile radio:

Category	Teleservice	Cab radio	General purpose radio	Operational radio	Shunting radio	ETCS data only radio
1 Speech transmission	11 Telephony	MI	M	M	M	NA
	12 Emergency calls	M	M	M	M	NA
2 Short message service	21 Short message MT/PP	MI	M	M	M	NA
	22 Short message MO/PP	MI	M	M	M	NA
	23 Short message cell broadcast	MI	M	M	M	NA
6 Facsimile transmission	61 Alternate speech and fax group 3	O	O	O	O	NA
	62 Automatic fax group 3	O	O	O	O	NA
9 Voice Group service*	91 Voice Group Call Service (VGCS)	MI	M	M	M	NA
	92 Voice Broadcast Service (VBS)	M	M	M	M	NA

MT/PP - Mobile Terminated/Point-to-Point

MO/PP - Mobile Originated/Point-to-Point

\* Voice Group service specifications contain implementation options. The options required for interoperability are as stated in [ASCI OPTIONS]

*Table 4-3: GSM teleservices to be supported*

4.3.2 The following bearer services, identified in section 2, are to be supported for each type of mobile radio:

Bearer service	Cab radio	General purpose radio	Operational radio	Shunting radio	ETCS data only radio
20. Asynchronous General Bearer Service	O	O	O	O	O
21. Asynchronous 300 bps T	O	O	O	O	O
21. Asynchronous 300 bps NT	O	O	O	O	O
22. Asynchronous 1.2 kbps T	O	O	O	O	O
22. Asynchronous 1.2 kbps NT	O	O	O	O	O
23. Asynchronous 1200/75 bps T	O	O	O	O	O
23. Asynchronous 1200/75 bps NT	O	O	O	O	O
24. Asynchronous 2.4 kbps T	MI	O	O	O	MI
24. Asynchronous 2.4 kbps NT	M	O	O	O	O
25. Asynchronous 4.8 kbps T	MI	O	O	O	MI
25. Asynchronous 4.8 kbps NT	M	O	O	O	O
26. Asynchronous 9.6 kbps T	MI	O	O	O	MI
26. Asynchronous 9.6 kbps NT	M	O	O	O	O
30. Synchronous General Bearer Service	O	O	O	O	O
31. Synchronous 1.2 kbps T	O	O	O	O	O
31. Synchronous 1.2 kbps NT	O	O	O	O	O
32. Synchronous 2.4 kbps T	O	O	O	O	O
32. Synchronous 2.4 kbps NT	O	O	O	O	O
33. Synchronous 4.8 kbps T	O	O	O	O	O
33. Synchronous 4.8 kbps NT	O	O	O	O	O
34. Synchronous 9.6 kbps T	O	O	O	O	O
34. Synchronous 9.6 kbps NT	O	O	O	O	O
40. General PAD Access Bearer Service	O	O	O	O	O
41. PAD access 300 bps T	O	O	O	O	O
41. PAD access 300 bps NT	O	O	O	O	O
42. PAD access 1.2 kbps T	O	O	O	O	O
42. PAD access 1.2 kbps NT	O	O	O	O	O
43. PAD access 1200/75 bps T	O	O	O	O	O
43. PAD access 1200/75 bps NT	O	O	O	O	O
44. PAD access 2.4 kbps T	O	O	O	O	O
44. PAD access 2.4 kbps NT	O	O	O	O	O
45. PAD access 4.8 kbps T	O	O	O	O	O
45. PAD access 4.8 kbps NT	O	O	O	O	O
46. PAD access 9.6 kbps T	O	O	O	O	O
46. PAD access 9.6 kbps NT	O	O	O	O	O
61. Alternate speech/data	O	O	O	O	NA
70. GPRS	O	O	O	O	O
81. Speech followed by data	O	O	O	O	NA

T - Transparent; NT - Non-transparent

Table 4-4: GSM bearer services to be supported

4.3.3 The following supplementary services, identified in section 2, are to be supported for each type of mobile radio:

Supplementary service	Cab radio	General purpose radio	Operational radio	Shunting radio	ETCS data only radio
Calling Line Identification Presentation (CLIP)	MI	M	M	M	MI
Calling Line Identification Restriction (CLIR)	O	O	O	O	NA
Connected Line Identification Presentation (CoLP)	MI	M	M	M	MI
Connected Line Identification Restriction (CoLR)	O	O	O	O	NA
Call Forwarding Unconditional (CFU)	M	O	O	O	NA
Call Forwarding on Mobile Subscriber Busy (CFB)	O	O	O	O	NA
Call Forwarding on No Reply (CFNRy)	O	O	O	O	NA
Call forwarding on Mobile Subscriber Not Reachable (CFNRC)	O	O	O	O	NA
Call waiting (CW)	MI	M	M	M	NA
Call hold (HOLD)	MI	O	O	M	NA
Multi Party Service (MPTY)	MI	O	O	M	NA
Closed User Group (CUG)	M	O	M	M	NA
Advice of Charge (Information) (AoCI)	O	O	O	O	NA
Advice of Charge (Charging) (AoCC)	O	O	O	O	NA
Barring of All Outgoing Calls (BAOC)	O	O	O	O	NA
Barring of Outgoing International Calls (BOIC)	O	O	O	O	NA
BOIC except those to Home PLMN Country (BOIC-exHC)	M	O	M	M	NA
Barring of All Incoming Calls (BAIC)	O	O	O	O	NA
Barring of Incoming Calls when Roaming Outside the Home PLMN Country (BIC-Roam)	M	O	M	M	NA
Unstructured Supplementary Service Data (USSD)	MI	M	M	M	NA
Follow me	MI	<u>M</u>	<u>M</u>	M	NA
Sub-addressing*	MI	O	O	O	NA
Enhanced Multi-Level Precedence and Pre-emption (eMLPP)	MI	M	M	M	MI
Explicit Call Transfer (ECT)	O	O	O	O	NA
Completion of Calls to Busy Subscribers (CCBS)	O	O	O	O	NA
User-to-User Signalling 1 (UUS1)	MI	M	M	M	MI

\* Sub-addressing is not a GSM supplementary service but for convenience is listed in the above table

Table 4-5: GSM supplementary services to be supported

4.3.4 The following EIRENE features are to be supported for each type of mobile radio:

	<b>Cab radio</b>	<b>General purpose radio</b>	<b>Operational radio</b>	<b>Shunting radio</b>	<b>ETCS data only radio</b>
Functional addressing (section 11)	MI	M	M	M	NA
Direct mode (section 15)	O	NA	O	O	NA
Shunting mode (section 14)	MI	NA	NA	M	NA
Multiple driver communications (section 5)	MI	NA	NA	NA	NA
Railway emergency calls (section 13)	MI	O	M	M	NA
enhanced Railway emergency calls (section 13A)	M	O	O	O	NA

*Table 4-6: EIRENE features to be supported*

4.3.5 If a Railway emergency call set up from an EIRENE radio is unsuccessful, the radio shall automatically re-attempt the call setup until the call setup is successful, a retry timer expires (duration 30 seconds, as specified in the [EIRENE FRS]) or the user abandons the call. (MI)

4.3.6 In compliance with the related layer 3 procedures, the EIRENE radio shall automatically repeat setup requests to the layer 3 GCC or BCC entity as soon as an indication is given from the layer 3 GCC or BCC entity on an abort of the establishment procedure without the service being explicitly rejected by the network. (MI)

#### **4.4 Core MMI requirements**

4.4.1 A service availability indication shall be provided to radio users, as defined in [EN 301 515, Index [26]]. (MI)

4.4.2 The user shall be prevented from entering direct mode if the GSM service is available. (M)

4.4.3 If the attempt to establish a Railway emergency call is not successful after 2 seconds, an indication shall be provided to the user of the status of the establishment request procedure. (MI)

## 4.5 Core environmental requirements

4.5.1 This subsection defines the core environmental and physical requirements for all EIRENE mobile equipment. The requirements provided in this section are augmented by those provided in later sections for each individual radio type, with each radio type being specified by the superset of the core plus specific requirements. (I)

4.5.2 All EIRENE mobile equipment shall comply with all environmental, EMC and physical specifications defined in the GSM standard, especially with reference to [EN 301 489 part 1 and part 7 and EN 301 515, Index [2] & [35]]. (M)

4.5.3 All EIRENE mobile equipment shall conform to [EN 60950] (Safety of Information Technology Equipment), including Electrical Business Equipment, 1993, plus amendments A1 and A2. (M)

4.5.4 The categories of requirements defined in each section describing mobile equipment are as follows: (I)

- climatic conditions (temperature, humidity, solar radiation, altitude, etc);
- physical conditions (flammability, contamination, physical protection, etc);
- mechanical conditions (shock and vibration);
- electrical conditions (power supply variation, battery life, overloading, etc);
- EMC (both emissions and immunity);
- tests required to validate compliance with EIRENE specification.

4.5.5 Any environmental and physical requirements stated may be superseded by national requirements provided the national standards provide a higher level of environmental and physical protection. Stricter national standards shall not prevent the use of other EIRENE mobiles in that country. (M)

4.5.6 The railway specific standards (e.g. [EN 50155, EN 50121, EN 50125]) should be re-examined for their applicability to the EIRENE system if any modifications are made to these standards in the future. (I)

4.5.7 All design, manufacturing, testing and installation of EIRENE mobile radio equipment shall comply with the quality procedures defined in [ISO 9001]. (M)

### *Climatic conditions*

4.5.8 EIRENE mobile equipment shall be capable of operating over a standard range of temperatures from -20°C to +55°C. (M)

4.5.9 EIRENE mobile equipment shall be capable of being stored (ie without being operational) at temperatures down to -40°C without any permanent damage. (M)

- 4.5.10 The equipment shall be capable of coping with temperature variations of up to +/- 1°C/minute. (M)
- 4.5.11 EIRENE mobile equipment shall be capable of operating between altitudes of -100m and 1800m, referenced to sea level. (M)
- 4.5.12 The equipment shall be able to cope with relative humidities of 100% for short periods, although the yearly average is expected to be 75%. The equipment shall also cope with 95% humidity for 30 days in the year. (M)
- 4.5.13 Operationally caused infrequent and slight moisture condensation shall not lead to any malfunction or failure. (M)
- 4.5.14 All equipment shall not degrade photochemically when exposed to solar radiation of up to 1200 W/m<sup>2</sup>. (M)
- 4.5.15 In normal operation of a mobile radio unit, it shall be expected that a combination of the above environmental conditions will be experienced. (M)

*Mechanical conditions*

- 4.5.16 All EIRENE mobile equipment shall be protected against shock and vibration in compliance with standards defined in [EN 50125] using tests defined in [EN 50155]. (M)
- 4.5.17 All handheld mobile equipment shall be capable of withstanding the following shocks: (M)
- non-repetitive shocks of up to 3g for up to 100ms under normal conditions;
  - free fall from 0.5m.
- 4.5.18 EIRENE mobile equipment shall be capable of being subjected to both sinusoidal and random vibration. (M)
- 4.5.19 Handheld mobile equipment shall be capable of withstanding the following levels of continuous sinusoidal vibration: (M)
- frequency range: 5-200 Hz;
  - peak-to-peak amplitude: 7.5 mm;
  - peak acceleration: 1.5g.
- 4.5.20 The random vibrations to be withstood by mobile equipment shall be 0.25g in all three axes of freedom. (M)

*Electrical*

- 4.5.21 For determining battery requirements, the transmit/receive duty cycles used shall be as shown in table 4-7 for each call type. (M)

Call type	Transmit	Receive
Point-to-point call	100%	100%
Group call	30%	100%
Broadcast call (originated)	100%	100%*
Broadcast call (receive)	0%	100%

\* Because it is necessary to receive a broadcast call while transmitting, the speaker's link to the network is via a standard point-to-point call

*Table 4-7: Transmit/receive duty cycles for different call types*

4.5.22 Battery requirements shall be provided without the use of discontinuous reception or transmission (DTX/DRX). (M)

4.5.23 Battery requirements shall be met based on full power during transmission and assuming hourly periodic location updating. (M)

*Electromagnetic Compatibility*

4.5.24 All railway and generic EMC standards define a maximum level of electromagnetic emissions across a range of frequencies. However, the nature of radio equipment implies a certain level of intentional electromagnetic emission in the transmission band. (I)

4.5.25 Deleted.

4.5.26 Deleted.

4.5.27 The transmission of electromagnetic radiation from all EIRENE mobile equipment shall comply with the radio frequency transmission masks defined in [EN 301 515, Index [35]] for the range of GSM frequencies defined in section 1 of this document. (M)

4.5.28 Deleted.

4.5.29 Deleted.

4.5.30 The emission and immunity standards for the general railway environment and ancillary services as defined in [EN 50121 parts 1, 2, 3-2 and 4] shall be considered. (M)

4.5.31 EIRENE mobiles will generate electromagnetic emissions in the GSM frequency band. It is the responsibility of national railways operating EIRENE networks to ensure that EIRENE equipment does not interfere with the normal operation of any on-train or ground based systems. (I)

4.5.32 In particular, EIRENE equipment could interfere with: (I)

- signalling relays and contacts;
- speedometers;
- public address;
- power transformers;
- track circuits;
- axle counters;
- train describers;
- other radio equipment;
- radar speed measurement equipment;
- switched mode power supplies;
- telecommunications circuits;
- electronic locking systems.

*Testing procedures*

4.5.33 The environmental and physical tolerance of the EIRENE mobile radio units shall be tested at a facility in accordance with [EN ISO/IEC 17025]. (M)

4.5.34 All EMC emission and immunity tests shall be performed in accordance with guidelines defined in [EN 61000 part4-3]. (M)

4.5.35 Environmental testing procedures shall follow guidelines defined in [EN 60068 part 1]. (M)

4.5.36 Specific environmental test procedures to be followed for EIRENE mobile equipment shall include the following tests as defined in [EN 60068]: (M)

- A Cold;
- B Dry heat;
- D Damp heat (cyclic);
- E Impact;
- F Vibration;
- G Acceleration;
- K Corrosive atmospheres;
- M Air pressure;
- N Change of temperature;
- P Fire hazard.

## **4.6 Alerting of a controller**

4.6.1 The feature “alerting of a controller” should be implemented. (O)

- 4.6.2 A controller can leave an ongoing group call or not listen to an ongoing group call or the ongoing group call can be on hold at the controller terminal. (I)
- 4.6.3 If the feature “alerting of a controller” is implemented, any entitled talking or listening service subscriber shall be able to alert a specific controller or its terminal in order to ask that controller to join the ongoing group call or to listen to it. (M)
- 4.6.3i The entitlement is a national issue. For example, it may be based on the registration of a functional number to the MSISDN of the service subscriber. (I)
- 4.6.4 If the feature “alerting of a controller” is implemented, the solution shall be based on the UUS-1 supplementary service. The requirements of [TS 102 610] shall be applied. (M)
- 4.6.5 If the feature “alerting of a controller” is implemented, the alerting process shall be triggered by a simple MMI action at the Mobile Station. (M)
- 4.6.6 If the feature “alerting of a controller” is implemented, the MMI action shall result in leaving the ongoing group call and shall be followed by sending a point-to-point voice call SETUP message with an eMLPP priority 3 through the network to the addressed controller terminal. (M)
- 4.6.7 If the feature “alerting of a controller” is implemented, the SETUP message shall contain a UUS-1 IE which carries the alerting tag as well as the group call reference number of the ongoing group call as specified in [TS 102 610]. (M)
- 4.6.8 If the feature “alerting of a controller” is implemented, the SETUP message should contain a UUS-1 IE, which carries the functional number registered to the MSISDN of the service subscriber as specified in [TS 102 610]. (O)
- 4.6.9 On receiving the SETUP message at the controller terminal, the request for a point-to-point voice call may be accepted or rejected, depending on the national implementation. The following two clauses explain the subsequent actions to be taken when the SETUP message is accepted or rejected. (I)
- 4.6.10 If the feature “alerting of a controller” is implemented, and if the SETUP message is accepted, the controller terminal shall send a CONNECT message to the mobile station of the service subscriber and a voice call shall be established. (M)
- 4.6.11 If the feature “alerting of a controller” is implemented, and if the SETUP message is rejected, the controller terminal shall send a RELEASE COMPLETE message to the mobile station of the service subscriber (point-to-point call is not established) and an indication shall be provided by the controller terminal. (M)
- 4.6.11i If the feature “alerting of a controller” is implemented, and if the SETUP message is rejected, the RELEASE COMPLETE message sent by the controller terminal shall contain a UUS-1 IE, which carries the alerting tag as well as the group call reference number of the on-going group call as specified in [TS 102 610]. (M)

- 4.6.11ii If the feature “alerting of a controller” is implemented, and if the SETUP message is rejected, the RELEASE COMPLETE message sent by the controller terminal should contain a UUS-1 IE, which carries the functional number registered to the MSISDN or ISDN number of the controller as specified in [TS 102 610]. (O)
- 4.6.12 If the feature “alerting of a controller” is implemented, the Mobile Station of the service subscriber shall rejoin the ongoing group call as soon as either the established voice point-to-point call is terminated or the RELEASE COMPLETE message is received or a timer started at the sending of the SETUP message in the mobile station is expired. In the event that the group call has already been terminated during the above procedure then the Mobile Station shall return to the idle condition. (M)

#### **4.7 Uplink Reply and Notification Response**

- 4.7.1 “Uplink Reply” and “Notification Response” procedures may be supported by EIRENE mobiles (O)
- 4.7.2 If the procedures “Uplink Reply” and “Notification Response” is supported by an EIRENE mobile, it shall be in accordance with [EN301 515, Index [4]] for VGCS and with [EN 301 515,Index [5]] for VBS. (M)
- 4.7.3 If an “Uplink Reply” and “Notification Response” supporting EIRENE mobile station receives an uplink access request in an uplink free message on the VGCS / VBS channel downlink it uses the Uplink Reply procedure and sends uplink access bursts on the VGCS / VBS call channel uplink with the establishment cause "reply on uplink access request". (I)
- 4.7.4 If an “Uplink Reply” and “Notification Response” supporting EIRENE mobile station moves to a cell with notifications containing no channel description, it establishes a dedicated connection and responds to the notification by use of the Notification Response procedure in order to receive the VGCS / VBS call. (I)

## 5 Cab radio

### 5.1 Introduction

5.1.1 This section identifies the system requirements for the EIRENE Cab radio. It defines how the functionality is to be provided by the Cab radio system and the man-machine interface. (I)

### 5.2 System components

5.2.1 Figure 5-1 shows the logical architecture of an EIRENE Cab radio. The architecture comprises the following elements: (I)

- **GSM Mobile Termination (GSM-MT)**: comprising GSM mobile equipment and SIM;
- **Direct Mode Mobile Termination (DM-MT)**: for direct mode communications;
- **EIRENE Cab radio applications**: standardised features outside GSM;
- **Man Machine Interface (MMI)**.

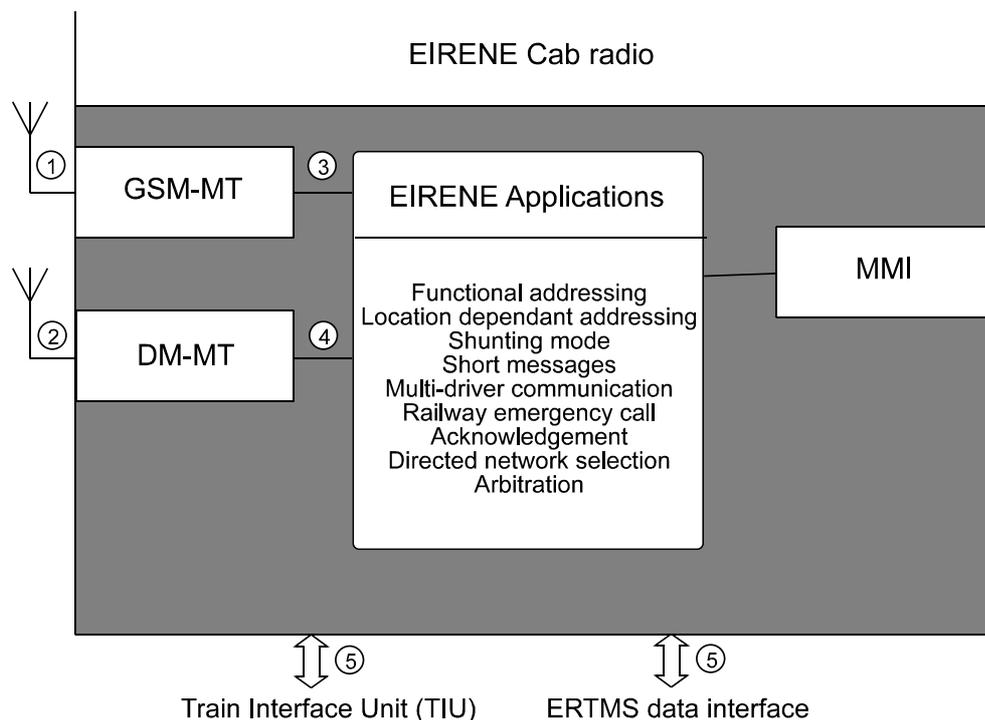


Figure 5-1: Logical Cab radio architecture and interfaces

5.2.2 The architecture comprises a number of interfaces between the different EIRENE-MS elements. (I)

5.2.2.1 **GSM-MT air interface** is mandatory for interoperability and conformant to GSM specifications. (MI)

- 5.2.2.2 **DM-MT air interface** used for Direct Mode is optional. However, where implemented, the requirements concerning this interface are mandatory for interoperability. (O)
- 5.2.2.3 **GSM-MT - EIRENE Applications interface** is specified to allow the option for separate procurement of GSM-MT and EIRENE Application equipment for the Cab radio. The Morane FFFIS [MORANE FFFIS MTI] specifies two types of interface based on V.24 and TDMA, both supporting [EN 301 515, Index [19]]. (O)
- 5.2.2.4 **DM-MT - EIRENE Applications interface** is specified to allow the option for separate procurement of DM-MT and EIRENE Application equipment for Cab radio. (O)
- 5.2.2.5 Interfaces may be provided to a Train Interface Unit and an ERTMS data interface. More requirements are given on these interfaces, where implemented, in subsections 5.10 and 5.15. (I)

### 5.3 Driver call-related functions

#### *Call controller*

- 5.3.1 Upon an appropriate MMI action, the radio shall initiate a call to the appropriate controller with 'Railway operation' priority (see section 10.2). (MI)
- 5.3.2 The calling driver's functional number shall be passed to the network using UUS1. (MI)

#### *Call other drivers in the area*

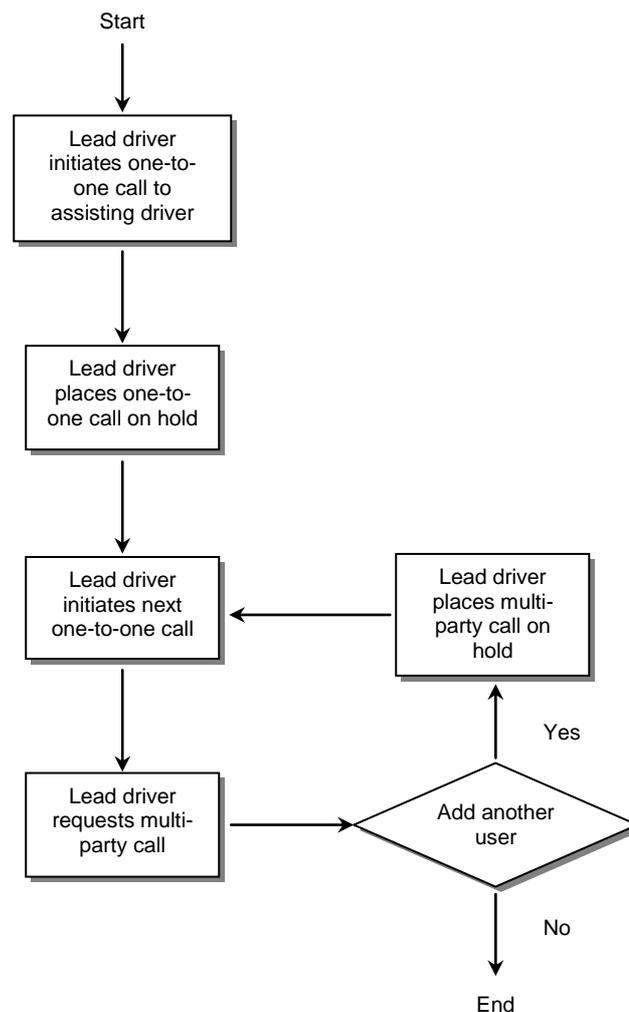
- 5.3.3 On receipt of a 'Call other drivers in area' request, the radio shall initiate a group call using the High priority group call in the context of group calls between drivers in the same area group identification (see section 9) priority (see section 10.2). (MI)
- 5.3.4 The calling driver's functional number shall be passed to the network using UUS1. (MI)

#### *Send Railway emergency call*

- 5.3.5 Activation of the 'Railway emergency call' function shall cause the radio to initiate a Railway emergency call as defined in section 13. (MI)
- 5.3.5i Activation of the 'enhanced Railway emergency call' function shall cause the radio to initiate a Railway emergency call as defined in section 13A. (M)
- 5.3.6 The calling driver's functional number shall be passed to the network using UUS1. (MI)

*Communicate with other drivers on same train*

- 5.3.7 Many trains employ multiple active traction vehicles. Where these vehicles are not connected by on-train wiring, it shall be possible for a permanent radio connection to be established between each of the active cabs. (I)
- 5.3.8 Where there is more than one active cab, the radio connection shall be provided using the GSM Multi-Party service. (MI)
- 5.3.9 The call will be established from the active cab of the lead traction vehicle. Each of the other cabs on the train will be contacted using its functional number (registered by the other drivers prior to the establishment of the call). The procedure for setting up a multi-party call is outlined in figure 5-2. The multi-party call shall have 'Railway operation' priority (see section 10.2) and whilst on-going a 'multi-drivers' indication shall be displayed permanently at all Cab radios. (MI)



*Figure 5-2: Multi-party call initiation*

*Call train staff*

- 5.3.10 Upon activation of the function 'Call train staff', the radio shall determine the appropriate functional number based on the staff member selected and the train number (see section 9). A GSM point-to-point voice call at 'Railway operation' priority (see section 10.2) shall then be initiated. (MI)

*Call other authorised users*

- 5.3.11 The Cab radio shall be capable of being used as a standard GSM telephone, such that the driver is able to call any valid number subject to closed user group, call barring or other restrictions. (MI)

*Receive short (SMS) text messages*

- 5.3.12 The Cab radio shall be able to receive, display and store incoming short (SMS) text messages (see section 12). (MI)

*Enter/leave shunting mode*

- 5.3.13 The Cab radio shall support shunting mode communications as defined in section 14. (MI)

*Enter/leave direct mode*

- 5.3.14 The Cab radio should support direct mode communications as defined in section 15. (O)

**5.4 MMI functions***Switch radio on and off*

- 5.4.1 When switched on, the radio shall initiate automatic self-testing using the GSM IMSI attach procedure. (MI)
- 5.4.1i When switched on, the radio shall initiate automatic selection of the default setting of the loudspeaker volume (see table 5-1). (MI)
- 5.4.2 Upon switch on, the Cab radio shall be registered with a mobile network (see section 10.5). (MI)
- 5.4.3 If registration is not successful an audible and visual indication shall be provided. (MI)
- 5.4.4 Upon registration, the mobile shall be accessible by calling the MSISDN or the Engine or Coach number with which it is associated. This shall require the home network database to maintain this correlation. (MI)

*Adjust loudspeaker volume*

5.4.5 The following table details the levels of adjustment and the three (Quiet, Normal and Noisy cab) loudspeaker ranges to be provided. (O)

Levels of adjustment		Driver adjustment		
		Quiet cab	Normal cab	Noisy cab
250 mW	24 dBm	1	1	
355 mW	25.5 dBm	2		
500 mW	27 dBm	3	2	1
1 W	30 dBm	4	3	2
2 W	33 dBm	5	4	3
4 W	36 dBm		5	4
8.5 W	39 dBm			5

*Table 5-1: Volume adjustment levels*

5.4.6 The radio should be able to provide five levels of adjustment (numbered 1 to 5 in table 5-1) for each volume range setting (see table 5-1). (O)

*Register and deregister train number*

5.4.7 Upon activation of the registration function, a USSD message (see section 11) shall be sent by the Cab radio. (MI)

5.4.8 Upon activation of the deregistration function, a USSD message (see section 11) shall be sent by the Cab radio. (MI)

5.4.9 Upon detection (automatically or based on a list stored in the Cab radio) of the additional on-train functions for equipment physically connected to the Cab radio, a USSD message (see section 11) shall be sent by the Cab radio after activation of the registration or deregistration function. (MI)

*Register and deregister stock number*

5.4.10 This procedure shall take place at the installation of the Cab radio. It shall be initiated by an external device or by a member of a maintenance team. (MI)

5.4.11 On-train functions for equipment physically connected to the Cab radio shall be registered or deregistered automatically based on a USSD message (see section 11) sent by the Cab radio. (MI)

*Audible and visual indications*

- 5.4.12 Cab radio audible and visual indications shall be as defined in the relevant sections of Parts 1-6 of [CENELEC ERGONOMIC]. (M)

*Select eREC Sector Identity*

- 5.4.13 The MMI shall provide a means to select the eREC Sector Identity for eREC operation. (M)
- 5.4.14 The MMI may provide a means to deactivate the eREC Sector Identity. (O)
- 5.4.15 The active Sector Identity used for call initiation (however entered at the MMI or received) shall be displayed. (M)

**5.5 Handling of calls**

- 5.5.1 The sequence of actions required for a mobile originated call to another user shall be as follows: (MI)
- Initiating a call: System is provided with the necessary information to set up call (e.g. number, bearer type, priority);
  - Indication: Provide an audible and visual indication;
  - Call arbitration: Management of call requests on the basis of call priority;
  - Conversation: Where the parties involved in the call can communicate;
  - Call termination: Where one of the parties involved in the call terminates the call.
- 5.5.2 The sequence of actions for a mobile terminated call to a driver shall be as follows: (MI)
- Call arbitration: Management of call requests on the basis of call priority;
  - Indication: Provide an audible and visual indication of incoming call;
  - Answering the call: Acceptance of incoming call by user (not required for auto answer);
  - Indication: Provide an audible and visual indication;
  - Conversation: Where the parties involved in the call can communicate;
  - Call termination: Where one of the parties involved in the call terminates the call.

5.5.3 The Cab radio system shall provide a means for the driver to terminate established calls which he is authorised to terminate. (MI)

*Initiating a call*

5.5.4 It shall be possible to initiate outgoing voice calls in one of four ways depending on the intended recipient(s) of the call: (MI)

- Emergency access: Capable of rapid activation in an emergency with a minimum of action being required by the driver (ie single red button);
- Priority access: Requiring the minimum of driver actions to initiate a call (eg a single key stroke);
- Stored number: Through the selection of a stored number or name (e.g. menu type access);
- Dial access: Facility for the driver to enter or select telephone or functional numbers manually.

*Emergency access*

5.5.5 Emergency access shall be provided to initiate the following call: (MI)

<b>Destination</b>	<b>Call type</b>	<b>eMLPP priority designation</b>	<b>Additional information</b>
Emergency call number	Group call	0	Functional number

*Table 5-2: Call types requiring MMI emergency access*

*Priority access*

5.5.6 Priority access shall be provided to initiate the following: (MI)

Destination	Call type	eMLPP priority designation	Additional information
Primary controller (*)	Point-to-point	3	Functional number
Secondary controller (*)	Point-to-point	3	Functional number
Power supply controller (*)	Point-to-point	3	Functional number
Other drivers in area	Group call	2	Functional number
Other drivers on same train	Point-to-point (Multi Party)	3	Functional number
Chief conductor	Point-to-point	3	Functional number

(\*) For these destinations, see the requirement below.

Table 5-3: Call types requiring MMI priority access

5.5.7 On activation of the “call other drivers on the same train” function, the MMI shall provide additional guidance to the user in the establishment and management of a Multi-Party call. (MI)

5.5.8 (\*) When there are several controllers of the same type associated with a cell, and no external means of selecting the appropriate one, the choice may be given by the system to the driver, or a VGCS call may be established to all of the relevant controllers after initiating the ‘Call controller’ function. (I)

*Stored numbers*

5.5.9 The driver shall be able to initiate a call by selecting a name/number from stored number information in the radio. (MI)

5.5.10 Facilities shall be provided to support a list of stored names/numbers of up to a minimum of 100 entries. (M)

5.5.11 Stored number access shall be provided to initiate the following calls: (MI)

Destination	Call type	eMLPP priority designation	Additional information
Calls to stored numbers	Point-to-point/ VGCS/VBS	4	Functional number

Table 5-4: Call types requiring MMI stored number access

5.5.12 Unless otherwise indicated at time of entry, calls from the stored numbers list shall be initiated as voice calls. (MI)

5.5.13 By default, calls will have a priority of railway information calls (eMLPP priority designation 4). It shall be possible to store a priority in association with a stored number. (MI)

*Dial access*

5.5.14 The driver shall be able to initiate a call by dialling any valid telephone number or functional number. (MI)

5.5.15 Dial access shall be provided to initiate the following calls: (MI)

<b>Destination</b>	<b>Call type</b>	<b>eMLPP priority designation</b>	<b>Additional information</b>
Calls to other users	Point-to-point/ VGCS/VBS	4	Functional number

*Table 5-5: Call types requiring MMI dial access*

5.5.16 Abbreviated dialling facilities shall be supported. (MI)

5.5.17 Dialled calls from the MMI shall be point-to-point voice calls unless otherwise entered from the MMI at the time of initiation. (MI)

5.5.18 By default, dialled calls shall have a priority of railway information calls (eMLPP priority designation 4). (MI)

*Receiving a call*

5.5.19 It shall be possible to receive and manage the following incoming calls: (MI)

- emergency calls;
- group calls;
- point-to-point calls;
- multi-party calls.

5.5.19i It shall be possible to receive and manage the incoming broadcast calls: (M)

*Call arbitration*

5.5.20 The Cab radio shall arbitrate between calls in the following cases: (M)

- an incoming call is received whilst the Cab radio is in an on-going call;
- a Cab radio user attempts to initiate a call whilst the Cab radio is in an on-going call.

5.5.21 The Cab radio shall apply the arbitration rules outlined in Table 5A-1 in Appendix 5A. (MI)

*Conversation*

- 5.5.22 Once a call has been established the connected parties shall be able to communicate. (MI)
- 5.5.23 Replacing the handset shall result in the outcomes listed in Tables 5A-2 and 5A-3. (MI)

*Call termination*

- 5.5.24 Calls shall be able to be terminated by either party subject to the requirements shown in tables 5A-2 and 5A-3. (MI)

*a) Outgoing calls*

- 5.5.25 Table 5A-2 in Appendix 5A shows the effect of replacing the handset or initiating the 'Call clear' procedure for the different types of outgoing calls. (MI)

*b) Incoming calls*

- 5.5.26 Table 5A-3 in Appendix 5A shows the effect of putting down the handset or initiating the 'Call clear' procedure for the different types of incoming calls. (MI)

**5.6 Other Cab radio functions***Handle incoming/outgoing calls to/from appropriate on-train users or devices*

- 5.6.1 Incoming calls to the Cab radio shall be routed to the on-train user or device identified by the sub-addressing field. (MI)

*Manual network selection*

- 5.6.1i Using the GSM "Manual" network selection procedure, the Cab radio application shall allow the driver to access a prioritised list of authorised networks (to be displayed as stated in section 10.5) and shall allow the driver to select a desired network from this list. This function shall not be available if there is an ongoing voice call involving the Cab radio. (MI)

*Directed network selection*

- 5.6.2 As a train approaches the limits of the coverage of the PLMN it is registered with, it will be necessary for it to register with the next PLMN providing coverage. (I)
- 5.6.3 A means of directed network selection should be provided to ensure that the MS registers with the required network. (O)

- 5.6.4 If directed network selection is implemented, the directed network selection procedure shall be initiated by an external trigger mechanism, which instructs the Cab radio application to select the required network unless a voice call is ongoing. (M)
- 5.6.4i If directed network selection is implemented and voice calls are ongoing at the time when the external device attempts to trigger a network change, an audible and visual indication shall be given to the driver and network change shall be deferred until the call is terminated or until coverage of the current network is lost. (M)
- 5.6.5 If directed network selection is implemented, the Cab radio application shall use the GSM “Manual” network selection procedure (through the AT interface [EN 301 515, Index [19]]) to instruct the MT to register with the required network. (M)

*Automatic network selection*

- 5.6.5i The Cab radio should be capable of selecting the most appropriate mobile radio network automatically using the selection criteria stated in section 10.5. (O)
- 5.6.5ii If automatic network selection is implemented, the driver shall be capable of deactivating and/or re-activating this function using simple MMI actions. (M)
- 5.6.5iii Whilst automatic network selection is enabled, the MMI shall display an indication. (MI)

*Service availability*

- 5.6.6 In idle mode, if the GSM Service Indicator (see [EN 301 515, Index [26]]) is lost, the mobile shall give an audible and visual indication. (MI)

*Alerting of a controller*

- 5.6.7 A Cab radio in a group call in Shunting mode should support Alerting of a controller as defined in section 4.6. (O)

## **5.7 Environmental and physical**

- 5.7.1 Train-mounted equipment including the Cab radio terminal equipment, MMI and antenna shall comply with all specifications in section 4 and all of those defined in this section, with those defined in this section taking priority. (M)
- 5.7.2 Two types of mobile radio equipment will be mounted in rolling stock: in-cab equipment and external equipment. Each type of equipment has slightly different requirements placed upon it in terms of EMC and climate. ([UIC 651] is a useful reference concerning the layout of cab equipment.) (I)

*Climatic conditions*

- 5.7.3 The Cab radio shall be capable of operating within a temperature range of -20°C to +70°C. (M)
- 5.7.4 The aerial and any other equipment mounted external to the train shall be capable of withstanding extremes of temperature from -40°C to +70°C. (M)
- 5.7.5 The aerial and any other equipment mounted external to the train shall function during rapid temperature fluctuations of up to 3°C/second. (M)
- 5.7.6 Any equipment mounted external to the train cab shall withstand the following additional physical conditions: (M)
- in-tunnel pressure pulses of 6 kPa (peak to peak) for up to 3 seconds;
  - pressure gradients of up to 100 kPa/s.

*Physical conditions*

- 5.7.7 Measures should be taken to reduce the risk of theft of radio equipment. Examples of such measures include physical protection, alarms and access control measures. (O)
- 5.7.8 Ease of maintenance should be taken into account in the design and installation of radio equipment. For example, maintenance access to antennas on vehicles should be provided. (O)
- 5.7.9 The “Subscriber Identity Module” (SIM card) shall be physically integrated with the radio set and shall not be able to be removed except by maintenance staff. (M)
- 5.7.10 Deleted.

*Mechanical conditions*

- 5.7.11 Any equipment mounted inside the train cab shall be capable of withstanding the following maximum levels of sinusoidal vibration: (M)
- frequency range: 5-200 Hz;
  - peak-to-peak amplitude: 7mm;
  - acceleration: 1.5g.
- 5.7.12 Any equipment mounted external to the train cab shall withstand the following maximum levels of sinusoidal vibration: (M)
- frequency range: 5-1000 Hz;
  - peak-to-peak amplitude: 5mm;
  - acceleration: 2.5g.

*Electrical*

- 5.7.13 The Cab radio shall comply with European standard [EN 50124]. (M)
- 5.7.14 An emergency power supply should be provided for Cab radios which will enable the driver's radio to continue to operate for a period of at least 1 hour in the event of failure of the train's main power supply, based on the following cycle (see section 4.5.21): (O)
- point-to-point calls 20%;
  - group calls 5%;
  - standby 75%.
- 5.7.15 Deleted.
- 5.7.16 The Cab radio main and backup power supplies shall comply with the voltage fluctuations and transients as defined in [EN 50155]. (M)
- 5.7.17 The driver and other in-cab equipment shall be protected against all electrical hazards arising from EIRENE mobile equipment as defined in [EN 50153]. (M)

*Electromagnetic Compatibility*

- 5.7.18 Deleted.
- 5.7.19 Electromagnetic interference immunity and emissions of the Cab radio shall comply with [EN 50121 parts 1, 2 and 3-2]. (M)
- 5.7.20 Deleted.
- 5.7.21 When installed in the train, the emissions from the Cab Radio and its associated antenna system (connecting cable and antenna) shall comply with the requirements defined in [EN 50121 parts 1 and 3-2]. (M)

*Testing procedures*

- 5.7.22 The Cab radio shall pass electrical tests as defined in [EN 50155]. (M)
- 5.7.23 Deleted.

**5.8 Cab radio interfaces to on-train systems**

- 5.8.1 The following list catalogues the interfaces that should be provided by the Cab Radio to the on-train systems (I):
- Train borne recorder;
  - ERTMS/ETCS interface;
  - Public Address interface;
  - UIC Intercom;

- Driver's Safety Device;
- Other interfaces;
- Train Interface Unit (TIU).

5.8.2 Where implemented, these interfaces are subject to the requirements stated in the following sections. (I)

### **5.9 Train borne recorder**

5.9.1 The Cab radio and the train borne recorder may be connected via the Train Interface Unit (TIU) or may be connected directly by means of a nationally determined interface. (O)

### **5.10 ERTMS/ETCS interface**

5.10.1 Some Cab radios will be required to provide communications for ERTMS/ETCS. (I)

5.10.2 If ERTMS/ETCS communications are required, an interface as defined in the FFFIS for EURORADIO [MORANE EURO FFFIS] shall be implemented. (MI)

### **5.11 Public Address interface**

5.11.1 If implemented, the Public Address interface should comply with the specifications of the UIC Fiche [UIC 568]. (O)

### **5.12 UIC Intercom**

5.12.1 If implemented, the UIC interface should comply with the specifications of the UIC Fiches [UIC 558, 568]. (O)

### **5.13 Driver's Safety Device**

5.13.1 The Cab radio and the Driver's Safety Device may be connected via the Train Interface Unit (TIU) or may be connected directly by means of a nationally determined interface. (I)

5.13.2 Where a driver safety device (DSD) interface is implemented, the activation of the DSD alarm shall trigger the Cab radio to send a SETUP message using the short dialling code as specified in Table 9-10 with 'railway operation' priority. (M)

5.13.3 The notification of a DSD Alarm Condition shall be implemented using the User to User Signalling supplementary service (UUS1). (M)

- 5.13.4 The SETUP user-to-user information element shall be as specified in [TS 102 610] and shall include the following UUS1 IE tags: (M)
- the PFN tag (M)
  - the DSD tag (M)
- 5.13.4i The SETUP user-to-user information element should include the train position UUS1 IE tag. (O)
- 5.13.5 The PFN tag shall always be the first of such tags as specified in [TS 102 610]. The remaining tags may be placed in any order after the PFN tag. Receiving applications shall be able to interpret either sequence (M)
- 5.13.6 The PFN tag shall contain the train number together with the driver function code of the engine detecting the alarm. In the case where no train number has been entered then this tag shall be coded to represent the null functional number as specified in [TS 102 610]. (M)
- 5.13.7 The DSD tag shall contain the locomotive engine number as per [TS 102 610]. (M)
- 5.13.8 In the case where GPS coordinates are not available to the cab radio, this tag shall either be omitted or filled with zeros to indicate no valid position. Receiving applications shall be able to interpret both alternatives. (M)
- 5.13.9 When receiving a DSD alarm notification, the receiving application shall release the call using DISCONNECT or RELEASE COMPLETE. No response UUIE tag is defined or required for this application. (M)

## **5.14 Other interfaces**

- 5.14.1 Other interfaces may take the form of additional audio and data inputs and outputs. (I)
- 5.14.2 Where other data interfaces are implemented, they should be of the RS422 standard. (O)

## **5.15 Train Interface Unit (TIU)**

- 5.15.1 Where necessary, a Train Interface Unit may be implemented to adapt on-train systems to the standard interfaces provided by the Cab radio. (I)
- 5.15.2 The interfaces between the TIU and the on-train systems are outside of the scope of EIRENE standardisation. (I)
- 5.15.3 Figure 5-3 shows an example of how the Train Interface Unit may be implemented: (I)

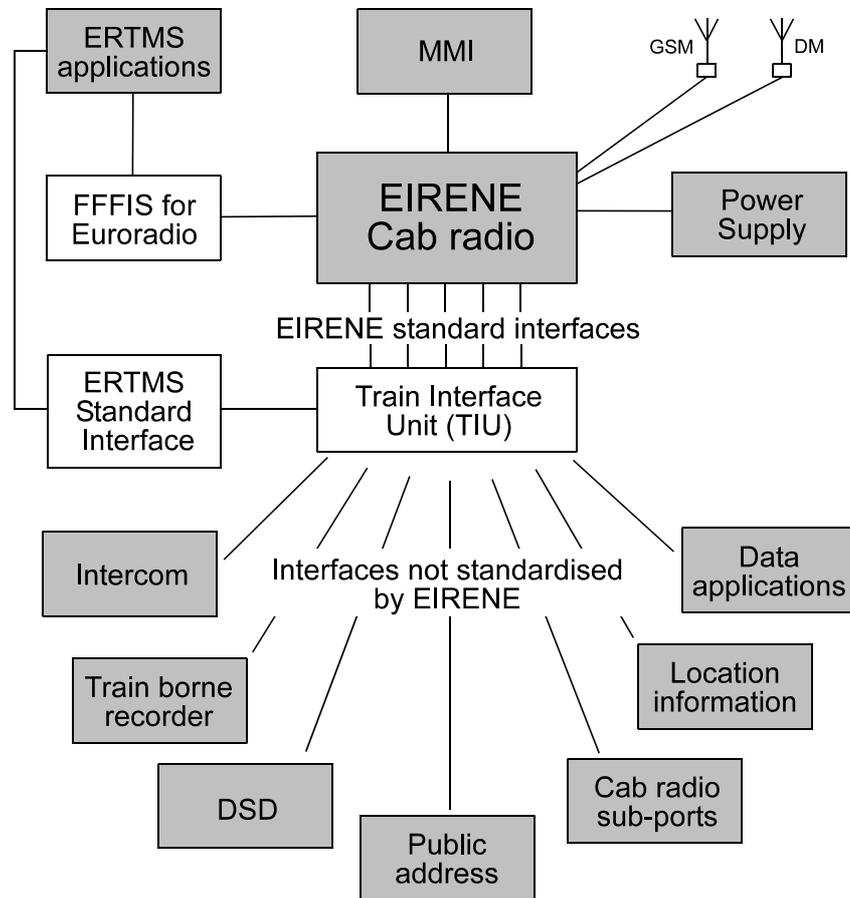


Figure 5-3: Interfaces to the Cab radio

## 5A Handling of calls

### 5A.1 Call arbitration table (MI)

On-going call	New call	Result	Comment
Emergency (Railway emergency call)	Emergency call (outgoing)	No change *	
	Intercom call (outgoing)	Intercom connected (2)	
	Public Address call (outgoing)	Public Address connected (2)	
	Call chief conductor (outgoing)	Emergency call maintained, new call sent by UIC Intercom link (3)	
	Incoming calls (including other emergency calls)	Emergency call remains connected Incoming call is indicated	
Other drivers same area (group call 200)	Emergency call (outgoing)	Leave the on-going call and establish the emergency call	
	Public Address call (outgoing)	Public Address connected (2)	
	Call chief conductor (outgoing)	Call sent by UIC Intercom link (3)	
	Intercom call (incoming)	Intercom connected (2)	
	Emergency call (incoming)	Leave the on-going call and join the emergency call	
	Other incoming calls	On-going call is maintained and incoming call is clearly indicated.	
All drivers in a given area (group call 555 )	Emergency call (outgoing)	Leave the on-going call and establish the emergency call	
	Public Address call (outgoing)	Public Address connected (2)	
	Call chief conductor (outgoing)	Call sent by UIC Intercom link (3)	
	Intercom call (outgoing)	Intercom connected (2)	
	Emergency call (incoming)	Leave the on-going call and join the emergency call	
	Other drivers in same area (group call 200)	Leave the on-going call and join the new call	
	Other incoming calls	On-going call is maintained and incoming call is clearly indicated	

On-going call	New call	Result	Comment
Controller (all types, and other operational calls)	Emergency call (outgoing)	Leave the on-going call and establish the emergency call	
	Public Address call(outgoing)	Leave the ongoing call and connect the Public Address	
	Call chief conductor (outgoing)	Call sent by UIC Intercom link (3)	
	Intercom call (outgoing)	Leave the ongoing call and connect the Intercom	
	Other outgoing calls (outgoing)	New call connected On-going call put on hold	
	Emergency call (incoming)	Leave the on-going call and join the emergency call	
	Other drivers in same area (group call 200)	Leave the on-going call and join the new call	
	All drivers in a given area (group call 555)	Maintain the on-going call and indicate the new call	
	Other incoming calls	Maintain the on-going call and indicate the new call	
Other drivers same train (multiple driver communications by radio link) (7)	Emergency call (outgoing)	Leave the on-going call and establish the emergency call	Leading driver may re-establish call to non leading drivers at the end of emergency call  Multi-driver communications placed on hold or driver may add controller to multi-driver communication
	Public Address call (outgoing)	Public Address connected (2)	
	Call chief conductor (outgoing)	Call sent by UIC Intercom link (3)	
	Emergency call (incoming)	Leave the on-going call and join the emergency call	
	Intercom (driver initiated)	Intercom connected (2)	
	Other outgoing calls (outgoing)	New call connected Multi-driver communication put on hold	
	Call to controller (outgoing)	Call connected	
	Other drivers same area (incoming) (group call 200)	Leave the on-going call and join the incoming call	
Other drivers same area (group call 555)	Maintain the on-going call and indicate the new call		

On-going call	New call	Result	Comment
	Other incoming calls from controller	Maintain the on-going call and add the controller to the call	
	Other incoming calls	Maintain the on-going call and indicate the new call	

<b>On-going call</b>	<b>New call</b>	<b>Result</b>	<b>Comment</b>
Public Address (over radio link)	Emergency call (outgoing)	Disconnect the Public Address and establish the emergency call	
	Public Address (outgoing)	No change (6)	
	Call chief conductor (outgoing)	Call sent (by Public Address)	
	Intercom (outgoing)	Public Address retained Intercom connected	
	Call controller (all types)	Public Address released Call sent	
	Intercom (incoming) Emergency (incoming) Other drivers in same area and Controller (all types)	Disconnect the Public Address PA and connect intercom  Disconnect the Public Address and join the incoming call.	
	Other calls	Public Address call is maintained, incoming call is indicated	
Public Address (not radio link)	Emergency call (outgoing)	Disconnect the Public Address and establish the emergency call	
	Call controller (all types)	Disconnect the Public Address PA and join the call	
	Public Address (outgoing)	No change (6)	
	Call chief conductor (outgoing)	Disconnect the Public Address and establish the call	
	Intercom (outgoing)	Disconnect the Public Address and connect the intercom	
	Other calls	Public Address PA kept remains connected (4)  Call established (5)	

<b>On-going call</b>	<b>New call</b>	<b>Result</b>	<b>Comment</b>
Intercom (over radio link)	Emergency (outgoing)	Intercom disconnected Emergency call established	
	Public Address (outgoing)	Intercom disconnected Public Address connected	
	Call chief conductor (outgoing)	Call sent (by Public Address or radio)	
	Intercom (outgoing)	No change	
	Call controller (all types)	Intercom disconnected Call established	
	Other calls	Intercom disconnected Call established	
Intercom (not over radio link)	Emergency (outgoing)	Intercom disconnected Emergency call established	
	Public Address (outgoing)	Intercom disconnected Public Address connected	
	Call chief conductor (outgoing)	Call sent (by Public Address or radio)	
	Intercom (outgoing)	No change	
	Other calls	Intercom remains connected (4) Call established (5)	
Group call in Shunting mode  (excluding Railway Emergency call)	Emergency call (outgoing)	Leave the on-going call and establish the emergency call	
	Public Address call (outgoing)	Public Address connected (2)	
	Call chief conductor (outgoing)	Call sent by UIC Intercom link (2, 3)	
	Intercom call (outgoing)	Intercom connected (2, 3)	
	Emergency call (incoming)	Leave the on-going call and join the emergency call	
	Other drivers in same area (group call 200)	No change (8)	
	Other outgoing calls (outgoing)	Only possible if group call is left first	

	Other incoming calls	On-going call is maintained and incoming call is clearly indicated	
Point to point call in Shunting mode (Operational call)	Emergency (outgoing)	Leave the on-going call and establish the emergency call	
	Public Address (outgoing)	Public Address connected (2)	
	Call chief conductor (outgoing)	Call sent by UIC Intercom link (2, 3)	
	Intercom (outgoing)	Intercom connected (2, 3)	
	Emergency (incoming)	Leave the on-going call and join the emergency call	
	Other drivers in same area (group call 200)	No change (8)	
	Other outgoing calls (outgoing)	New call connected On-going call put on hold	
	Other incoming calls	Maintain the on-going call and indicate the new call	

**Key:**

1. Except broadcast
2. Radio call transferred to the loudspeaker
3. No change if no UIC Intercom link
4. On handset
5. On loudspeaker
6. No access if Public Address is busy by other
7. Lead driver only
8. Group 200-VGCS is de-activated in shunting mode

**Note:** Change Network and Registration/Deregistration are not possible during a call.

*Table 5A-1: Call arbitration rules*

## 5A.2 Call termination of outgoing calls table

Type of call	Replacing handset	Pressing the key used for call clearing	Notes	
Point-to-point	Call terminated	Call terminated	(1)	(MI)
Multi-party call (normal)	Call terminated	Call terminated	(1)	(MI)
Voice Broadcast call (normal)	Call terminated	Call terminated	(1)	(M)
Group call (normal)	Call terminated	Call terminated	(1)	(MI)
Multi-party call (other drivers same train)	Voice to loudspeaker	Call terminated	(2)	(MI)
Voice Group call (emergency)	Voice to loudspeaker	Call terminated	(2) (3)	(MI)

- (1) Action by the driver on using the "Emergency", "Intercom" or "Public Address" functions has the same effect as activating the 'Call clear' procedure
- (2) If the driver activates the "Intercom" or "Public Address" procedures with the handset lifted, the call is transferred to the loudspeaker.
- (3) Call can also be cleared by the Controller.

*Table 5A-2: Effect of handset replacement/pressing the key used for call clearing - outgoing calls*

### 5A.3 Call termination of incoming calls table

Type of call	Replacing handset	Pressing the key used for call clearing	Notes	
Point to point	Call terminated	Call terminated	(1)	(MI)
Multi-party call (normal)	Leave the call (+)	Leave the call (+)	(1)	(MI)
Voice Broadcast call (normal)	Voice to loudspeaker	Leave the call (+)	(1)	(M)
Voice Group call (normal)	Voice to loudspeaker	Leave the call (+)	(1)	(MI)
Multi-party call (other drivers same train)	Voice to loudspeaker	Leave the call (+)	(2)	(MI)
Group call (emergency)	Voice to loudspeaker	No change	(2)	(MI)

- (+) Call still remains ongoing between other parties if more than one user remains in the call.
- (1) Action by the driver on using the "Emergency", "Intercom" or "Public Address" functions has the same effect as activating the 'Call clear' procedure
- (2) If the driver activates the "Intercom" or "Public Address" procedures with the handset lifted, the call is transferred to the loudspeaker.

*Table 5A-3: Effect of handset replacement/pressing the key used for call clearing - incoming calls*

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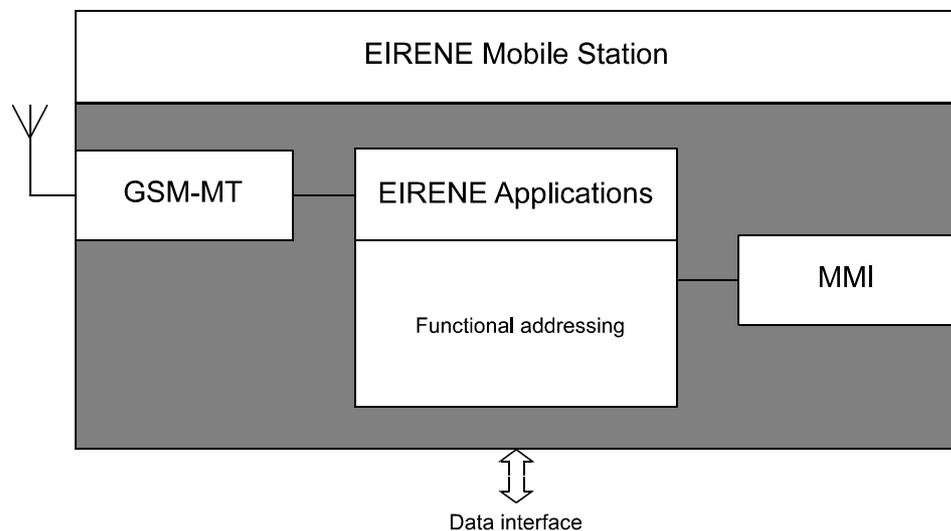
## 6 General purpose radio

### 6.1 Introduction

6.1.1 This section identifies the EIRENE applications which may be used in the General purpose radio and the functionality to be provided by the General purpose radio is detailed. (I)

### 6.2 System components

6.2.1 The logical architecture of the General purpose radio is illustrated in figure 6-1. (I)



*Note: this figure only shows mandatory applications – for a full list see table 4-6*

*Figure 6-1: Logical General purpose radio architecture and interfaces*

6.2.2 A standard data interface shall be provided to allow a computer to be connected to the radio. (M)

6.2.3 The General purpose radio shall operate as a standard GSM terminal, supplying mobile services as defined in section 4. (M)

### 6.3 General purpose radio functions

*Switch radio on*

6.3.1 Automatic self-testing of the radio shall use the GSM IMSI attach procedure. (M)

6.3.2 Upon switch on, once the radio is connected to a mobile network, it shall be able to receive all calls made using the MSISDN or appropriate group call number. (M)

*Register and deregister functional number*

- 6.3.3 It shall be possible to register and deregister a functional number by the user entering his functional number, which is transmitted to the ground along with the subscriber's IMSI, using USSD (see section 11). (M)

*Send/receive Railway emergency call*

- 6.3.4 If the General purpose radio supports the Railway emergency call option listed in Table 4-6 activation of the 'Railway emergency call' function shall cause :
- the radio to initiate a Railway emergency call as defined in section 13. (O)
  - the radio to initiate an enhanced Railway emergency call if the General purpose radio supports eREC as defined in section 13A. (O)

*Select eREC Sector Identity*

- 6.3.5 If the General purpose radio supports the eREC option listed in Table 4-6 :
- the MMI shall provide a means to select the eREC Sector Identity for eREC operation. (M)
  - the MMI may provide a means to deactivate the eREC Sector Identity. (O)
  - the active Sector Identity used for call initiation (however entered at the MMI or received) shall be displayed. (M)

## **6.4 Environmental and physical**

- 6.4.1 The full environmental and physical specification of the General purpose shall be as close as possible to that of a Commercial-Off-The-Shelf (COTS) GSM mobile whilst adhering to the specifications provided in section 4. (M)

*Climatic conditions*

- 6.4.2 The General purpose radio shall comply with the core climatic conditions defined in section 4. (M)

*Physical conditions*

- 6.4.3 SIM cards should be fixed into the radio to protect against accidental loss. (O)

*Mechanical conditions*

- 6.4.4 No specific mechanical requirements need to be placed upon the General purpose radio over and above those defined in section 4. (I)

*Electrical*

6.4.5 General purpose radios shall be equipped with rechargeable batteries capable of providing a minimum of eight hours operation over the temperature range +18°C to +25°C from a single charge, based on the following cycle (see section 4.5.21): (M)

- point-to-point calls                    20%;
- group calls                                5%;
- standby                                     75%.

6.4.6 Changing the battery shall not result in the loss of data stored in the radio. (M)

6.4.7 The General purpose radio shall be suitable for use with a car adapter kit. (M)

*Electromagnetic Compatibility*

6.4.8 The General purpose radio shall comply with [EN 61000 part 6-1 and EN 61000 part 6-3] (generic EMC for residential, commercial and light industry). (M)

*Testing procedures*

6.4.9 No specific testing procedures need to be used on the General purpose radio over and above those given in section 4. (I)

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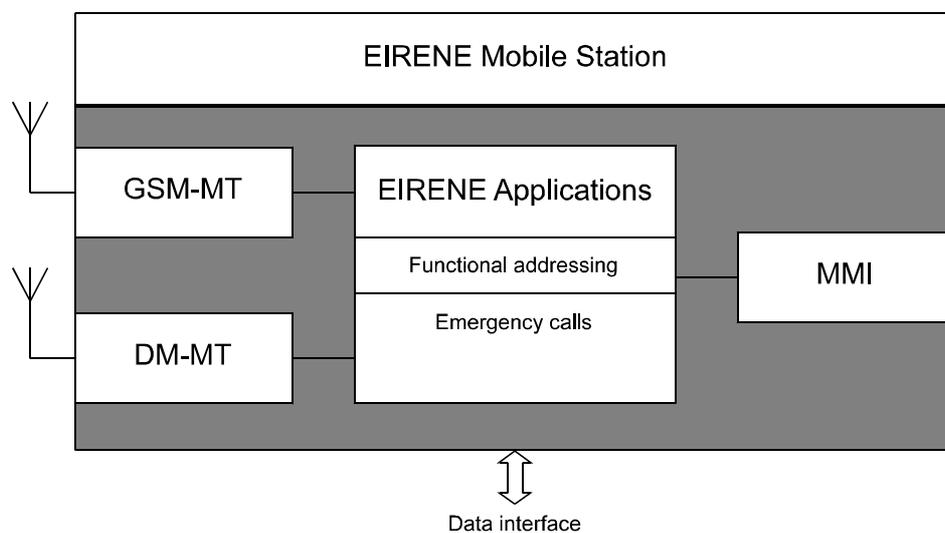
## 7 Operational radio

### 7.1 Introduction

7.1.1 This section identifies the EIRENE applications which may be used in the Operational radio and the functionality to be provided by the Operational radio is detailed. (I)

### 7.2 System components

7.2.1 The logical architecture of the Operational radio is illustrated in figure 7-1. (I)



*Note: the provision of direct mode is optional*

*Note: this figure only shows mandatory applications – for a full list see table 4-6*

*Figure 7-1: Logical Operational radio architecture and interfaces*

7.2.2 A standard data interface shall be provided to allow a computer to be connected to the radio. (M)

7.2.3 The Operational radio shall operate as a standard GSM terminal, supplying mobile services as defined in section 4. (M)

### 7.3 Operational radio functions

*Switch radio on*

7.3.1 Automatic self-testing of the radio shall use the GSM IMSI attach procedure. (M)

7.3.2 Upon switch on, once the radio is connected to a mobile network, it shall be able to receive all calls made using the MSISDN or appropriate group call number. (M)

*Register and deregister functional number*

- 7.3.3 It shall be possible to register and deregister a functional number by the user entering his functional number, which is transmitted to the ground along with the subscriber's IMSI, using USSD (see section 11). (M)

*Call controller*

- 7.3.4 Upon receipt of the call establishment request, the radio shall retrieve the stored number for the appropriate controller from the SIM or other storage location. (M)

- 7.3.5 Once an appropriate number has been obtained, the radio shall initiate a call to this number with 'Railway operation' priority (see section 10.2). Any functional number associated with the user shall be passed to the network using UUS1 (see section 11.5). (M)

*Send/receive Railway emergency call*

- 7.3.6 Activation of the 'Railway emergency call' function shall cause :

- the radio to initiate a Railway emergency call as defined in section 13. (M)
- the radio to initiate an enhanced Railway emergency call if the Operational radio supports eREC as defined in section 13A. (O)

- 7.3.7 The calling user's functional number, if there is one, shall be passed to the network using UUS1. (M)

*Enter/leave direct mode*

- 7.3.8 The Operational radio should support direct mode communications as defined in section 15. (O)

- 7.3.9 Deleted.

*Select eREC Sector Identity*

- 7.3.10 If the Operational radio supports the eREC option listed in Table 4-6:

- the MMI shall provide a means to select the eREC Sector Identity for eREC operation. (M)
- the MMI may provide a means to deactivate the eREC Sector Identity. (O)
- the active Sector Identity used for call initiation (however entered at the MMI or received) shall be displayed. (M)

**7.4 Deleted.**

7.4.1 Deleted.

**7.5 Environmental and physical**

7.5.1 The Operational radio shall comply with the basic standards defined for all EIRENE mobile equipment in section 4. In addition, the Operational radio is specified to allow its use in the operating environment experienced on the operational railway (e.g. maintenance), with the specifications in this section taking priority over those in section 4 where any discrepancy is identified. (M)

*Climatic conditions*

7.5.2 The Operational radio shall cope with rapid temperature fluctuations of up to 3°C/second. (M)

7.5.3 The Operational radio shall be capable of withstanding exposure to extreme environmental conditions [EN 300 019]. The lowest class defined in this standard shall be fulfilled as minimum. Higher classes may be selected based on national needs. (M)

*Physical conditions*

7.5.4 The Operational radio shall conform to IP 54 [EN 60529] as a minimum. (M)

7.5.5 SIM cards shall be fixed into the radio such that they can only be removed by the use of a tool. (M)

*Mechanical conditions*

7.5.6 The Operational radio shall be capable of withstanding the following shocks: (M)

- semi-sinusoidal shocks of up to 5g for up to 100ms under normal conditions;
- shocks of up to 10g for up to 5ms under exceptional conditions;
- free fall from 1.0m.

*Electrical*

7.5.7 The Operational radio user shall be protected against all electrical hazards arising from the mobile equipment as defined in [EN 50153]. (M)

7.5.8 Operational radios shall be equipped with rechargeable batteries capable of providing a minimum of eight hours operation over the temperature range -10°C to +55°C from a single charge, based on the following cycle (see section 4.5.21): (M)

- point-to-point calls 20%;
- group calls 60%;
- standby 20%.

7.5.9 Changing the battery shall not result in the loss of data stored in the radio. (M)

7.5.10 The Operational radio shall be suitable for use with a car adapter kit. (M)

*Electromagnetic compatibility*

7.5.11 The Operational radio shall comply with [61000 part 6-2 and part 6-4] (generic EMC for the industrial environment). (M)

*Testing procedures*

7.5.12 No specific testing procedures need to be used on the Operational radio over and above those given in section 4. (I)

## 7A Shunting radio

### 7A.1 Introduction

7A.1.1 This section identifies the EIRENE applications which may be used in the Shunting radio and the functionality to be provided by the Shunting radio is detailed. (I)

7A.1.2 The goal of the Shunting radio specification is to define a unified, common terminal platform agreed on by the railway operators. It should be possible to use this common terminal platform with interfaces, applications and accessories to fulfil specific national railway needs. (I)

7A.1.3 The Shunting radio or a combination of Shunting radio and accessories shall comply with the requirements applicable to the Operational radio modified by the requirements that follow in this section. (M)

### 7A.2 System components

7A.2.1 The logical architecture of the Shunting radio is illustrated in figure 7A-1. (I)

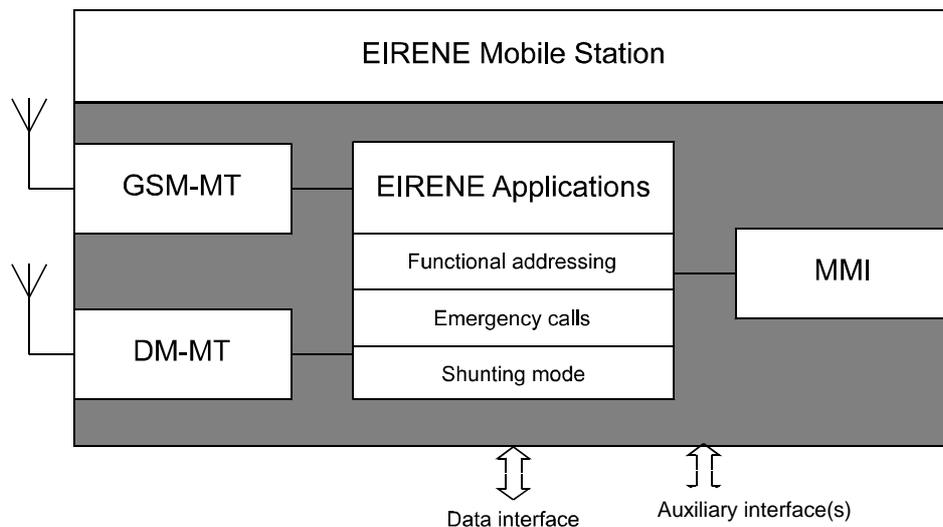


Figure 7A-1: Logical Shunting radio architecture and interfaces

7A.2.2 Auxiliary interface connector(s) shall be provided to support various voice, control and other functions. (M)

7A.2.3 For the standard data interface and auxiliary interface(s) either cable or wireless connections should be used. (I)

7A.2.4 The auxiliary interface shall support as a minimum the following functions: (M)

- Control panel:
  - Emergency button;
  - Push-to-talk;

- Link assurance;
- Alerting of a controller;
- Shunting group selector.
- Loudspeaker;
- Microphone;
- Antenna connection direct or coupled;
- Data;
- Power output for low power consuming accessory;
- Charging connector;
- Headset.

7A.2.5 It should be possible to rotate the information shown on the display by 0 and 180 degrees using MMI display options. (O)

### **7A.3 Shunting radio functions**

#### *Call controller*

7A.3.1 A Shunting radio in a group call, in Shunting mode, should support Alerting of a controller as defined in section 4.6. (O)

7A.3.2 A Shunting radio in a group call, not in Shunting mode, should support Alerting of a controller as defined in section 4.6. (O)

#### *Enter/leave shunting mode*

7A.3.3 In addition to Operational radio functionality, the Shunting radio shall support shunting mode communications as defined in this section and section 14. (M)

#### *Other functions*

7A.3.4 Link Assurance Signal shall be supported. (M)

7A.3.4i The following functions should be supported: (O)

- Tilt alarm
- SIM tool kit
- Over-The-Air application
- Positioning information

7A.3.5 Based on national needs, the multi-party service (as required in table 4-5) may be used, for example in cases where a point-to-point call between two parties needs to involve a dispatcher or another third party for a short period of time.(I)

7A.3.6 The Tilt Alarm application (“man down” function) is used to check the orientation of the handheld terminal (e.g. the posture of the shunting participant) in order to ensure safe shunting operation. (I)

- 7A.3.7 The Over-The-Air (OTA) application is used by the maintenance staff to update the SIM card content remotely over the air. (I)
- 7A.3.8 The positioning information service, based on satellite positioning systems like GPS or Galileo, is used to provide the location of the Shunting radio which can be used in operational and/or emergency situations (e.g. position of the shunter for operational planning or for the use in combination with the Tilt Alarm application). (I)

#### **7A.4 Environmental and physical**

- 7A.4.1 In addition to 7A.1.3, the Shunting radio is specified to allow its use in the “Trackside environment” (see list of definitions), with the specifications in this section taking priority over those mentioned before where any discrepancy is identified. (M)
- 7A.4.2 The requirements shall be fulfilled with the Shunting radio alone or with a combination of the Shunting radio and accessories. (M)
- 7A.4.3 The design and construction of Shunting radios must take into account the very specific characteristics of trackside operation, which are: (I)
- Contamination with iron particles and particles from the brakes;
  - Users habitually wear thick gloves for hand protection during their work;
  - Mechanical parts are often contaminated with grease;
  - In the limited space between coaches, equipment carried on the users body ( such as a shunting radio) is subjected to considerable mechanical shock and abrasion due to the repeated and unavoidable contact with the various mechanical obstacles;
  - The use of the radio including accessories must not lead to getting caught on obstacles (e.g. getting wrapped or strangled).

##### *Shunting radio climatic conditions*

- 7A.4.4 The Shunting radio or the combination of the Shunting radio and its accessories should be capable of operating over the following standard range of temperatures (O):
- -30°C to +55°C (Extended conditions): display working properly, reduced working time due to battery characteristics;
  - -50°C to +70°C (Extreme conditions): display may slow down, but the functionality remains, reduced working time due to battery characteristics.
- 7A.4.5 The Shunting radio or the combination of the Shunting radio and its accessories shall comply to protection standard [EN 300 019]. The lowest class defined in this standard shall be fulfilled as minimum. Higher classes may be selected based on national needs. (M)

*Accessories physical conditions*

- 7A.4.6 The Shunting radio accessories should be usable in a temperature range of -50°C to +70°C and should comply to dust and water protection standards according to IP65 [EN 60529] or higher. (O)

*Electromagnetic compatibility*

- 7A.4.7 The shunting radio shall comply with [EN 61000 part 6-2 and part 6-4] (generic EMC for the industrial environment). (M)

## 8 Controller equipment specifications

### 8.1 General

- 8.1.1 Functional requirements relating to controller equipment specifications can be found in the EIRENE Functional Requirements Specification [EIRENE FRS]. (I)
- 8.1.2 Controller equipment interfaces to the GSM-R Network Switching Subsystem (NSS). (I)
- 8.1.3 This interface to controller equipment may be implemented as an IP based interface. (O).
- 8.1.4 If controller equipment has an IP based interface using SIP to the GSM-R NSS, it shall comply with [TS 103 389] (M).

### 8.2 Termination of VGCS/VBS calls

- 8.2.1 An entitled controller may terminate a VGCS/VBS call based on DTMF signalling [EN 301 515, Index [4] & [5]]. (I)
- 8.2.2 To terminate a VGCS/VBS call by DTMF signalling, the 3-digit sequence “\*\*\*\*” shall be used. (M)
- 8.2.3 In order to minimise the discomfort caused by the DTMF tone added in the voice channel, the duration of the tone generated by the fixed line dispatcher shall be  $70\text{ms} \pm 5\text{ms}$ , and there shall be a minimum gap of 65ms between each tone. (M)

### 8.3 Muting and unmuting for VGCS calls

- 8.3.1 Muting and unmuting shall be in line with [EN 301 515, Index [4]]. (M)
- 8.3.1a A controller (originating, joining or re-joining) shall be able to talk to all VGCS call members immediately, except to the current talking service subscriber using the common uplink. In this case, the controller shall not need to indicate the wish and can speak immediately. (M)
- 8.3.2 A controller who wishes to start talking to all VGCS call members including the current talking service subscriber shall perform an action, for example pressing a button, whereupon the 3-digit DTMF sequence “###” shall be transferred to the network. If this controller wants to stop talking he shall perform an action, whereupon the 3-digit DTMF sequence “#\*\*” shall be transferred to the network. (M)
- 8.3.3 The terminal of the controller should receive a single DTMF grant tone “#” of duration  $100\text{ms} \pm 5\text{ms}$  sent by the network if it has detected the 3-digit DTMF sequence “###” and if the controller was not previously talking. (O)
- 8.3.4 Deleted.

8.3.5 The duration of each tone (see 8.3.2 and 8.3.4) added in the voice channel, shall be 70ms  $\pm$  5ms, and there shall be a minimum gap of 65ms between each tone. (M)

#### **8.4 Shunting operation**

8.4.1 If the controller equipment is used in shunting operation, the Alerting of a controller in a group call service should be used. (O)

8.4.2 If the service is implemented, it shall be as defined in section 4.6. (M)

#### **8.5 Joining and Re-Joining of Group Calls**

8.5.1 A controller entitled to originate a specific group call shall also be entitled to join or re-join that group call. This is independent of that controller's entitlement to receive the group call when initiated by another party. (M)

8.5.2 If a controller is not entitled to originate a specific group call then that controller shall not be entitled to join or re-join that group call. This is independent of that controller's entitlement to receive the group call when initiated by another party. (M)

## 9 Numbering plan

### 9.1 General

9.1.1 International standardisation of the numbering plan is required to ensure interworking between networks. Furthermore, standardised allocation of numbers to subscribers is likely to facilitate schemes for identification, barring etc. (I)

9.1.2 This section addresses the following: (I)

- numbering plan requirements;
- numbering plan limitations;
- types of numbers;
- EIRENE numbering plan;
- short dialling codes;
- group addresses.

9.1.3 The precise details of the numbering plan to be chosen for particular railways will depend upon the railway network configuration, its interconnection with other railway networks and its interconnection with public telecommunication networks. Equipment design must therefore be such as to give maximum flexibility in numbering arrangements. However, it may be generally assumed that numbers (excluding access prefixes) will not exceed 15 digits in length and will consist entirely of the digits **1** to **9** and **0**. (I)

9.1.4 Characters **\*** and **#** may be used locally to gain access to special facilities such as short code dialling. However, these arrangements do not form part of the network numbering plan. (I)

9.1.5 Procedures for handling the relationship between EIRENE Numbers and MSISDN numbers (ie registration, deregistration and re-registration) are specified in section 11. (I)

9.1.6 Each railway should have appropriate call-barring facilities to prevent unintended access to the GSM-R network by non-authorized users. (O)

### 9.2 Numbering plan requirements

#### *Use of Train Number*

9.2.1 Within each GSM-R network, each Train Number must be unique for the period of the journey. (I)

9.2.2 Every On-Train Function shall be identified by a standard code and shall conform to the list of functions given in Appendix 9A of this section. (MI)

- 9.2.3 All Train Function Numbers and their associated MSISDN numbers shall be stored in the same routing database, which is the database of the GSM-R network in which the train is currently operating. (MI)

*Use of Engine Number*

- 9.2.4 Every On-Engine Function shall be identified by a standard code and shall conform to the list of functions given in Appendix 9A of this section. (MI)

- 9.2.5 The Engine Function Number(s) and associated MSISDN numbers shall at any time be stored as an entry in the routing database of the home GSM-R network<sup>4</sup> of the engine. (MI)

*Use of Coach Number*

- 9.2.6 The Coach Function Number(s) and associated MSISDN number(s) shall at any time be stored as an entry in the routing database of the home GSM-R network of the coach. (MI)

*Use of Shunting Team, Maintenance Team or Train Controller Number*

- 9.2.7 Every Function shall be identified by a standard code and shall conform to the list of functions given in Appendix 9A of this section. (MI)

- 9.2.7i Subject to operational rules, it is permissible for a shunting participant not to register to a functional number. (I)

- 9.2.8 The functional numbers of the Shunting Team Members, Maintenance Team Members and Train Controller (and any associated MSISDN numbers) shall be stored as entries in the routing database of the home GSM-R network. (MI)

*Use of MSISDN number*

- 9.2.9 Implementation of the EIRENE numbering plan shall not prohibit any authorised caller from using the MSISDN number where known, thus enabling mobiles to be assigned to particular personnel where this is appropriate. (MI)

*Use of group call Service Areas*

- 9.2.10 Service areas shall be defined within each railway network. (MI)

- 9.2.11 The numbering of Service Areas for group calls and broadcast calls shall be made in accordance with GSM Technical Specifications [EN 301 515, Index [21] & [4]] and [EN 301 515, Index [22] & [5]] respectively. (MI)

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<sup>4</sup> The home GSM-R network is the mobile network to which the mobile on the engine is subscribed.

*Use of Maintenance and shunting group ID's*

- 9.2.12 Additional Group-ID range(s) may be selected by the operator (e.g. ranges denoted as "Reserved for national use" in table 9-8). (O)
- 9.2.13 If national group-ID ranges are used, and if CT6 registration is required, the corresponding Team Type in the Function Codes is applied (e.g. for group-ID range 5xx, Team Type 5 is used and for group-ID range 6xx, Team Type 6 is used). (I)

**9.3 Numbering plan limitations**

- 9.3.1 The EIRENE network can not be considered as a fully private network, as some parts of either the mobile or fixed networks may be provided by public operators. This leads to certain restrictions on the implementation of a numbering plan. These restrictions are given below. (I)

*Number allocation*

- 9.3.2 To achieve integration of the EIRENE numbering plan with the national public numbering plan, telephone numbers have to be allocated by the various numbering regulatory bodies on a national basis. If functional numbers are to be used outside the EIRENE network, they will require either a public number allocation or, alternatively, an EIRENE Network Access Number (ENAN) may be used as described in 9.11 (I)
- 9.3.3 Each national railway should obtain a public numbering allocation for MSISDN numbers from the relevant regulatory bodies. (O)
- 9.3.4 The EIRENE numbering plan shall be standardised to allow interoperability and shall be implemented as a private numbering plan within the GSM-R network. (MI)

*Use of alphanumerical numbers*

- 9.3.5 In some countries Train Numbers are alphanumeric. These numbers do not comply with a numbering plan that can be interpreted by telephone switches and are therefore not supported by the call routing solution given in section 11. (I)
- 9.3.6 If alphanumerical numbering is required within a railway network, then these numbers may either be translated at the user terminal into a subscriber number or conveyed between the calling party and a routing database using a nationally determined approach. (I)

**9.4 Types of numbers**

- 9.4.1 Within the GSM-R network, the user shall be able to dial the following types of numbers: (MI)

- **National EIRENE Number (NEN):** this number is used to route a call from the calling party to a called party registered within the same GSM-R network;
- **International EIRENE Number (IEN):** this number is used to route a call from the calling party to a called party registered within another GSM-R network;
- **MSISDN numbers:** the number used by a subscriber of a public fixed (or mobile) network for calling a mobile station of a GSM PLMN;
- **Short Dialling Code (SDC):** this number is used to allow 'speed dialling' functionality.

9.4.2 In addition, Breakout Codes (BCs) shall be used to allow users within the GSM-R network to access external numbers. (MI)

9.4.3 Access from the GSM-R network to external networks shall be as detailed in section 9.10. (MI)

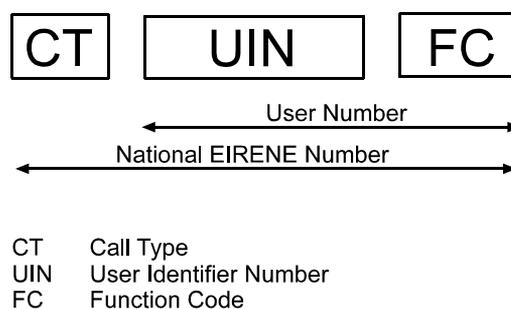
## 9.5 Use of National EIRENE Numbers

9.5.1 National EIRENE Numbers are used to set up calls within a single GSM-R network. (I)

9.5.2 Every railway network shall consider a number as a National EIRENE Number (NEN) unless the number is preceded by an International Code, identifying another GSM-R network. (MI)

### *Structure of National EIRENE Number*

9.5.3 The National EIRENE Number shall consist of three distinct parts, as shown in figure 9-1: (MI)



*Figure 9-1: National EIRENE Number structure*

### 1) Call Type:

The Call Type (CT) prefix is used to distinguish between the different types of User Numbers that are allowed within the national EIRENE numbering plan. It is an indication to the network of how to interpret the number dialled. (I)

**2) User Identifier Number:**

The User Identifier Number (UIN) shall be one of the following numbers (as identified by the CT): (MI)

- **Train Number (TN):** a number given to a train by operational staff for a particular journey. This number shall be unique for the duration of the journey.
- **Note.** For certain Train Numbers (e.g. 1234 and 123), a risk exists when dialling a number by keying in individual digits e.g. by the dispatcher. In this circumstance the risk of connecting to an un-intended train exists if there is a delay between keyed-in digits. There is no risk of ambiguity if block dialling is employed.
- **Engine Number (EN):** a unique number given to a tractive unit to identify it permanently. The UIC has introduced a uniform identification marking system for tractive stock crossing frontiers [UIC 438-3]. In order to call a particular locomotive, it shall be possible to call a number associated with the tractive unit's stock number. The actual number of the unit, which shall be used as the EN, is based on the complete identification number.
- **Coach Number (CN):** a unique number given to a coach (which is not a tractive unit) to identify it permanently. The UIC has introduced a uniform identification marking for passenger rolling stock [UIC 438-1]. In order to call a particular coach it shall be possible to call a number associated with the vehicle marking. The total vehicle marking consists of 12 digits. The actual number of the coach is denoted by seven digits (positions 5 to 11 of the complete vehicle marking), which shall be used as the CN<sup>5</sup>.
- **Shunting Team Location Number (STLN)**
- **Maintenance Team Location Number (MTLN)**
- **Train Controller Location Number (TCLN)**
- **Group Location Number (GLN)**
- **Mobile Subscriber Number (MSN)**

**3) Function Code:**

The Function Code (FC) is used as an identification of, for example, the person or equipment on a particular train, or a particular team within a given area. (I)

*National EIRENE Numbering Plan*

- 9.5.4 The contents of the fields of a National EIRENE Number shall be as defined below: (MI)

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<sup>5</sup> In order to prevent duplication of numbering, as each railway is free to allocate the coach number leading to number uniqueness per country only, the Owning or registering Railway code should be added as the first digits.

1) Call Type (CT)

This prefix defines how to interpret the User Number that follows. It shall consist of one or two digits as defined in table 9-1.

Digit	Use
1	<b>Reserved for short codes (see section 9.8)</b>
2	Train Function Number (ie TN + FC)
3	Engine Function Number (ie EN + FC)
4	Coach Number (ie CN + FC)
50	Group calls
51	Broadcast calls
52-55	Reserved for international use
56-57	Reserved for national use
58	Reserved for system use (Group call signalling)
59	Reserved for system use (Broadcast call signalling)
6	Maintenance and shunting team members
7	Train controllers
8	Mobile Subscriber Number
9	Reserved for breakout codes (see section 9.10) and national use
0	Reserved for access to public or to other GSM-R networks (see section 9.10)

*Table 9-1: Call Type field format*

2) User Number (UN)

The UN is variable in length and depends on the information on which it is based. The following formats are defined:

- **Train Function Numbers (TFN)** shall take one of the forms as defined in table 9-2. Leading zeros shall be used in those situations where the train number is less than five digits.

<b>Train Number</b>	<b>Use</b>
0000XFF	train number with one significant digit
000YXFF	train number with two significant digits
00YXXFF	train number with three significant digits
0YXXXFF	train number with four significant digits
YXXXXFF	train number with five significant digits
XXXXXXFF	train number with six significant digits
XXXXXXXXFF	train number with seven significant digits
XXXXXXXXXXFF	train number with eight significant digits
	<b><i>FF - Function Code as defined in Appendix A table 9A-1</i></b>
	<b><i>Y not equal to 0</i></b>

*Table 9-2: UN - Train Function Number field format*

- **Engine Function Numbers (EFN)** shall take the format as defined in table 9-3.

<b>Engine Number</b>	<b>Use</b>
XXXXXXXXXXFF	XXXXXXXXXX : number of powered unit allocated by each Railway FF : Function Code as defined in Appendix A table 9A-1

*Table 9-3: UN - Engine Function Number field format*

- **Coach Function Numbers (CFN)** shall take the format as defined in table 9-4.

<b>Coach Number</b>	<b>Use</b>
XXXXXXXXXXFF	XXXXXXXXXX : vehicle number allocated by each Railway FF : Function Code as defined in Appendix A table 9A-1

*Table 9-4: UN - Coach Function Number field format*

- **Maintenance and Shunting Team Members.** The UIN field format for calls to shunting teams and maintenance teams shall consist of a Location Number (LN), which identifies the location where the called party is registered, followed by a Function Code (FC). The Location Number shall consist of 5 digits and shall be assigned on a national basis. The Function Code shall consist of 4 digits. The first digit of the FC is related to the Team Type (TT) and is specified by table 9-5.

Team Type	Description
1 – 3	Reserved for international use
4	Reserved for national use
5	Shunting Team
6 – 9	Reserved for national use
0	Reserved for international use

Table 9-5: UIN - Team Type field format

The composition of the Function Code field for calls to shunting teams and maintenance teams shall be as defined in table 9-6.

FC	Function description
TT,Y,XX	Team type, team member function and team number  TT : team type Y : team member function XX : team number  As defined in Appendix 9A table 9A-2

Table 9-6: Function Code field format for CT=6

- **Train Controllers.** The UIN field for calls to train controllers shall be a Location Number (LN) which identifies the location where the called party is registered. The Location Number shall consist of 5 digits and shall be assigned on a national basis.

The FC field for calls to train controllers shall consist of two digits and be as defined in table 9-7.

FC	Function description
01	Primary controller
02	Secondary controller
03	Power supply controller
04 - 10	Reserved for international use
11-99	Reserved for national use

Table 9-7: Function Code field format for CT=7

- **Mobile Subscriber Number (MSN).** The UN of the MSN shall consist of the Subscriber Number.
- **Group and broadcast calls.** The UIN field format for group calls shall be a Service Area (SA) indicator, which identifies the area in which the group call is to be active. Each Service Area shall be allocated on a national basis. In network boundary areas, the Service Area shall be allocated on a bilateral basis. (See also subsection 9.9.)

The group ID field format for group calls shall consist of three digits and be as defined in table 9-8.

Group ID	Function Description
1xx	Reserved for national use
200	High priority group call in the context of group calls between drivers in the same area (section 5.3.3)
201-298	Reserved for national use
299	Train groups: Emergency call
3xx	Reserved for national use
4xx	Reserved for national use
500	Shunting groups: Default group
501 – 529	Shunting groups: Dedicated shunting groups
530	Station and security staff: Default group
531-538	Station and security staff: Reserved for international use
539	Station and security staff: High-priority call
54x	Reserved for international use
550-554	Reserved for international use
555	Operational group call to drivers in the same area <sup>1</sup>
556-559	Reserved for international use
560	Trackside maintenance groups: Default group
561-568	Trackside maintenance groups: Reserved for international use
569	Trackside maintenance groups: High-priority call
570	Controller groups: Default group
571-578	Controller groups: Reserved for international use
579	Controller groups: High-priority call
58x	Reserved for international use
590-598	Reserved for international use
599	Shunting groups: Emergency call
6xx	Reserved for national use
7xx	Reserved for national use
8xx	Reserved for national use
9xx	Reserved for national use
0xx	Reserved for national use

<sup>1</sup> Group ID 555 is optional for the network.

Notes:

Internationally specified eMLPP priorities will be allocated to group IDs belonging to the class “Reserved for international use” as and when functional requirements are defined.

Nationally specified eMLPP priorities allocated to group IDs belonging to the class “Reserved for national use”, if used, shall have no impact on interoperability and on Railway emergency calls 299 and 599 including the handling on all terminals.

*Table 9-8: Group ID field format for CT=5*

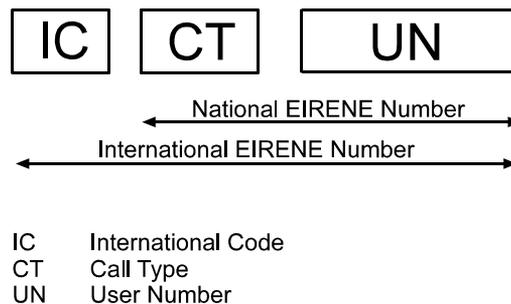
## 9.6 Use of International EIRENE Numbers

9.6.1 International EIRENE Numbers are used for calls between GSM-R networks. Additional fields are added to the National EIRENE Number as routing indicators. The use of such indicators is discussed in subsection 9.10. (I)

9.6.2 GSM-R networks shall recognise International EIRENE Numbers starting with the IC of the GSM-R network in which the calling party is currently operating as National EIRENE Numbers. (MI)

### *Structure of International EIRENE Number*

9.6.3 The International EIRENE Number shall consist of three distinct parts, as shown in figure 9-2: (MI)



*Figure 9-2: International EIRENE Number structure*

- International Code (IC), which shall be used to route calls to the appropriate GSM-R network;
- National EIRENE Number (NEN), which consists of the combination of Call Type and User Number and which is used to identify the called party.

### *International EIRENE Numbering plan*

9.6.4 The fields of an International Functional Number shall be defined as follows: (MI)

#### **1) International Code (IC)**

The International Code field shall consist of three digits and shall be based on the [ITU-T E.164] country code (XCC or CCC), allocated by the UIC on a network-by-network basis.

## 2) National EIRENE Number (NEN)

The format of the National EIRENE Number field shall be as defined in subsection 9.5.

### 9.7 Use of MSISDN numbers

9.7.1 At least one MSISDN number shall be allocated to each mobile station. (MI)

9.7.2 The structure of the MSISDN numbers shall comply with GSM Technical Specification [GSM NUMBERING]. (MI)

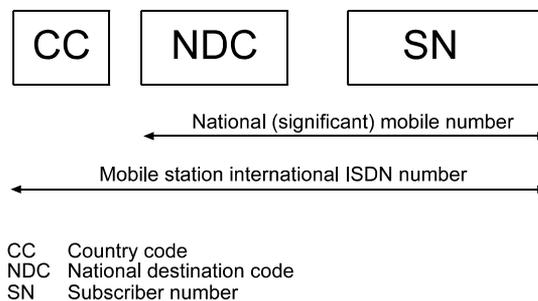


Figure 9-3: Number structure of MSISDN number

9.7.3 Within each GSM-R network, the following relationships between the MSISDN Subscriber Number and the National EIRENE Number shall be identified: (MI)

9.7.3.1 The MSISDN Subscriber Number shall be equal to the National EIRENE Number for Call Type = 8. (MI)

9.7.3.2 For any other Call Type except 8, the MSISDN Subscriber Number may be equal to the National EIRENE Number (O).

9.7.4 It shall be possible for authorised subscribers of fixed and mobile networks to call mobiles using the appropriate MSISDN number. (MI)

### 9.8 Use of Short Dialling Codes

9.8.1 For certain functions, standardised short codes shall be implemented for mobile originated calls. (MI)

9.8.2 Each short dialling code shall consist of four digits. (MI)

9.8.3 Short dialling codes shall start with the first digit equal to 1 (ie CT=1). (MI)

- 9.8.4 The short dialling codes can be defined on a national basis, but it is essential that certain codes be used on an international basis in order to achieve interoperability. These codes shall be as given in table 9-10. (MI)

<b>Code</b>	<b>Description</b>
10(00-99)	Reserved for national use
11(00-19)	Reserved for national use
112X	<b>Not used</b> (note: 112 reserved for public emergency)
11(30-99)	Reserved for national use
12XX*	Route to most appropriate primary controller
13XX*	Route to most appropriate secondary controller
14XX*	Route to most appropriate power supply controller
15XX*	Route to most appropriate ERTMS/ETCS RBC
1600	Railway Security Staff ***
1612	Confirmation call for high priority calls and railway emergency calls (see section 13)
16YY**	Reserved for international use
1700	Driver Safety Device
17(01-99)	Reserved for international use
18(00-99)	Reserved for national use
19(00-99)	Reserved for national use

\* XX may be used to provide supplementary location information within a cell. Where no additional information is available the default value shall be 00.

\*\* YY is neither 00 nor 12.

\*\*\*This use is optional. The SDC number is harmonized for all railways in EU.

*Table 9-10: Internationally defined short codes*

- 9.8.5 In addition, the network shall support the special short codes as defined in table 9-11. (M)

<b>Code</b>	<b>Description</b>
112	European emergency number

*Table 9-11: Special short codes*

## 9.9 Use of group addresses

- 9.9.1 Standardisation of UIC group addresses is required to provide interoperability between the fixed railway networks within the GSM-R network. (MI)
- 9.9.2 The group address consists of a Service Area (5 digits) and a Function Code (3 digits) and has a Call Type 5 (see table 9-1). (MI)
- 9.9.3 The Service Area shall be defined on a national basis. (MI)
- 9.9.4 In network boundary areas, the Service Area shall be allocated on a bilateral basis. (MI)
- 9.9.5 Function Codes shall be defined within the framework given in table 9-8 on an international basis. (MI)

## 9.10 Access to external networks

- 9.10.1 Access to other GSM-R networks shall be possible by using a Breakout Code (BC) as part of the dialled number. (MI)
  - 9.10.1i Access to other GSM-R networks may be possible by using an Access Code (AC) as part of the dialled number if the NSN (National Significant Number) following the CC (Country Code) is assigned by the national telecommunication regulator to the GSM-R operator. (O)

Note: NSN=NDC (National Destination Code) + SN (Subscriber Number) (I)

- 9.10.1ii The BC for access to other GSM-R networks is defined in table 9-12a, and is followed by the full international EIRENE number of the called party. (MI)

Breakout Code	Network
900	Other GSM-R network (International EIRENE Numbering plan as defined in subsection 9.6)

Table 9-12a: Breakout Code (other GSM-R Networks)

- 9.10.1iii The AC for access to other GSM-R networks is defined in table 9-12b, and is followed by the CC + NDC + SN of the other GSM-R network. The number format complies with [ITU-T E.164]. (M)

<b>Access Code</b>	<b>Network</b>
00 (or +)	Other GSM-R network (designated by CC + NDC)

*Table 9-12b: Access Code (other GSM-R networks)*

9.10.1iv It is the responsibility of each individual GSM-R operator to acquire a public domain NDC from their national telecommunications regulator. (I)

9.10.1v Access to private networks shall be performed by using a BC, defined in table 9-12c. (MI)

<b>Breakout Code</b>	<b>Network</b>
901	Gateway to private railway network (private numbering plan)
902 – 909	<b>Reserved for national breakout codes</b>

*Table 9-12c: Breakout Codes (private networks)*

9.10.1vi All other CT9 numbers are reserved for railway national fixed networks and systems. (I)

9.10.2 The GSM-R network shall allow users direct access to public networks, subject to call barring restrictions. (M)

9.10.3 Where access to public networks is allowed, this shall be performed by using an Access Code (AC), defined in table 9-13, followed by the international or national number of the called subscriber as defined in [ITU-T E.164]. (M)

9.10.4 Deleted.

<b>Access Code</b>	<b>Network</b>
00 (or +)	Calls to international public networks
0	Calls to national public networks (note: "0" is followed by a digit ≠ "0")

*Table 9-13: Access Codes for calls to public networks*

## **9.11 Calls from external networks to the GSM-R network**

- 9.11.1 Access to the GSM-R network should be performed by dialling an EIRENE Network Access Number (ENAN)<sup>6</sup>, followed by the relevant National or International Functional Number as defined in subsections 9.5 and 9.6 respectively. (O)
- 9.11.2 Provision should be made to prevent unauthorised calls to mobiles from outside the GSM-R network. (O)

## **9.12 Generic numbering scheme for international calls**

- 9.12.1 In this section an international call is understood as a call which is routed via the interconnection-link between two EIRENE networks x and y (see also section 11.6). (I)
- 9.12.2 International calls need a numbering scheme supporting the routing between all the involved interconnected networks. (I)
- 9.12.3 International calls can be point-to-point calls or VGCS / VBS calls. (I)
- 9.12.4 The IAM (Initial Address Message) as an ISUP message (ISUP is the ISDN user part) is sent during the setup procedure on the interconnection-link from one EIRENE network to the other one. (I)
- 9.12.5 The IAM contains in addition to the User-to-User Information (UUI) the called number (CDN), the original called number (orig CDN) if the CDN is determined by the EIRENE network in the case of functional addressing, the calling number (CGN), the Nature Of Address (NOA) as well as the Numbering Plan Indicator (NPI). (I)
- 9.12.6 "CC+NDC+SN" numbers with NOA set to INTL (international) are specified. (I)
- 9.12.7 "900+IC" numbers with NOA set to UNKNOWN are specified. (I)
- 9.12.8 It is to be agreed multilaterally between all the involved network operators which number format ("900+IC; NOA=UNKNOWN" or "CC+NDC+SN; NOA=INTL") is to be used. (I)
- 9.12.8i The agreement has to take into account NDC allocations and the relevant ITU recommendations (e.g. [ITU-T E.164] for the number length and [ITU-T Q.731.3] for the NOA at an international gateway exchange) if the call is routed through a public network. (I)

*Point to point calls*

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<sup>6</sup> The ENAN may be either an NDC in the case of direct dialling of EIRENE numbers, or a nationally defined telephone number allowing indirect dialling through public networks.

9.12.9 Dialed numbers and numbers sent on the interconnection-link shall be in line with table 9-14. (M)

9.12.10 The re-directed IAM is optional and can be used in order to prevent unnecessary tromboning. MSRN is the Mobile Subscriber Roaming Number. (I)

CT	Director	Number Type	Allowed Dialed Digits	Sent Number Format in the ISIP Message on the Interconnection-Link	
				NPI	NDA
E-164 IAM	y>x	CDN	*100-CC+ADC-SN (NA if CDN is determined by the ERENE network)	E-164	CC+ADC-SN
		CGN	NA	E-164	SDN/MSRN (CC+ADC-SN) Originally dialed digits
		orig CDN	NA	UNKNOW	Needed if CDNs determined by the ERENE network in the case of Functional IC+CT+UN
		LUU	NA	NA	
		CDN	NA	E-164	MSRN (CC+ADC-SN)
redirected IAM to MSSS(y>y)		CGN	NA	E-164	SDN/MSRN (CC+ADC-SN)
		orig CDN	NA	E-164	UNKNOW
		LUU	NA	NA	Originally dialed digits
		CDN	NA	NA	IC+CT+UN
		LUU	NA	NA	
CT23.467.89 IAM	y>x	CDN	900+IC+CT+UN (CT23.467.89)	E-164	UNKNOW
		CGN	NA	E-164	NTL
		LUU	NA	NA	SDN/MSRN (CC+ADC-SN) IC+CT+UN
		CDN	NA	E-164	MSRN (CC+ADC-SN)
		orig CDN	NA	E-164	SDN/MSRN (CC+ADC-SN)
redirected IAM to MSSS(y>y)		LUU	NA	E-164	UNKNOW
		LUU	NA	NA	IC+CT+UN

Table 9-14: Numbering scheme for ptp calls

*VGCS / VBS Calls*

- 9.12.11 Dialed numbers and numbers sent on the interconnection-link shall be in line with table 9-15. (M)
- 9.12.12 The GCRef is the 8-digit Group Call Reference number consisting of the 5-digit group call area and the 3-digit group identity. (I)
- 9.12.13 Table 9-15 covers the scenarios Service Subscriber (SS) originated VGCS / VBS call if the SS is linked to the anchor MSC (A-MSC) as well as linked to a relay MSC (R-MSC). (I)
- 9.12.14 Table 9-15 covers the scenarios dispatcher originated VGCS / VBS call if the dispatcher is linked to the A-MSC as well as linked to an R-MSC. (I)
- 9.12.15 The IAM related to the setup of the connection to a terminating dispatcher terminal contains the generic number (GN) belonging to the calling number. (I)
- 9.12.16 Table 9-15 specifies for the GN and the CGN of the IAM related to the setup of the connection to a terminating dispatcher different options and combinations. Multilateral agreements between all the involved network operators are needed for the selection as well as setting of the options and combinations. (I)
- 9.12.17 Table 9-15 refers to the system-internal MAP messages for the provision of the GCN (group call number). The message contains the GT (global title) of the A-MSC and the R-MSC. (I)



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## 9A Function Codes

9A.1 Function Codes identify the actual user of a mobile. (I)

9A.2 The Function Codes used in association with the Train Function Number (CT=2), Engine Function Number (CT=3) and Coach Function Number (CT=4) shall conform to table 9A-1. (MI)

Function Code	Function description
00	Spare alarm
01	Leading driver
02	Driver 2
03	Driver 3
04	Driver 4
05	Driver 5
06	Fax
07	Intercom
08	Public address
09	Reserved for international use
10	Chief conductor
11	Second conductor
12	Third conductor
13	Fourth conductor
14 – 19	Train crew international use
20	Catering staff chief
21 – 29	Reserved for international use (catering staff)
30	Railway security services chief
31 – 39	Reserved for international use (security services)
40	ERTMS/ETCS
41-49	Reserved for international use (ERTMS/ETCS)
50	Train-borne recorder
51	Diagnostics
52	Train data bus
53	Train location system
54-59	Reserved for international applications for on train equipment
60	Pre-recorded passenger info
61	Displayed passenger information unit
62 – 69	Reserved for international use (passenger services)
70 – 79	Reserved for international use
80 – 99	Reserved for national use

Note: Function Codes are reserved for international applications except when shown as “Reserved for national use”.

Table 9A-1: Function Code field for CT=2, 3 and 4

9A.3 The Function Codes used in association with Maintenance and Shunting Services Team Numbers (CT=6) shall conform to table 9A-2. (MI)

Function Code	Function description
TT,y,xx TT=1-3	Reserved for international use
TT,y,xx TT=4	Reserved for national use
TT,y,xx TT=5	y = 0 Shunting leader 1 – 3 Shunting team member 4 Train driver 5 – 9 Reserved for national use  xx = 00 Default shunting group 01 – 29 Dedicated shunting groups* 30 – 99 Reserved
TT,y,xx TT=6-9	Reserved for national use
TT,y,xx TT=0	Reserved for international use

\* As defined in table 9-8, FCs 5y01 – 5y29 provide dedicated shunting groups 01 – 29

Table 9A-2: Function Code field for CT=6

## **9B Numbering plan overview**

- 9B.1 This appendix provides an overview of the numbering plan as defined in this section of the EIRENE SRS, detailing the allocation of numbers within the National and International EIRENE Numbering plan. (I)

BC	IC	CT	UIN	FC/group ID	Comment
1			0 0 0		Reserved for national use
1			0 9 9		Reserved for national use
1			1 2 X		Not used
1			2 X X		Route to most appropriate primary controller
1			3 X X		Route to most appropriate secondary controller
1			4 X X		Route to most appropriate power supply controller
1			5 X X		Route to most appropriate ERTMS/ETCS RBC
1			6 1 2		High priority call confirmations including railway emergency calls
1			6 Y Y		Reserved for international use
1			7 0 0		Driver Safety Device
1			7 Y Y		Reserved for international use
1			8 Y Y		Reserved for national use
1			8 Y Y		Reserved for national use
2			0 0 0 0 X	F F	Train Function Number; TN consists of one digit
2			0 0 0 Y X	F F	Train Function Number; TN consists of two digits
2			0 0 Y X X	F F	Train Function Number; TN consists of three digits
2			0 Y X X X	F F	Train Function Number; TN consists of four digits
2			Y X X X X	F F	Train Function Number; TN consists of five digits
2			X X X X X	F F	Train Function Number; TN consists of six digits
2			X X X X X X	F F	Train Function Number; TN consists of seven digits
2			X X X X X X X	F F	Train Function Number; TN consists of eight digits
3			X X X X X X X X	F F	Engine Function Number
4			X X X X X X X X X	F F	Coach Function Number
5	0	S	S S S S S	1 X X	Group call - Reserved for national use
5	0	S	S S S S S	2 0 0	Group call - Train groups. High priority call between drivers in the same area
5	0	S	S S S S S	2 0 1	Group call - Reserved for national use
5	0	S	S S S S S	2 0 2	Group call - Reserved for national use
5	0	S	S S S S S	2 0 3	Group call - Reserved for national use
5	0	S	S S S S S	2 0 4	Group call - Reserved for national use
5	0	S	S S S S S	2 9 9	Group call - Train groups. Emergency call
5	0	S	S S S S S	3 X X	Group call - Reserved for national use
5	0	S	S S S S S	4 X X	Group call - Reserved for national use
5	0	S	S S S S S	5 0 0	Group call - Shunting groups. Default group
5	0	S	S S S S S	5 0 1	Group call - Shunting groups. Team number 01
5	0	S	S S S S S	5 2 9	Group call - Shunting groups. Team number 29
5	0	S	S S S S S	5 3 0	Group call - Station and security staff. Default group
5	0	S	S S S S S	5 3 1	Group call - Station and security staff. Reserved for international use
5	0	S	S S S S S	5 3 2	Group call - Station and security staff. Reserved for international use
5	0	S	S S S S S	5 3 3	Group call - Station and security staff. High priority call
5	0	S	S S S S S	5 4 X	Group call - Reserved for international use
5	0	S	S S S S S	5 5 X	Group call - Reserved for international use
5	0	S	S S S S S	5 5 0	Group call - Reserved for international use
5	0	S	S S S S S	5 5 1	Group call - Reserved for international use
5	0	S	S S S S S	5 5 2	Group call - Reserved for international use
5	0	S	S S S S S	5 5 3	Group call - Reserved for international use
5	0	S	S S S S S	5 5 4	Group call - Reserved for international use
5	0	S	S S S S S	5 5 5	Group call - Operational Group call to drivers in the same area
5	0	S	S S S S S	5 5 6	Group call - Reserved for international use
5	0	S	S S S S S	5 5 7	Group call - Reserved for international use
5	0	S	S S S S S	5 5 8	Group call - Reserved for international use
5	0	S	S S S S S	5 5 9	Group call - Reserved for international use
5	0	S	S S S S S	5 6 0	Group call - Trackside maintenance groups. Default group
5	0	S	S S S S S	5 6 1	Group call - Trackside maintenance groups. Reserved for international use
5	0	S	S S S S S	5 6 2	Group call - Trackside maintenance groups. Reserved for international use
5	0	S	S S S S S	5 6 3	Group call - Trackside maintenance groups. Reserved for international use
5	0	S	S S S S S	5 6 4	Group call - Trackside maintenance groups. Reserved for international use
5	0	S	S S S S S	5 6 5	Group call - Trackside maintenance groups. High priority call
5	0	S	S S S S S	5 6 6	Group call - Controller groups. Default group
5	0	S	S S S S S	5 6 7	Group call - Controller groups. Reserved for international use
5	0	S	S S S S S	5 6 8	Group call - Controller groups. Reserved for international use
5	0	S	S S S S S	5 6 9	Group call - Controller groups. Reserved for international use
5	0	S	S S S S S	5 7 0	Group call - Controller groups. High priority call
5	0	S	S S S S S	5 7 1	Group call - Controller groups. Reserved for international use
5	0	S	S S S S S	5 7 2	Group call - Controller groups. Reserved for international use
5	0	S	S S S S S	5 7 3	Group call - Controller groups. Reserved for international use
5	0	S	S S S S S	5 7 4	Group call - Controller groups. Reserved for international use
5	0	S	S S S S S	5 7 5	Group call - Controller groups. Reserved for international use
5	0	S	S S S S S	5 7 6	Group call - Controller groups. Reserved for international use
5	0	S	S S S S S	5 7 7	Group call - Controller groups. Reserved for international use
5	0	S	S S S S S	5 7 8	Group call - Controller groups. Reserved for international use
5	0	S	S S S S S	5 7 9	Group call - Controller groups. Reserved for international use
5	0	S	S S S S S	5 8 X	Group call - Reserved for international use
5	0	S	S S S S S	5 9 0	Group call - Reserved for international use
5	0	S	S S S S S	5 9 1	Group call - Reserved for international use
5	0	S	S S S S S	5 9 2	Group call - Reserved for international use
5	0	S	S S S S S	5 9 3	Group call - Reserved for international use
5	0	S	S S S S S	5 9 4	Group call - Reserved for international use
5	0	S	S S S S S	5 9 5	Group call - Reserved for international use
5	0	S	S S S S S	5 9 6	Group call - Reserved for international use
5	0	S	S S S S S	5 9 7	Group call - Reserved for international use
5	0	S	S S S S S	5 9 8	Group call - Reserved for international use
5	0	S	S S S S S	5 9 9	Group call - Reserved for international use
5	0	S	S S S S S	6 X X	Group call - Reserved for national use
5	0	S	S S S S S	7 X X	Group call - Reserved for national use
5	0	S	S S S S S	8 X X	Group call - Reserved for national use
5	0	S	S S S S S	9 X X	Group call - Reserved for national use
5	0	S	S S S S S	0 X X	Group call - Reserved for national use
5	1	S	S S S S S	1 X X	Broadcast call - Reserved for international use
5	1	S	S S S S S	2 X X	Broadcast call - Train groups
5	1	S	S S S S S	3 X X	Broadcast call - Station and security staff groups
5	1	S	S S S S S	4 X X	Broadcast call - Reserved for national use
5	1	S	S S S S S	5 X X	Broadcast call - Shunting groups
5	1	S	S S S S S	6 X X	Broadcast call - Trackside maintenance groups
5	1	S	S S S S S	7 X X	Broadcast call - Controller groups
5	1	S	S S S S S	8 X X	Broadcast call - Reserved for international use
5	1	S	S S S S S	9 X X	Broadcast call - Reserved for international use
5	1	S	S S S S S	0 X X	Broadcast call - Reserved for international use
5	2				Reserved for international use
5	3				Reserved for international use
5	4				Reserved for national use
5	5				Reserved for national use
5	6				Reserved for national use
5	7				Reserved for national use
5	8				Reserved for system use (Group call signalling)
5	9				Reserved for system use (Broadcast call signalling)
6	L	L	L L L L L	1 Y X X	Reserved for international use
6	L	L	L L L L L	2 Y X X	Reserved for international use
6	L	L	L L L L L	3 Y X X	Reserved for international use
6	L	L	L L L L L	4 Y X X	Reserved for national use
6	L	L	L L L L L	5 0 X X	Shunting team - Team leader
6	L	L	L L L L L	1 X X	Shunting team - Team member #1
6	L	L	L L L L L	2 X X	Shunting team - Team member #2
6	L	L	L L L L L	3 X X	Shunting team - Team member #3
6	L	L	L L L L L	4 X X	Shunting team - Train driver
6	L	L	L L L L L	5 X X	Reserved for national use
6	L	L	L L L L L	6 X X	Reserved for national use
6	L	L	L L L L L	7 X X	Reserved for national use
6	L	L	L L L L L	8 X X	Reserved for national use
6	L	L	L L L L L	9 X X	Reserved for national use
6	L	L	L L L L L	0 Y X X	Reserved for national use
7	L	L	L L L L L	0 1	Primary controller
7	L	L	L L L L L	0 2	Secondary controller
7	L	L	L L L L L	0 3	Power supply controller
7	L	L	L L L L L	0 4	Reserved for international use
7	L	L	L L L L L		
7	L	L	L L L L L	1 0	Reserved for international use
7	L	L	L L L L L	1 1	Reserved for national use
7	L	L	L L L L L		
7	L	L	L L L L L	9 9	Reserved for national use
8					Mobile Subscriber Number
9	0	0	0 0		Gateway to other GSM-R network
9	0	1	0 1		Gateway to private railway network
9	0	X	0 X		Reserved for national use
0					Reserved for PSIN Access Codes

Table 9B-1: National Functional Numbering plan overview

## **10 Subscriber management**

### **10.1 Introduction**

10.1.1 In order to provide a consistent level of service in each railway network and, in particular, to ensure interoperability for train drivers and other users roaming between networks, it is important to harmonise subscription details and other information stored in the network. (I)

10.1.2 For the purposes of defining common subscription profiles, a number of subscription types might be used, for example: (I)

- Cab radio;
- on-train radio;
- ETCS data only radio;
- controller;
- trackside worker;
- general staff;
- data systems;
- administration/management.

### **10.2 Allocation of priorities**

10.2.1 In order to provide a consistent international service, it is necessary to ensure that priorities are allocated consistently across all railways. The following allocation of UIC priority levels to eMLPP priority codes is mandatory: (MI)

UIC Priority	Automatic answering*	eMLPP priority designation	Pre-emption (of)
Railway emergency	Y	0	Control-command (safety) and below
Control-command (safety)	Y	1	Public emergency, high priority calls, group calls between drivers in the same area that have been initiated by a driver and below
Public emergency, high priority calls and group calls between drivers in the same area that have been initiated by a driver	Y	2	Railway operation. Control-command (information) and below
Railway operation (e.g. calls from or for drivers and controllers including group calls between drivers in the same area that have been initiated by a controller) and Control-command (information)	Y**	3	Railway information and all other calls
Railway information and all other calls	N	4	-

\* Auto answer applies to voice calls to mobile users as defined in [EN 301 515, Index [27]] (eMLPP) and also for calls to ETCS data only radios.

\*\* Mandatory for cab radio, optional for other user equipment.

*Table 10-1: Allocation of priorities*

- 10.2.2 Levels 0 – 4 are designed to interwork with the ISDN MLPP service. (I)
- 10.2.3 Calls received from external networks which do not support MLPP should be assigned the default MLPP priority 4 in the EIRENE network gateway switch in order to be pre-emptable in the parts of the EIRENE network which apply the MLPP service. (O)
- 10.2.4 For calls sent to external networks which do not support MLPP the “MLPP indicator” in the “Optional Backward Call Indicators Parameter” should be set to “MLPP user” in the EIRENE network gateway switch in order to be pre-emptable in the parts of the EIRENE network which apply the MLPP service. (O)

- 10.2.5 Calls received from or sent to external networks which support MLPP should be preemptable based on their MLPP priority and according to operator' rules in the parts of the EIRENE network which apply the MLPP service. (O)

### **10.3 Access classes**

- 10.3.1 User access classes are defined in GSM so that under critical conditions, part of the user population can be barred from accessing the network in order to avoid congestion. However, such barring can be overridden by a user being a member of one or more of the following special access classes: (I)

- 11 open to network operator;
- 12 security services;
- 13 public utilities;
- 14 emergency services;
- 15 network operator staff.

- 10.3.2 Access classes should not be used under normal network operating conditions, where the GSM eMLPP may be used to provide a better grade of service to certain users. (O)

- 10.3.3 For consistent working on public networks and in international roaming, the use of access classes in a railway network shall comply with the GSM specification. (M)

- 10.3.4 If special access classes (e.g. 12 - 14) are assigned within a railway's network to certain high priority users, it ought to be noted that when roaming, this will only have an effect on a national public network, subject to bilateral agreement. (I)

### **10.4 Closed user groups**

- 10.4.1 Closed User Groups (CUGs) may be employed by railways as an additional security measure. Such facilities may be particularly important if public network access to the radio system is provided (e.g. to prevent members of the public calling drivers and drivers calling members of the public). (I)

- 10.4.2 Any implementation of CUGs must take account of requirements for interoperability. (M)

### **10.5 Network selection**

- 10.5.1 SIM cards shall contain a list of authorised networks so that networks shall be displayed (or automatically selected if automatic network selection has been enabled) in the following order of priority (see [MORANE SIM] for more details): (MI)

- home EIRENE network;

- ‘foreign’ EIRENE networks;
- non-EIRENE networks (with order of priority predetermined by virtue of international subscriptions and roaming agreements).

10.5.1i In order to shorten the duration of the network selection procedure, Mobile Stations designed for use in EIRENE networks shall give preference to the GSM frequency band allocated for railway use (see 3.5.2). (MI)

10.5.2 The use of “Over The Air” in conjunction with the SIM Application Toolkit [EN 301 515, Index [36]] to update SIM cards in the home network is recommended (see [MORANE SIM] for more details). (I)

## 10.6 Cell broadcast message identifiers

10.6.1 Railway mobiles shall be provided with cell broadcast message identifiers in order to accept SMS-CB messages. (M)

## 10.7 Security Algorithms

GSM-R uses three different security algorithms called A3, A5, and A8. (I)

The A5 encryption algorithm scrambles the user's voice and data traffic between the handset and the base station to provide privacy. An A5 algorithm is implemented in both the handset and the base station subsystem (BSS). (I)

An A3/A8 algorithm is implemented in Subscriber Identity Module (SIM) cards and in GSM network Authentication Centres. It is used to authenticate the customer and generate a key for encrypting voice and data traffic. In practice, A3 and A8 are generally implemented together (known as A3/A8). (I)

10.7.1 **Encryption.** Copy of the specifications of the A5/1 algorithm specification is available to qualified industry parties (GSM network operators and manufacturers of eligible GSM equipment) on application to the GSM Association. Licensing of A5/3 encryption algorithms for Railway networks is managed by ETSI. (I)

10.7.1i In case of encryption, ciphering/deciphering algorithms referenced in [EN 301 515, Index [3]] shall be used. (MI)

10.7.1ii In case of encryption, EIRENE networks shall be capable of operation using A5/1 encryption algorithm (M)

10.7.1iii In case of encryption, EIRENE networks should be capable of operation using A5/3 encryption algorithm (O)

- 10.7.1iv If A5/3 encryption algorithms is selected, it shall comply with [EN 301 515, Index [47], Index [48], Index [49], Index [50]]. (M)
- 10.7.2 Deleted.
- 10.7.3 EIRENE mobiles shall be capable of operation using ciphering/deciphering algorithms defined in [EN 301 515, Index [3] for all countries in which they need to roam. (M)
- 10.7.3i In case of encryption, EIRENE mobiles shall be capable of operation using A5/1 encryption algorithm (M)
- 10.7.3ii In case of encryption, EIRENE mobiles should be capable of operation using A5/3 encryption algorithm (O)
- 10.7.4 **Authentication.** Each railway is free to implement its own authentication algorithms without any resulting loss in cross-border interoperability. (I)
- 10.7.5 It shall be possible to use the authentication algorithm as defined in [EN 301 515, Index [46]]. (M)

## **11 Functional numbering and location dependent addressing**

### **11.1 Introduction**

- 11.1.1 There is a requirement to be able to address communications to a 'functional number' rather than a more permanent subscriber number. Such numbers are generally only associated with a user for a limited period of time. (I)
- 11.1.2 This is an important issue which will affect interoperability and the ability to use public network services. There are specific features of individual railways which make it difficult to develop a concise and universally acceptable system within GSM. (I)
- 11.1.3 To accommodate the different requirements of the individual railways, the following approach has been adopted: (I)
- all responsibility for handling addressing lies with the network infrastructure and other ground based equipment, rather than additional functionality in the mobile;
  - each railway will be responsible for implementing addressing schemes which best meet its needs;
  - national addressing schemes are to use the internationally standardised ground-train protocol, based on a single standardised GSM service, for exchanging information between the ground and mobiles.

### **11.2 Ground-train addressing**

- 11.2.1 The ground-train addressing can be divided into two areas: (I)
- functional addressing of mobile users;
  - location dependent addressing of fixed network users.
- 11.2.2 The first is related to passing information to provide an association between a mobile's subscriber number and its functional number. The latter is concerned with ensuring that calls from a mobile terminal (in particular, Cab radios) are routed to the correct destination (ie primary controller, secondary controller), based on the current location of the mobile. (I)
- 11.2.3 The numbering plan to be used with functional addressing shall be in accordance with the numbering plan given in section 9. (MI)

### **11.3 Functional numbering**

#### *General*

- 11.3.1 Functional numbering provides the mechanism by which a mobile terminal, or an item of equipment connected to a mobile terminal, can be addressed by a number identifying the function for which it is being used. (I)

- 11.3.2 Mobile access to the functional numbering scheme for registration, deregistration and re-registration shall apply the USSD messages and protocols over the air interface as specified in the GSM Follow-me service. (MI)
- 11.3.3 The implementation of functional numbering at a network level is left open for national railways subject to the requirements for interconnecting EIRENE networks identified in section 11.6. (I)
- 11.3.4 Further information may be obtained from [MORANE FA FFFS, MORANE FA FIS]. (I)

*Functional number management*

- 11.3.5 For communication over the (Um) air interface, the USSD messages and protocols as specified in the GSM Follow-me service shall be used to manage the following types of functional numbers: (MI)
  - Train number;
  - Engine number;
  - Coach number;
  - Shunting team number;
  - Maintenance team number.
- 11.3.6 It shall be possible to limit user access to functional number registration and deregistration facilities based on each of the types of functional number identified in 11.3.5. (MI)
- 11.3.7 Mobile stations shall use the following sequences for the control of the functional number management: (MI)

Procedure	Sequence
Interrogation	*#214*SI***#
Registration	**214*SI***#
Deregistration	##214*SI***#
Re-registration Definition in section 11.3.14	**214*SI***# followed by ##214*SI***#
Forced De-registration	##214*SI*88*MSISDN*#

Where SI Supplementary Information represents the International Functional Number (also called the International EIRENE Number), as defined in section 9.6.3.

Note: This table is for information only. The Follow Me service control sequences are based on the USSD specified in [EN 301 515, Index [15]].

- 11.3.7i The Sub-System Number (SSN) to be used and set for Follow-Me Functional Number management shall be SSN=6. (MI)
- 11.3.8 The network operator shall implement the required functionality to validate the information exchanged between the mobile and network on registration and deregistration. (M)
- 11.3.8i Functionality shall be provided by the system for the operator management of Functional Numbers, including the removal of the relationship between Functional Numbers and MSISDN Numbers. (M)
- 11.3.8ii The use of the forced de-registration mechanism (without notification) to achieve this requirement is acceptable. (I)
- 11.3.8iii The system shall require manual confirmation prior to the removal of the relationship between Engine Number and MSISDN Number. (M)

*Registration*

- 11.3.9 The result of the registration procedure shall be sent back to the mobile. In the event of a failure, an indication of the cause shall be provided. Information on the outcome shall be provided to the mobile according to [EN 301 515, Index [17]] and [EN 301 515, Index [34]]. (MI)
- 11.3.9i In the event of a registration procedure failing owing to the functional number already being registered to another mobile, the Cab radio shall be capable of providing the user with the ability to perform automatically the forced de-registration of the previously registered mobile and the registration of this functional number to the user's mobile. This shall result in the following sequence of actions being performed by the user's Cab radio (see 11.3.7 for details of message structure): (MI)
  1. Send interrogation message (from mobile to network).
  2. Receive MSISDN (from network to mobile).
  3. Send a forced de-registration message (from mobile to network).
  4. Receive the answer (from network to mobile).
  5. Send a registration message (from mobile to network).
  6. Receive the answer (from network to mobile).
  7. Inform the user whether the registration of the functional number to the user's mobile was successful (performed by the mobile).
- 11.3.9ii The functionality described in 11.3.9i should also be available for other types of mobiles. (O)
- 11.3.9iii In the cases described in 11.3.9i and 11.3.9ii, national rules may dictate that, prior to or instead of performing the sequence described in 11.3.9i steps 1-7, the user shall perform a specified action (e.g. call a dispatcher in the case of drivers). (I)

11.3.9iv The sequence described in 11.3.9i steps 1-7 may be interrupted or may require additional user action such as a confirmation. (I)

*Deregistration*

11.3.10 Deregistration shall only be performed by the subscription identified by the MSISDN number which is associated with the functional number. (MI)

11.3.11 Deleted.

11.3.12 The result of the deregistration procedure shall be sent back to the mobile. In the event of a failure, an indication of the cause shall be provided. Information on the outcome shall be provided to the mobile according to [EN 301 515, Index [17]] and [EN 301 515, Index [34]]. (MI)

*Re-registration*

11.3.13 Re-registration consists of a registration procedure followed by a deregistration procedure. (I)

11.3.14 Re-registration of on-train functional numbers based on the train number shall be performed every time a train leaves one EIRENE network and enters into another EIRENE network. (MI)

11.3.15 Deregistration of a functional number shall not be carried out until registration of the functional number has been carried out and confirmed as being successful. (MI)

11.3.16 Each railway should define a suitable time-out interval to be applied as part of the deregistration procedure for on-train functional numbers. (O)

*Functional numbering network interworking*

11.3.17 The exchange of information between EIRENE networks is handled by the GMSCs and shall use the standardised protocol as detailed in section 11.6. (MI)

**11.4      Re-establishment of functional number correlation**

11.4.1 In the event of losing correlation between functional numbers and MSISDNs, provision for recovery from such a situation shall be made. (M)

11.4.2 Each national railway is responsible for implementing a suitable recovery mechanism and ensuring that the use of unverified functional numbers is prevented. (I)

11.4.3 Deleted.

11.4.4 Deleted.

11.4.5 Deleted.

**11.5 Presentation of functional identities**

11.5.1 The called party functional identity shall be presented to the user initiating a call and the calling party functional identity shall be presented to the user receiving a call. (MI)

11.5.2 The calling party functional number shall be passed to the receiving mobile using the User to User Signalling supplementary service (UUS1) during call setup. (MI)

11.5.3 If the calling party functional number is not available or if the calling party is not registered then the CLI of the calling party shall be displayed on the receiving mobile's display. (MI)

11.5.4 The user-to-user information element in the SETUP, ALERT or CONNECT messages, as defined in [EN 301 515, Index [16]], shall be used to transfer the functional number of the calling party to the called party. (MI)

11.5.5 The user-to-user information element shall use the following format: (MI)

8	7	6	5	4	3	2	1	Octet	
User-User Information Element Identifier								1	Binary
Length of User-User contents								2	
User-User protocol discriminator								3	
0	0	0	0	0	0	0	0		
Tag defines presentation of Functional Identity								4	
0	0	0	0	0	1	0	1		
Length of Numeric FN								5	
Numeric FN								6	BCD
Digit 2				Digit 1					
Digit m				Digit m-1				n	

11.5.6 If no valid functional number is available, a fixed length User-to-User Information Element shall be used with the following format: (MI)

8	7	6	5	4	3	2	1	Octet	
	User-User Information Element Identifier							1	Binary
Length of User-User contents								2	
0	0	0	0	0	0	1	1		
User-User protocol discriminator								3	
0	0	0	0	0	0	0	0		
Tag defines presentation of Functional Identity								4	BCD
0	0	0	0	0	1	0	1		
Functional number								5	
0	0	0	0	0	0	0	0		

11.5.7 Further information may be obtained from [MORANE PFN FFFS, MORANE PFN FIS]. (I)

## 11.6 Inter EIRENE network interfacing

11.6.1 Interconnection of EIRENE networks is required to allow international call routing. It is not envisaged that any routing database information is exchanged between EIRENE networks. (I)

11.6.2 The interconnection of EIRENE networks should take place by interconnecting GMSCs. (O)

11.6.3 The protocol used for routing of calls shall be Signalling System No 7 (SS7) as defined by the ITU-T. The signalling system suite shall include the Mobile Application Part (MAP). (M)

11.6.4 Call setup between EIRENE networks using international functional numbers shall be based on the combination of the Breakout-Code (BC) and International Code (IC) as specified in section 9. (M)

11.6.5 The Country Code (CC) followed by the National Significant Number NSN (as specified in [ITU-T E.164, Chapter 6.2]) shall be used as the Global Title, which forms part of the Signalling Connection Control Part (SCCP) protocol messages and is used for inter-network routing of messages. (M)

## 11.7 Location dependent addressing

### General

11.7.1 Location dependent addressing may be provided in the following ways: (I)

- a) cell dependent routing;
- b) using location information from external sources.

*Cell dependent routing*

- 11.7.2 As a minimum, call routing using location dependent addressing shall be based on the use of short codes in conjunction with cell dependent routing. (MI)
- 11.7.3 Further information on cell dependent routing for location dependent addressing may be obtained from [MORANE LDA FFS] [MORANE LDA FIS]. (I)

*Location information from external sources*

- 11.7.4 Location information may be provided by systems external to the radio system, for example ground-based systems such as track circuits. (I)
- 11.7.5 If a more accurate way of location determination is used, then position information shall be provided to the radio system which shall be used to associate the short code with the called party subscriber number. (M)
- 11.7.6 If implemented, the use of location information from train-based systems external to the radio system shall comply with the requirements stated in the enhanced Location Dependent Addressing FRS and IRS [eLDA FRS] and [eLDA IRS]. (M)

**11.8 Calls from external networks to the EIRENE network**

- 11.8.1 Facilities shall be provided to prevent unauthorised calls to mobiles either by functional number or MSISDN number from outside the EIRENE network. (MI)

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## **12 Text messaging**

### **12.1 Introduction**

12.1.1 There is no requirement for an internationally standardised pre-defined messaging application. However, it is anticipated that individual national railways may have a requirement for pre-defined messages, in which case the application will be specified as part of individual national procurements. (I)

### **12.2 System requirements**

12.2.1 Where text messaging is implemented in the network, the Short Message Service (SMS) shall be used. (MI)

12.2.2 The maximum length of an un-concatenated message segment shall be 160 characters. A message can include several segments, in which case the maximum limit is 153 characters per segment<sup>7</sup>. (MI)

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<sup>7</sup> Message length assumes uncompressed GSM default 7 bit alphabet is used. See 3GPP 23.040 section 9.2.3.24.1 and 3GPP 23.038 section 4.

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## **13 Railway emergency calls**

### **13.1 Introduction**

- 13.1.1 This section covers the use of the EIRENE radio system for Railway emergency calls. The section also discusses the facility for confirmation of such emergency calls and the storage of confirmation for post-incident analysis. (I)
- 13.1.2 A Railway emergency call is a group call for warning drivers, controllers and other concerned personnel of a dangerous situation in a pre-defined area. Two types of Railway emergency calls are defined: (I)
- Train emergency calls (for Railway emergencies whilst not involved in Shunting operations);
  - Shunting emergency calls (for Railway emergencies whilst involved in Shunting operations).
- 13.1.3 This section describes the handling of voice calls for Railway operational emergencies and does not cover public emergency calls (ie handling of '112' calls). (I)

### **13.2 Provision of Railway emergency calls**

- 13.2.1 Railway emergency calls are defined as those calls of 'Railway emergency' priority (see section 10) which are routed to a pre-defined user or group of users due to a railway operational emergency. (I)
- 13.2.2 All Railway emergency calls shall be implemented and shall be considered established as specified in GSM VGCS (Specifications [EN 301 515, Index [21] & [4]]). (MI)
- 13.2.3 It shall be possible to configure Railway emergency group call areas to contain combinations of cells controlled by one or more MSC(s) within one or more network(s). (M)
- 13.2.4 Where Railway emergency group call areas are controlled by more than one MSC within one or more network(s), a unique anchor MSC is defined for each group call area. (I)
- 13.2.5 For international Railway emergency calls, in order to minimise call set-up times, it is recommended that the anchor MSC always directly controls the cell where the Railway emergency call was originated. (I)

### **13.3 Initiation of Railway emergency calls**

- 13.3.1 A Railway emergency call shall be initiated by using the appropriate function code for the required type of Railway emergency call (see Table 9-8). (MI)

- 13.3.2 The call area and list of train controllers for each emergency group call will be fixed in the Group Call Register (GCR) of the anchor MSC. (I)
- 13.3.3 The Railway emergency group IDs required for interoperability are defined in section 9.5. The composition of each group is a matter for national implementation, although all areas shall have a group defined for all mandated Group IDs. (MI)

#### **13.4 Receipt of Railway emergency calls**

- 13.4.1 Each mobile shall store a list of emergency Group IDs in the SIM appropriate to its function (the Cab radio will store Group ID 299 and 599 - see table 9-8). (MI)
- 13.4.2 All Railway emergency group IDs required for interoperability and appropriate to the operation of the mobile shall maintain active status whilst the mobile is powered up. (MI)
- 13.4.3 The fixed network user will only receive emergency voice calls if designated a dispatcher or group member in any of the calls defined in the GSM GCR. (I)
- 13.4.4 On receipt of a Railway emergency call, the controller's display should indicate the location of the train. (O)
- 13.4.5 If the requirement in 13.4.4 is implemented, as a minimum the location information shall be provided by the GSM network (e.g. current cell or base station serving the mobile). (M)
- 13.4.6 The mechanism for transferring the functional number of the originating mobile to controllers is defined in [EN 301 515, Index [6], Release 4] using the Information Element "Compressed OTDI" in the Immediate Setup 2 message from the originating mobile. (I)
- 13.4.7 If the GSM Release 99 capability and the Immediate Setup 2 feature defined in [EN 301 515, Index [6], Release 4] are supported by the network, the network shall set the MSC Release bit in the "Control Channel Description" information element to "1". Otherwise, the MSC Release bit in the "Control Channel Description" information element shall be set to "0" (zero) [EN 301 515, Index [41]]. (MI)

#### **13.5 Confirmation of Railway emergency calls**

- 13.5.1 For post-incident analysis it is important that the initiation and receipt of Railway emergency calls by mobiles is confirmed by a message sent to a ground-based location (and also registered in the train borne recorder, in cases where a train borne recorder is connected to the Cab radio). (I)
- 13.5.2 The application shall be able to deduce that a confirmation is necessary from the call priority, as all calls of 'Railway emergency' priority must be confirmed. (MI)

- 13.5.3 Confirmation of Railway emergency calls shall be implemented using the User to User Signalling supplementary service (UUS1). (MI)
- 13.5.4 After clear down of the Railway Emergency call, the mobile application shall start the confirmation process by automatically originating a call. In order to avoid network congestion the call set up shall be delayed by a random offset. (MI)
- 13.5.5 Railway Emergency call confirmation messages shall be of eMLPP priority 4 - "Railway information and all other calls" (see section 10.2). (MI)
- 13.5.6 The user information contained in the confirmation message shall be: (MI)
- Cab radio: the engine number or train number (if registered);
  - other mobiles: the user's functional number (if registered).
- 13.5.7 Confirmation messages shall be sent to a confirmation centre using a defined short code (see table 9-10), which shall be associated with the GSM network. (MI)
- 13.5.8 In the case of Cab radio, details of the confirmation shall be passed to the train borne recorder if a train borne recorder is connected to the Cab radio. (MI)
- 13.5.9 The user-to-user information elements in the following messages, as defined in [EN 301 515, Index [16]], shall be used for the confirmation of Railway Emergency calls: (MI)
- SETUP: transfer of confirmation message to confirmation centre;
  - RELEASE COMPLETE: acknowledgement of the confirmation message.
- 13.5.10 The SETUP and RELEASE COMPLETE user-to-user information element shall be as specified in the [TS 102 610]. (MI)
- 13.5.10i Confirmation centres shall be capable of decoding messages in either format A or B. (MI)
- 13.5.11 Deleted.
- 13.5.12 Deleted.
- 13.6 Enhancement of Railway emergency calls**
- 13.6.1 Railway Emergency Call functionality can be improved using enhanced Railway Emergency Call (eREC). (I)
- 13.6.2 eREC implementation shall comply with the requirements in section 13A. (M)

### 13A.1 Introduction

- 13A.1.1 National railway operational rules regarding handling of Railway emergency calls involve safety procedures which frequently result in reducing train speed, or even stopping all trains upon reception of REC. (I)
- 13A.1.2 The current behaviour of VGCS does not allow discriminating between calls with the same group ID in a given cell. This may result in some specific locations (dense areas, junctions...) in broadcasting calls to a geographical area which may not fit to the strict operational requirements. This behaviour in the context of Railway emergency call causes unnecessary production loss. (I)
- 13A.1.3 eREC provides discrimination of Railway emergency calls in a given cell. This allows a system configuration fitting operational requirements and reducing production loss. (I)
- 13A.1.4 The following chapters describe the general concept, define the related functions and procedures, and specify the system requirements for eREC. (I)
- 13A.1.5 An eREC capable network and an eREC capable mobile shall be compliant with [eREC SPECIFICATIONS]. (M)

### 13A.2 Backwards compatibility

- 13A.2.1 An eREC capable network shall be able to simultaneously provide service to eREC and non-eREC capable mobiles. (MI)
- 13A.2.2 An eREC capable mobile shall be able to operate in either eREC or non-eREC capable network. (MI)

### 13A.3 eREC system description

#### 13A.3.1 eREC Sector

- 13A.3.1.1 eREC introduces the concept of Sector. A Sector is an area defined according to railway operational needs (e.g. a given line or track), and is independent of the radio coverage area (i.e. a single cell may comprise multiple Sectors). A single eREC Sector Identity is assigned to each Sector. (I)
- 13A.3.1.2 An eREC Sector Identity ranges from 1 to 9. (M)
- 13A.3.1.3 The eREC Sector Identity is an attribute associated with a Railway Emergency Call to provide discrimination to users in a given area. (I)

### 13A.3.2 eREC Registration/Deregistration

13A.3.2.1 An eREC capable mobile shall subscribe to eREC service by applying the eREC registration procedure. Once registered, the network shall be able to provide service to the mobile and the mobile shall be able to receive Sector Identity updates. (M)

13A.3.2.2 An eREC capable mobile shall unsubscribe from eREC service by applying the eREC deregistration procedure. (M)

13A.3.2.3 eREC management data shall be included in the functional number registration and deregistration sequences defined in paragraph 11.3.7. (M)

### 13A.3.3 eREC Sector Identity Update procedure

13A.3.3.1 An eREC capable mobile shall support the following means to receive Sector Identity updates:

- over the air interface using eREC specific USSD messaging (M) <sup>(1)</sup>
- via Human Machine Interface of the mobile (M)
- via balises (O)

<sup>(1)</sup> the eREC Sector Identity itself is obtained from a train location information database. This interface is beyond the scope of this specification.

13A.3.3.2 An eREC capable mobile shall be informed about the Sector Identity Update method(s) supported by the network at eREC service registration. (M)

13A.3.3.3 The eREC Sector Identity Update procedure over the air interface may be supported by an eREC capable network. (O)

### 13A.3.4 eREC Sector Identity Validation

13A.3.4.1 The eREC Sector Identity Validation is used to detect potential misconfiguration of the Sector Identity(ies) used by an eREC capable mobile. It relies on a cell-based network configuration providing (if and where necessary) all valid eREC Sector Identities. (I)

13A.3.4.2 The eREC Sector Identity Validation Method may be supported by an eREC capable network. (O)

13A.3.4.3 The eREC Sector Identity Validation Method shall be supported by an eREC capable mobile. (M)

13A.3.4.4 SMS Cell Broadcast (SMS-CB) shall be used as a bearer for eREC Sector Identity Validation. (M)

### 13A.3.5 eREC call handling

13A.3.5.1 eREC shall use VGCS as a basis with the existing 3-digit Group ID. (M)

13A.3.5.2 The eREC Sector Identity shall be conveyed on the radio interface as part of existing call signalling:

- the Sector Identity shall be prepended to the Group Id in the eREC capable mobile call setup. (M)
- the Sector Identity shall be transmitted as the last digit of the Group Call Area. (M)

13A.3.5.3 The Group Call Register of an eREC capable network shall support configuration of eREC service using eREC Sector Identities. (M)

13A.3.5.4 eREC call management shall be based on the following main requirements:

- Call initiation: depending on service configuration, eREC capable mobile shall provide the appropriate eREC Sector Identity at call setup. (M)
- Network call establishment: eREC capable network shall establish and notify the call using the eREC Sector Identity as configured in the Group Call Register. (M)
- Call reception: eREC capable mobile shall join the call if the Sector Identity in the notification messages matches an active eREC Sector Identity. (M)

13A.3.5.5 The interface between the eREC capable network and the dispatcher equipment shall be unchanged: procedures for call initiation, reception and termination are identical to REC operation and based on Group Call Register configuration. (M)

### 13A.3.6 Confirmation of enhanced Railway Emergency Calls

13A.3.6.1 Confirmation of High Priority Calls shall support specific data for eREC for both eREC capable mobile and network. (M)

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## **14 Shunting mode**

### **14.1 Introduction**

14.1.1 The purpose of shunting mode is to provide an effective means of communication to a group of personnel who are involved with a shunting operation. (I)

14.1.2 The shunting group may comprise the following roles: shunting leader(s), shunting driver(s), controller(s) and other shunting members. (I)

14.1.2i In shunting mode, subject to operational rules, it is possible for a shunting participant to register to a role with its functional number or not to register. (I)

14.1.3 Deleted.

### **14.2 System requirements: Shunting Radio**

#### *Enter shunting mode*

14.2.1 The procedure for entering shunting mode is described in 14.4. (I)

14.2.2 Deleted.

14.2.3 Deleted.

14.2.4 Deleted.

#### *Leave shunting mode*

14.2.5 The procedure for leaving shunting mode is described in 14.4. (I)

14.2.6 Deleted.

### **14.3 System requirements: Cab radio**

#### *Enter shunting mode*

14.3.1 The procedure for entering shunting mode is described in 14.4. (I)

14.3.2 Deleted.

14.3.3 Deleted.

#### *Leave shunting mode*

14.3.4 The procedure for leaving shunting mode is described in 14.4. (I)

#### 14.4 System requirements: Shunting radio and Cab radio

14.4.1 On entering shunting mode, the radio shall perform the following steps:

- De-activate all active group-ID's on the SIM card except 299, e.g. 200 (if available on the SIM card), etc. (MI)
- Depending on maintenance settings, activating group-ID 500 and joining an ongoing group call is performed in one of the following ways: (O)
  - Automatically
  - No activation
  - Activation option presented to the user
- Activate group-ID 599 on the SIM card and assign emergency button to shunting emergency. (MI)
- De-activate group-ID 299 on the SIM card, if available on the SIM card. (MI)
- Depending on maintenance settings, de-registration of existing functional registrations is performed in one of the following ways: (O)
  - Automatically
  - No de-registration
  - De-registration option presented to the user

14.4.2 Deleted.

14.4.3 Deleted.

14.4.4 Deleted.

*During shunting mode*

14.4.5 During shunting mode, the radio should provide the following choices, when the shunting registration procedure (CT6) is not used: (O)

- Choose/change group-ID (including de-activation/activation of the group-ID and join an ongoing group call)
- Choose/change an area code, if used for filtering of incoming group calls
- Registration/de-registration of other functional identities (CT2)

- Registration of other functional identities (CT6)
- 14.4.6 During shunting mode, the radio shall or should provide the following choices, when the shunting registration procedure (CT6) is used: (MI)
- Change group-ID (including de-registration/registration of the functional identity and de-activation/activation of the group-ID and join an ongoing group call)
  - Change area (including de-registration/registration of the functional identity)
  - Change role (including de-registration/registration of the functional identity)
- 14.4.6i During shunting mode, the radio should provide the choice for registration/de-registration of other functional identities (e.g. CT 2/6), when the shunting registration procedure (CT6) is used: (O)
- 14.4.7 If registration is unsuccessful, this shall be indicated to the user. (MI)
- 14.4.8 In shunting mode there should not be a limit on the number of shunting participants per group call if the shunting registration procedure is not used. (O)
- 14.4.9 During shunting operation, besides the emergency group-ID 599, only one group-ID shall be active at the time on the radio. (MI)
- 14.4.10 During shunting operation, depending on operational rules, any user should be able to leave an ongoing group call except the shunting emergency call (e.g. to make a point to point call). The user should be able to re-join the group call. (O)
- 14.4.11 The shunting data (group-ID, area code and function code) shall be stored in non-volatile memory to be used for the start-up procedure. (MI)

*Switch radio off/on in shunting mode*

- 14.4.12 When a radio operating in shunting mode is switched off (either after a user MMI action or a loss of power), it should automatically return to shunting mode when it is switched on again, and it should retain its shunting mode settings (area code and group IDs). It should then interrogate the network and synchronise its functional registrations. (O)

*Leave shunting mode*

- 14.4.13 It should be possible to leave shunting mode directly without first having to leave an ongoing operational shunting call, except in the case of a shunting emergency call. (O)
- 14.4.14 When a radio leaves shunting mode, the ongoing group call shall not be terminated automatically. (MI)

- 14.4.15 On leaving shunting mode, the radio shall perform the steps described in requirements 14.4.16 – 14.4.22 in the following order: (MI)
- 14.4.16 The radio shall de-activate all active group-ID's on the SIM card except 599 (e.g. 500, etc.). (MI)
- 14.4.17 Depending on maintenance settings, the radio should perform de-registration of existing functional registrations in one of the following ways: (O)
- Automatically
  - No de-registration
  - De-registration option presented to the user
- 14.4.18 The radio shall activate group-ID 299 on the SIM card, if available on the SIM card, and assign emergency button to train emergency. (MI)
- 14.4.19 The radio shall de-activate group-ID 599 on the SIM card. (MI)
- 14.4.20 The radio shall activate group-ID 200 on the SIM card, if available on the SIM card. (MI)
- 14.4.21 The radio should activate other group-IDs that were active before entering shunting mode and join an ongoing group call. (O)
- 14.4.22 The radio should register of functional identities that were active before entering shunting mode. (O)

## 14.5 Numbering plan

- 14.5.1 The full numbering plan for shunting mode group calls is defined in subsection 9.9. (I)
- 14.5.2 Valid group IDs shall be as defined in table 14-9.

Quantity	Name	Usage	Group ID	Category
1	Default Shunting Group	Common initiation	500	(MI)
29	Dedicated Shunting Group	Shunting	501-529	(MI)
1	Emergency Shunting Group	Emergency (for the whole area)	599	(MI)
n	National Shunting Group	Shunting	Any out of the national reserved ranges	(O)

Table 14-9: Valid Group IDs

14.5.3 Additional Group-IDs required for shunting may be selected by the operator from section 9 (e.g. ranges denoted as “Reserved for national use”). (O)

#### 14.6 Control of shunting group membership

14.6.1 Users will not be prevented from joining a dedicated shunting group by technical means but only by operational rules. (I)

14.6.2 Deleted.

14.6.3 Deleted.

#### 14.7 Link assurance signal

14.7.1 Deleted.

14.7.2 Deleted.

14.7.3 Deleted.

14.7.4 Deleted.

14.7.5 Deleted.

##### *Link Assurance: generic*

14.7.6 The link assurance signal is a means to provide end-to-end verification between shunting users that a voice communication link is intact. This facility is required principally for the safer conduct of pushing manoeuvres to verify the continuous availability of the radio channel while a shunting worker is guiding a train driver. (I)

14.7.7 The link assurance transmitter shall be available in shunting radios. (M)

14.7.8 The link assurance service should be available in point-to-point communications in any mode and for all group communications in Shunting mode (except the EIRENE Default Shunting Group and shunting emergency calls). (O)

14.7.9 It should be possible, using maintenance facilities, to switch between the following audible modes: (O)

- Audible Mode 1: The link assurance tone shall be audible to all members of the call including the link assurance transmitter.

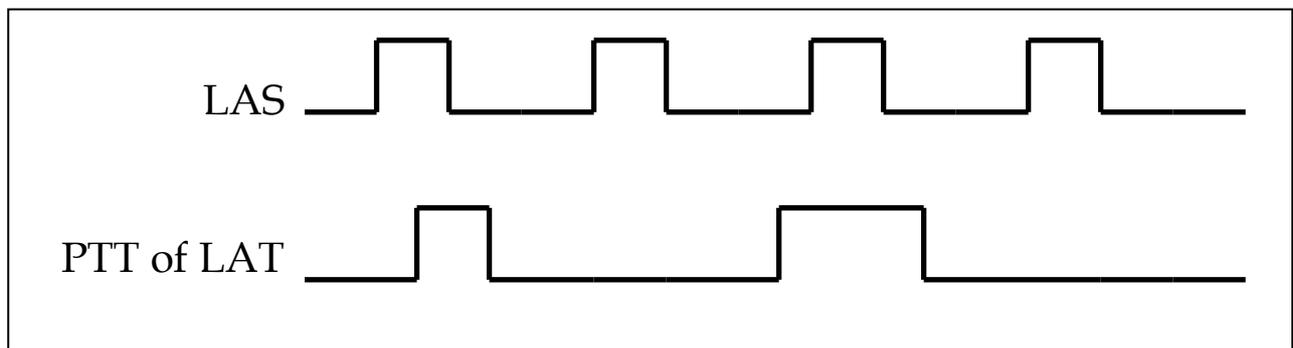
- Audible Mode 2: The link assurance tone shall not be audible to the link assurance transmitter.
- 14.7.10 The link assurance signal shall consist of an intermittent audio tone (820Hz +/- 5Hz). The tone shall be of X second duration, followed by an interval of Y seconds with no tone (silent interval). (MI)
- 14.7.10i X and Y should be configurable by a maintenance setting between 1 and 10 seconds in steps of 0.5 seconds. (O)
- 14.7.11 If Speaker Mode 2 is used, it is recommended that the value of Y is chosen to be between 5 seconds and 10 seconds. (I)
- 14.7.12 The link assurance tone audio level at the transmitter side should be adjustable, using maintenance facilities. (O)
- 14.7.13 It should be possible, using maintenance facilities, to switch between the following Link Assurance Signal operating modes: (O)
- LAS Operating Mode 1: In order to transmit the link assurance tone, the participant must continuously hold a button depressed. If the button is released, the link assurance service will stop.
  - LAS Operating Mode 2: The participant transmitting the link assurance tone must confirm the transmission of that tone by periodically pressing a button (for example the PTT or LAS button). If the tone is not confirmed within a configurable time period, the link assurance service will stop (dead man's function).
  - LAS Operating Mode 3: The participant transmitting the link assurance tone does not need to confirm the transmission of the tone. The link assurance signal will continue until the service is deliberately stopped (no dead man's function).
- 14.7.14 There should be a clear audible indication for the link assurance transmitter when periodic confirmation is required. (O)
- 14.7.15 Subject to operational rules only one shunting participant at a time is allowed to transmit the link assurance signal. (I)
- 14.7.16 The link assurance signal shall be deactivated upon receipt of a shunting emergency call. (MI)
- 14.7.17 The link assurance service shall not prohibit the use of the shunting emergency service. (MI)
- 14.7.18 Subject to operational rules (e.g. for critical shunting) shunting participants can make a choice between the group communication LAS and the point-to-point LAS services. (I)

14.7.19 During link assurance, an incoming call, at the mobile link assurance transmitter, with the same or lower priority should only be indicated visually to the user (there should be no audible indication). (O)

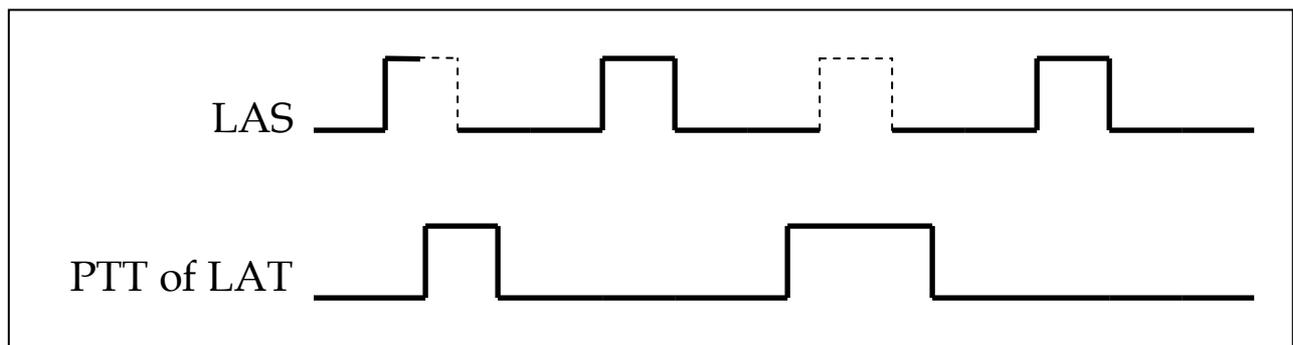
14.7.20 It should be possible, using maintenance facilities, to select one of the following LAS suppressing modes: (O)

- Suppressing Mode 1: The transmission of the tone of the Link Assurance Signal is not suppressed when the LAT presses the PTT button (see figure 14-1);
- Suppressing Mode 2: The transmission of the tone of the Link Assurance Signal is suppressed when the LAT presses the PTT button (see figure 14-2);

14.7.21 The following drawings illustrate the suppression options for link assurance. (I)



*Figure 14-1: LAS in group mode, no suppression of LAS.*



*Figure 14-2: LAS in group mode, suppression of LAS.*

*Link Assurance with group communication*

14.7.22 It should be possible, using maintenance facilities, to select one of the following LAS speaker modes: (O)

- Speaker Mode 1: The LAT retains the uplink during LAS, only the Link Assurance Transmitter is able to speak (see figure 14-3);

- Speaker Mode 2: The LAT seizes and releases the uplink as defined in 14.7.10 in order to transmit each instance of the LAS tone, thereby allowing any other participant to request to speak between LAS tones (see figure 14-4);

- 14.7.23 The Link Assurance Transmitter can gain the uplink and occupy the speech path at any time if no other participant in the group is speaking. (I)
- 14.7.24 A participant who is not the Link Assurance Transmitter can gain the uplink during the silent interval and occupy the speech path, when the speech path is available. The duration of the speech connection is only limited by uplink duration timer. During this time the LAT will not be able to transmit the LAS. (I)
- 14.7.25 The use of the speech channel as described in 14.7.24 will be regulated by operational rules defined by the national operators. (I)
- 14.7.26 The following drawings illustrate the principle of group communication link assurance with Speaker Mode. (I)

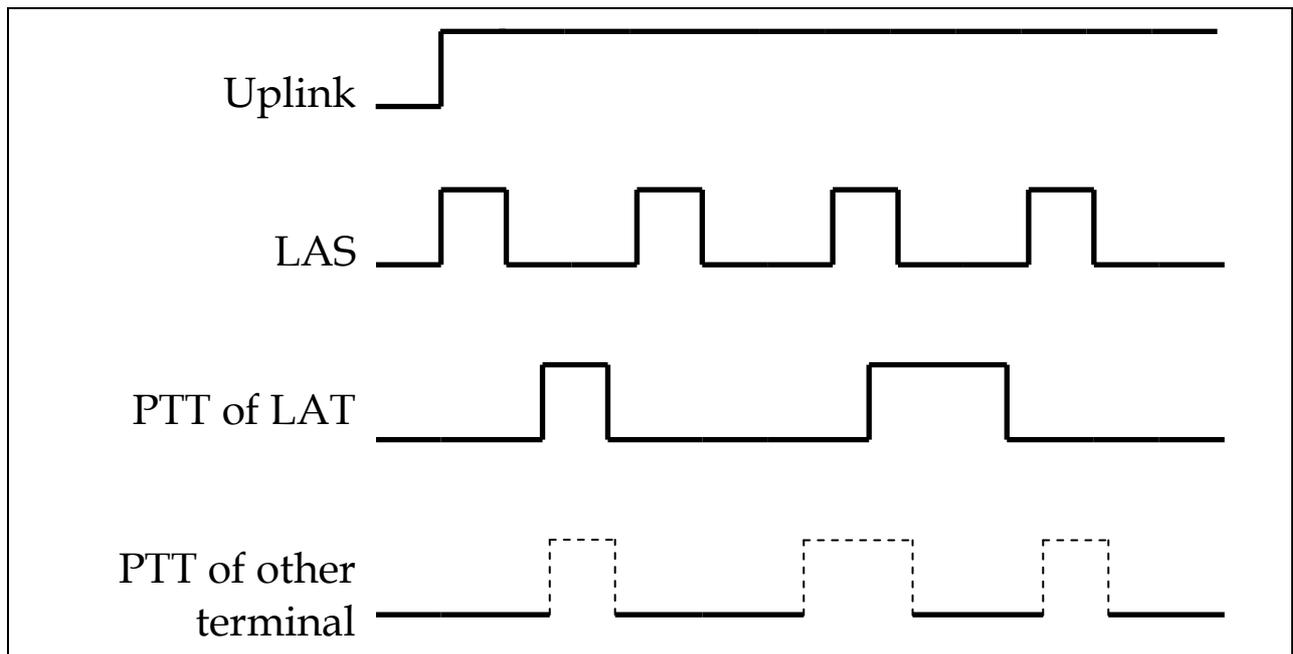
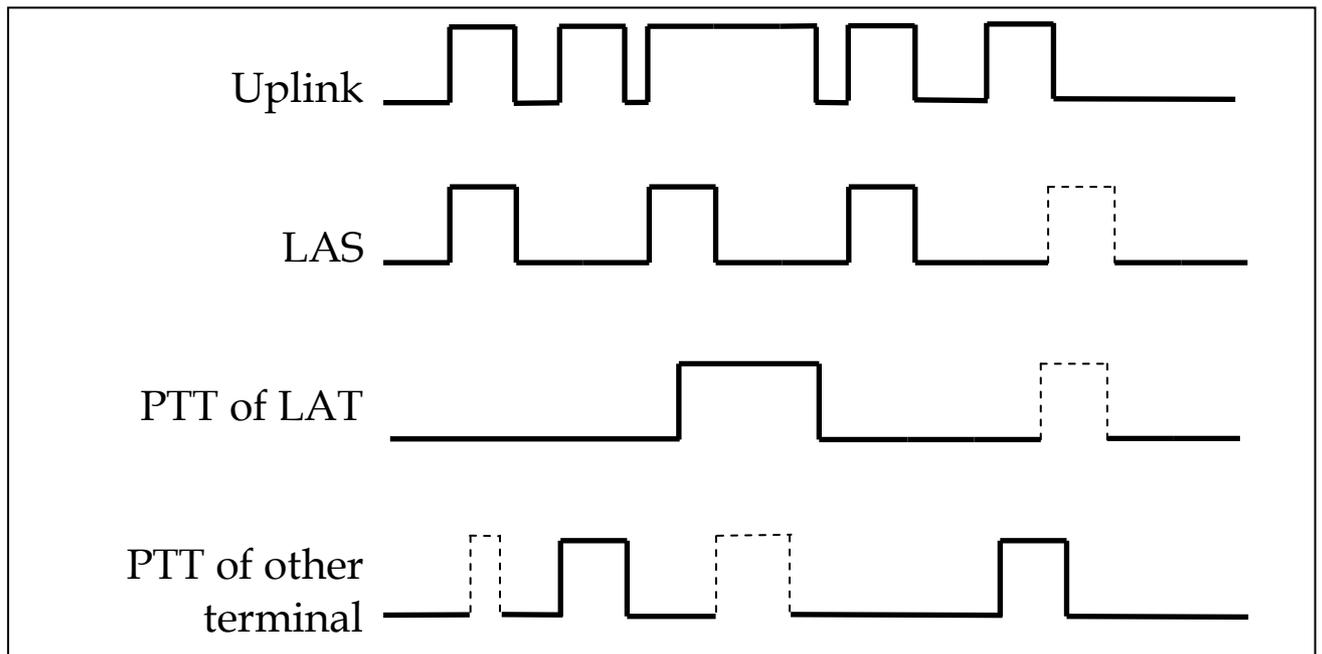


Figure 14-3: LAS in group mode, Speaker Mode 1.



*Figure 14-4: LAS in group mode, Speaker Mode 2.*

14.7.27 After the LAS was initiated by the LAT it should be possible, using maintenance facilities, to configure the expected behaviour of the LAS continuation when the LAT or another terminal in the group has pressed PTT during the pause of the sequence: (O)

- Terminating Mode 1: LAS sequence is stopped after an other terminal than LAT terminal has pressed PTT; (see figure 14-5)
- Terminating Mode 2: LAS sequence is stopped after LAT has pressed PTT; (see figure 14-6)
- Terminating Mode 3: LAS sequence continues after an other terminal than LAT has pressed PTT; (see figure 14-7)
- Terminating Mode 4: LAS sequence continues after LAT terminal has pressed PTT; (see figure 14-8)

14.7.28 The following drawings illustrate the principle of group communication link assurance with Terminating Mode. (I)

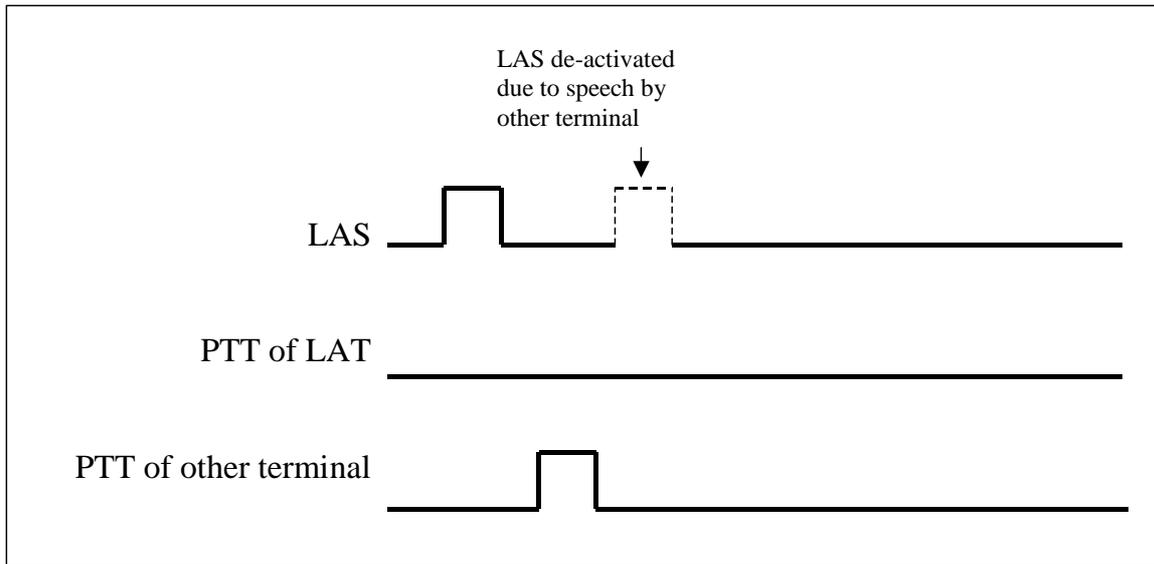


Figure 14-5: LAS in group mode, Terminating Mode 1.

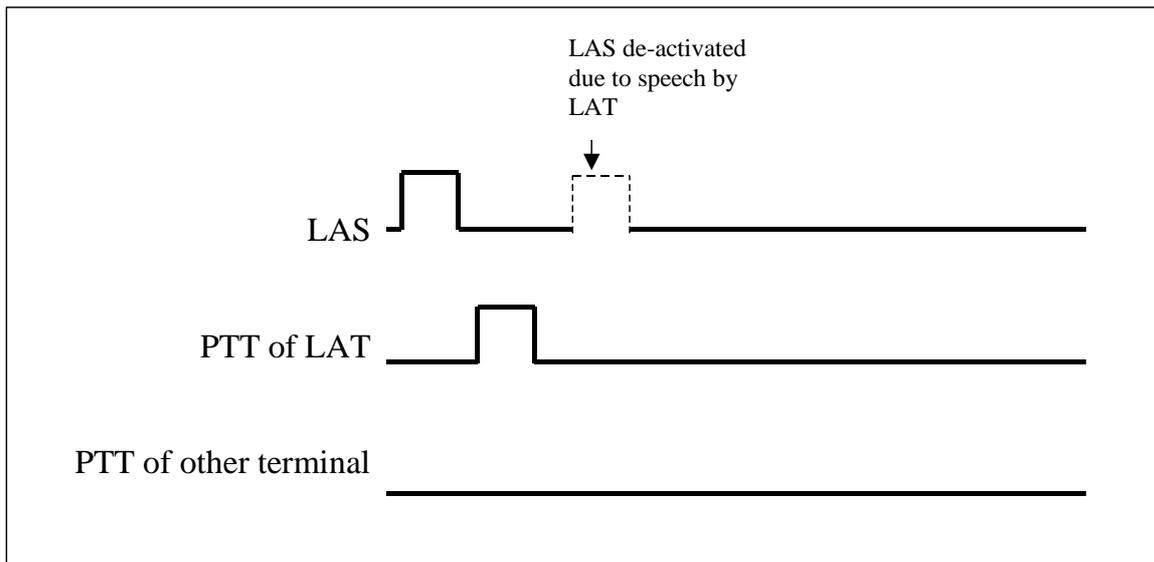


Figure 14-6: LAS in group mode, Terminating Mode 2.

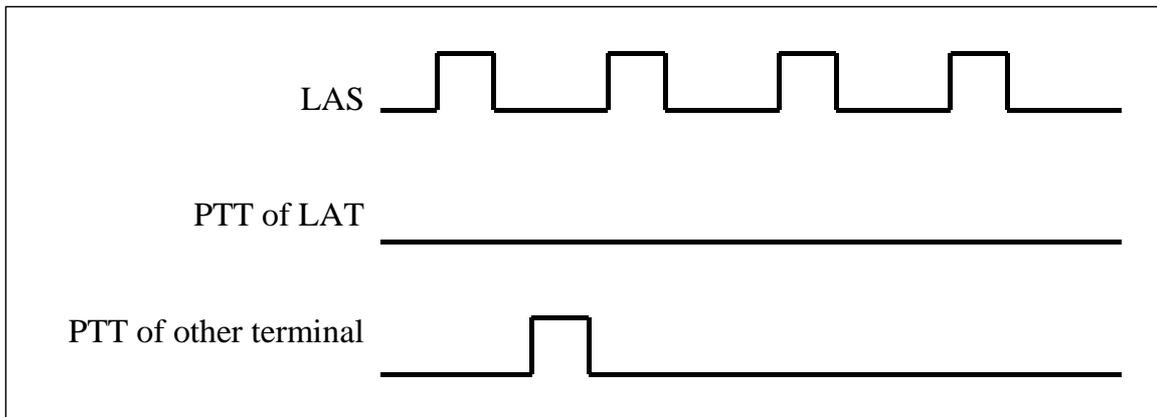


Figure 14-7: LAS in group mode, Terminating Mode 3.

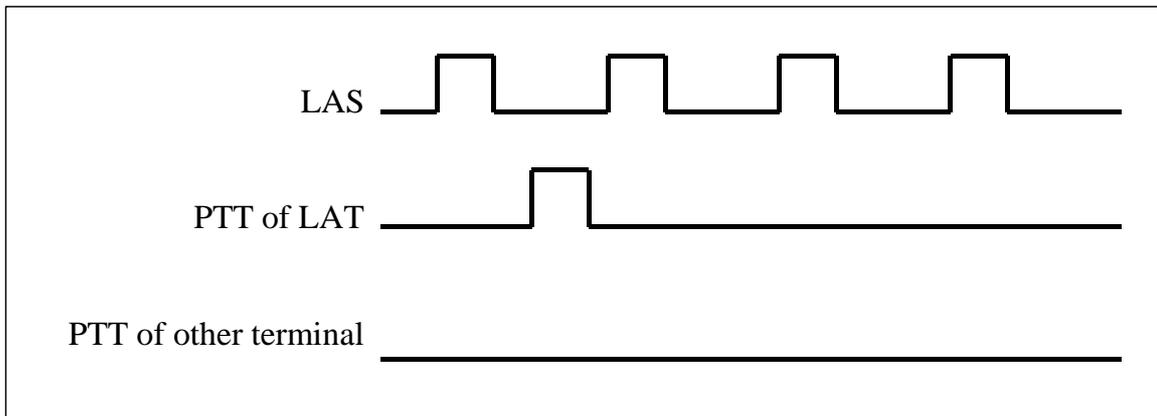
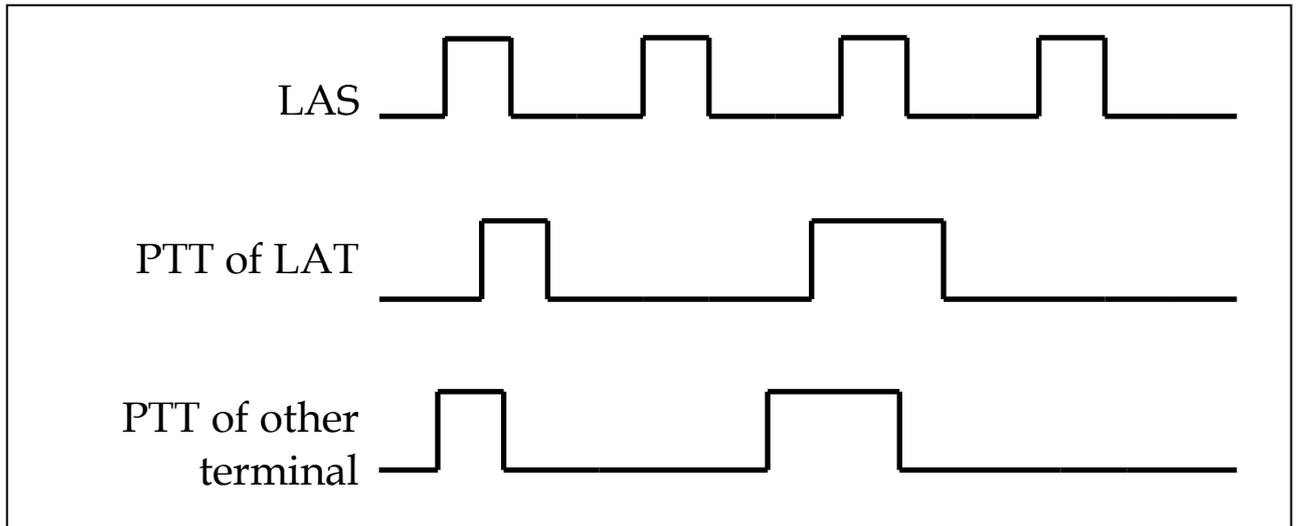


Figure 14-8: LAS in group mode, Terminating Mode 4.

*Link Assurance with point to point communication*

- 14.7.29 When LAS is used in point-to-point mode, the PTT button should always be used by the participants to enable the microphone. (O)
- 14.7.30 In the case described in 14.7.29, the microphone shall be muted when the PTT button is released. (M)

14.7.31 There is no mechanism to prevent both participants from speaking at the same time by simultaneously pressing their PTT buttons (see figure 14-9). (I)



*Figure 14-9: LAS in point-to-point mode, including more than one PTT.*

- 14.7.32 There is no mechanism to prevent both participants from sending the link assurance signal at the same time. (I)
- 14.7.33 The use of LAS will be regulated by operational rules defined by the national operators. (I)

14.7.34 For an overview of all the options and modes of Link Assurance, please refer to table 14-10. (I)

<b>Overview of LAS Modes</b>			
<i>Ref. Nr.</i>	<i>Subject</i>	<i>Option</i>	<i>Title</i>
14.7.9	Tone locally audible	Yes	Audible Mode 1
14.7.9	Tone locally audible	No	Audible Mode 2
14.7.13	LAS operation	Continuously	LAS Operating Mode 1
14.7.13	LAS operation	Confirm	LAS Operating Mode 2
14.7.13	LAS operation	On/off	LAS Operating Mode 3
14.7.20	LAS tone when pressing PTT at LAT	Not suppressed	Suppressing Mode 1
14.7.20	LAS tone when pressing PTT at LAT	Suppressed	Suppressing Mode 2
14.7.22	During LAS channel open to	LAT	Speaker Mode 1
14.7.22	During LAS channel open to	Anybody in the group	Speaker Mode 2
14.7.27	LAS tone after uplink occupied	Periodically retry	Uplink Occupied Mode 1
14.7.27	LAS tone after uplink occupied	DE-activate	Uplink Occupied Mode 2
14.7.27 & 28	LAS terminating after PTT other	Stop	LAS Terminating Mode 1
14.7.27 & 28	LAS terminating after PTT LAT	Stop	LAS Terminating Mode 2
14.7.27 & 28	LAS terminating after PTT other	Continue	LAS Terminating Mode 3
14.7.27 & 28	LAS terminating after PTT LAT	Continue	LAS Terminating Mode 4

Table 14-10: Overview of different LAS modes.

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## 15 Direct mode

### 15.1 Introduction

- 15.1.1 The operational requirement for direct mode is to: (I)
- 1) provide short range fall-back communications between train drivers and trackside personnel in the event of failure of all railway and/or public GSM services normally available;
  - 2) provide short range communications for railway personnel operating in remote areas where no GSM facilities are available.

### 15.2 System requirements

- 15.2.1 Implementation of direct mode is optional. However, where implemented, the following requirements shall be mandatory. (I)
- 15.2.2 Frequency modulated equipment conforming to [ETSI 300 086] shall be used for direct mode. (M)
- 15.2.3 Direct mode equipment shall have a maximum transmit power of 1 Watt. (M)
- 15.2.4 Direct mode equipment sensitivity shall be at least -107dBm. (M)

#### *Frequency range and mode of operation*

- 15.2.5 Direct mode equipment shall be capable of operation in the channels defined in table 15-1. (M)

Channel	Frequency
1	876.0125 MHz
2	876.0250 MHz
3	876.0375 MHz
4	876.0500 MHz
5	876.0625 MHz

*Table 15-1: Direct mode channel frequencies according to [ECC(02)05]*

- 15.2.6 Direct mode shall operate in simplex mode, a radio link that uses a single frequency for alternate transmission and reception. (M)
- 15.2.7 Voice transmission from direct mode equipment shall be possible only when the Push-To-Talk (PTT) button is pressed. (M)

*CTCSS*

- 15.2.8 Continuous Tone Coded Squelch Systems (CTCSS) shall be implemented on all direct mode equipment. (M)
- 15.2.9 The CTCSS tone shall be at a frequency of 203.5 Hz. (M)
- 15.2.10 The CTCSS modulation shall be within the limits defined in table 15-2. (M)

<b>System</b>	<b>Angle</b>
Channel Spacing kHz	Peak Deviation $\pm$ Hz
12.5	200 to 400

*Table 15-2: CTCSS modulation limits**Direct mode common access channel*

- 15.2.11 The purpose of the common access channel is to provide a point of contact and information for all direct mode users. For example, if one direct mode user wished to initiate contact with another user, communication would begin with a request for the desired partner on the access channel. After receiving a reply, both parties may transfer to a free direct mode channel and continue. (I)
- 15.2.12 Direct mode channel 1 (876.0125 MHz) shall serve as the common access channel. (M)
- 15.2.13 Equipment should default to operation on the common access channel (direct mode channel 1) on entry into direct mode. (O)

*Direct mode interaction with GSM-R*

- 15.2.14 Direct mode communications will only be used in the event of normal GSM-R services being unavailable. (I)
- 15.2.15 The presence of the GSM-R network shall be indicated to direct mode users. (M)
- 15.2.16 All terminals shall ensure that when GSM-R services are available, the user is prevented from entering direct mode. (M)
- 15.2.17 In the event of GSM-R causing disruption to ongoing direct mode communications, each railway will define a protocol for re-establishing contact by means of GSM-R. (I)

*Shunting link assurance signal*

- 15.2.18 All direct mode equipment shall provide the facility to broadcast an in-band audio shunting link assurance signal as defined in subsection 14.7.10. (M)

## 16 ETCS data only radio

### 16.1 Introduction

16.1.1 This section identifies the system requirements for the ETCS data only radio. It defines how the functionality is to be provided by a data radio that is dedicated to ETCS communications. (I)

### 16.2 System components

16.2.1 Figure 16-1 shows the logical architecture of an ETCS data only radio. The architecture comprises the following elements: (I)

- a) **GSM Mobile Terminations (GSM-MT):** comprising one or more GSM mobile equipments and SIM;
- b) GSM bearer services;
- c) Air interface  $U_m$  (1)
- d) ETCS data interface  $I_{GSM}$  (2)
- e) There should be no MMI, maintenance indications may be provided.

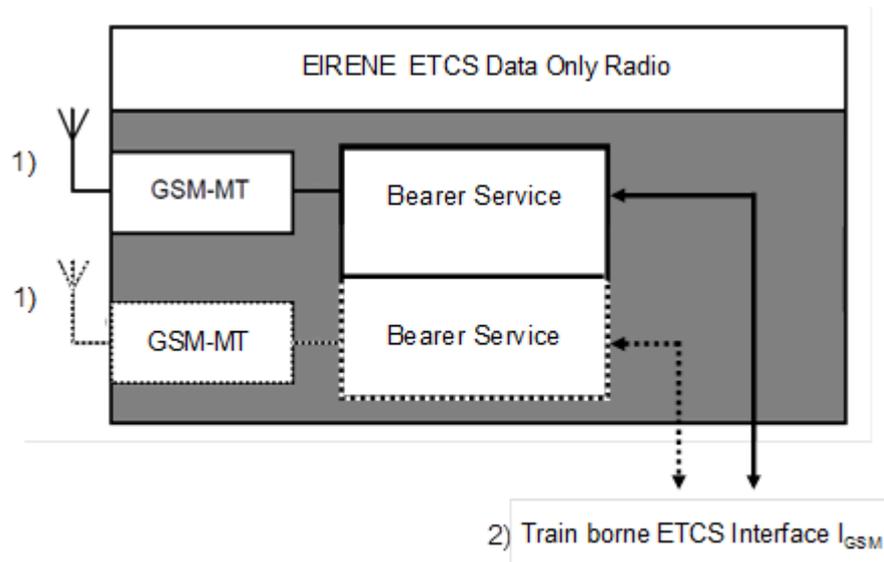


Figure 16-1: Logical ETCS data only radio architecture and interfaces

16.2.2 The architecture shall comprise a number of interfaces between the different EIRENE-MS elements. These are: (MI)

- 1) GSM-MT air interface ( $U_m$ ): mandatory for interoperability and conformance to GSM specifications.

- 2) GSM-MT - Train-borne ETCS interface ( $I_{GSM}$ ): specified to allow the control of GSM-MT by the train-borne ETCS system, following FFFIS for EURORADIO specification [MORANE EURO FFFIS].

### 16.3 System requirements

- 16.3.1 The ETCS data only radio is a key component of the end to end ETCS system to fulfil the necessary QoS requirements specified in [Subset-093]. (I)
- 16.3.2 The ETCS data only radio shall be capable to be operated in circuit switched mode. (MI)
- 16.3.3 The ETCS data only radio should be capable to be operated in packet switched mode (e.g. GPRS). (O)
- 16.3.4 All GSM-MT of the ETCS data only radio shall be initialised and controlled, for example with regard to network selection and call handling, by the ETCS train-borne system according to FFFIS for EURORADIO specification [MORANE EURO FFFIS]. (MI)
- 16.3.5 The ETCS data only radio shall be capable to be used within the band 876-880 MHz (uplink) and 921-925 MHz (downlink). (MI)
- 16.3.6 The ETCS data only radio should be capable to be used within the band 880-915 MHz (uplink) and 925-960 MHz (downlink). (O)
- 16.3.7 The ETCS data only radio shall be capable to support the requirements as mentioned in chapter 5 “Transmitter characteristics” and chapter 6 “Receiver characteristics” of [ETSI TS 102 933-1]. (O)

### 16.4 Environmental and physical

- 16.4.1 Train-mounted equipment including the ETCS data only radio equipment and antennas shall comply with all specifications in section 4 and all of those defined in this section, with those defined in this section taking priority. (M)

#### *Climatic conditions*

- 16.4.2 The ETCS data only radio shall be capable of operating within a temperature range of -20°C to +70°C. (M)
- 16.4.3 The aerial and any other equipment mounted external to the train shall be capable of withstanding extremes of temperature from -40°C to +70°C. (M)
- 16.4.4 The aerial and any other equipment mounted external to the train shall function during rapid temperature fluctuations of up to 3°C/second. (M)

- 16.4.5 Any equipment mounted external to the train cab shall withstand the following additional physical conditions: (M)
- in-tunnel pressure pulses of 6 kPa (peak to peak) for up to 3 seconds;
  - pressure gradients of up to 100 kPa/s.

*Physical conditions*

- 16.4.6 Measures should be taken to reduce the risk of theft of ETCS data only radio equipment. Examples of such measures include physical protection, alarms and access control measures. (O)
- 16.4.7 Ease of maintenance should be taken into account in the design and installation of ETCS data only radio equipment. For example, maintenance access to antennas on vehicles should be provided. (O)
- 16.4.8 The “Subscriber Identity Module” (SIM card) shall be physically integrated with the ETCS data only radio set and shall not be able to be removed except by maintenance staff. (M)

*Mechanical conditions*

- 16.4.9 Any equipment mounted inside the train cab shall be capable of withstanding the following maximum levels of sinusoidal vibration: (M)
- frequency range: 5-200 Hz;
  - peak-to-peak amplitude: 7mm;
  - acceleration: 1.5g.
- 16.4.10 Any equipment mounted external to the train cab shall withstand the following maximum levels of sinusoidal vibration: (M)
- frequency range: 5-1000 Hz;
  - peak-to-peak amplitude: 5mm;
  - acceleration: 2.5g.

*Electrical*

- 16.4.11 The ETCS data only radio shall comply with European standard [EN 50124]. (M)
- 16.4.12 If the ETCS train-borne equipment has an emergency power supply which will enable it to continue to operate in the event of failure of the train’s main power supply, it is recommended that this supply is also used to power the ETCS data only radio. (I)
- 16.4.13 The ETCS data only radio main and backup power supplies shall comply with the voltage fluctuations and transients as defined in [EN 50155]. (M)

- 16.4.14 The cab radio and other in-cab equipment shall be protected against all electrical hazards arising from EIRENE mobile equipment as defined in [EN 50153]. (M)

*Electromagnetic Compatibility*

- 16.4.15 Electromagnetic interference immunity and emissions of the ETCS data only radio shall comply with [EN 50121 parts 1, 2 and 3-2]. (M)

- 16.4.16 When installed in the train, the emissions from the ETCS data only radio and its associated antenna system (connecting cable and antenna) shall comply with the requirements defined in [EN 50121 parts 1 and 3-2]. (M)

*Testing procedures*

- 16.4.17 The ETCS data only radio shall pass electrical tests as defined in [EN 50155]. (M)

## **17 Interconnection, Roaming and Border Crossing**

### **17.1 Border Crossing**

- 17.1.1 To enable interoperable international train traffic, the respective EIRENE networks shall be able to be configured to support Border Crossing. (MI)
- 17.1.2 [FFFS for BX] specifies technical conditions and functionalities that shall be fulfilled to achieve international train traffic Voice and Data Services functionality when Crossing Borders between EIRENE Networks. (M)

## A References

### A.1 List of normative references

Specification	Title
CENELEC ERGONOMIC	Railway applications – Communication, signalling and processing systems – European Rail Traffic Management System – Driver Machine Interface, TS50459 Parts1-6:2005.
EIRENE FRS	‘UIC Project EIRENE Functional Requirements Specification’, UIC CODE 950-7.3.0
FFFS for BX	FFFS for Voice and Data Services Functionality at borders between GSM-R networks O-8300 version 2.0
MORANE EURO FFFIS	‘Radio Transmission FFFIS for Euroradio’, MORANE A 11 T 6001 12
ASCI OPTIONS	ETSI TS 103 169 ‘Railway Telecommunications (RT); ASCI Options for Interoperability for GSM operation on Railways version 1.1.1 (2011-09)’
MORANE CHPC FFFS	‘FFFS for Confirmation of High Priority Calls’, MORANE F 10 T 6002 5
MORANE CHPC FIS	‘FIS for Confirmation of High Priority Calls’, MORANE F 12 T 6002 5
MORANE FA FFFS	‘FFFS for Functional Addressing’, MORANE E 10 T 6001 4.1
MORANE FA FIS	‘FIS for Functional Addressing’, MORANE E 12 T 6001 5.1
MORANE LDA FFFS	‘FFFS for Location Dependent Addressing’, MORANE F 10 T6001 4
MORANE LDA FIS	‘FIS for Location Dependent Addressing’, MORANE F 12 T6001 3
MORANE PFN FFFS	FFFS for Presentation of Functional Numbers to Called and Calling Parties’, MORANE F 10 T 6003 4
MORANE PFN FIS	‘FIS for Presentation of Functional Numbers to Called and Calling Parties’, MORANE F 12 T 6003 4
MORANE SIM	‘FFFIS for GSM-R SIM Cards’. MORANE P 38 T 9001 4.2

Specification	Title
SUPP SERVICES	<p>ETSI TS 122 081 “Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); Line identification Supplementary Services; Stage 1 (3G TS 22.081 version 3.2.0 Release 1999)”</p> <p>ETSI TS 122 082 “Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Call Forwarding (CF) Supplementary Services; Stage 1 (3GPP TS 22.082 version 3.0.2 Release 1999)”</p> <p>ETSI TS 122 083 “Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); Call Waiting (CW) and Call Holding (HOLD) Supplementary Services - Stage 1 (3G TS 22.083 version 3.0.1 Release 1999)”</p> <p>ETSI TS 122 084 “Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); MultiParty (MPTY) Supplementary Services - Stage 1 (3G TS 22.084 version 3.0.1 Release 1999)”</p> <p>ETSI TS 122 085 “Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); Closed User Group (CUG) Supplementary Services - Stage 1 (3G TS 22.085 version 3.1.0 Release 1999)”</p> <p>ETSI TS 122 086 “Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); Advice of Charge (AoC) Supplementary Services - Stage 1 (3G TS 22.086 version 3.1.0 Release 1999)”</p> <p>ETSI TS 122 088 “Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); Call Barring (CB) Supplementary Services - Stage 1 (3GPP TS 22.088 version 3.0.2 Release 1999)”</p> <p>ETSI TS 122 091 “Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); Explicit Call Transfer (ECT) (3GPP TS 22.091 version 3.1.0 Release 1999)”</p> <p>ETSI TS 122 093 “Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); Completion of Calls to Busy Subscriber (CCBS); Service description, Stage 1 (3G TS 22.093 version 3.0.1 Release 1999)”</p>

<b>Specification</b>	<b>Title</b>
DTMF SIGNALLING	ETSI TS 123 014 “Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Support of Dual Tone Multi Frequency (DTMF) signalling (3GPP TS 23.014 version 3.2.0 Release 1999)”
GSM NUMBERING	ETSI TS 123 003 “Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Numbering, addressing and identification (3GPP TS 23.003 version 3.15.0 Release 1999)”
TS 102 281	ETSI TS 102 281 v2.3.0 “Railways Telecommunications (RT); Global Systems for Mobile Communication (GSM); Detailed requirements for GSM operation on Railway”
TS 102 610	ETSI TS 102 610 v1.3.0, “Railways Telecommunications (RT); Global System for Mobile communications (GSM); Usage of the User to User Information Element for GSM Operation on Railways”
TS 102 933-1	ETSI TS 102 933-1, Railway Telecommunications; GSM-R improved receiver parameters; Part 1: Requirements for radio reception, limited to chapter 5 and 6 for ETCS data only radio
TS 102 933-2	ETSI TS 102 933-2, Railway Telecommunications; GSM-R improved receiver parameters; Part 2: Radio conformance testing, as applicable for testing of radio parameters for ETCS data only radio
TS 103 066	ETSI TS 103 066 v1.1.2, “Railways Telecommunications (RT); Rel-4 Core Network requirements for GSM-R”
TS 103 147	ETSI TS 103 147 v1.1.1, “Railway Telecommunications (RT); GSM-R Core Network Redundancy”
TS 103 389	ETSI TS 103 389 v1.2.1, “Railway Telecommunications (RT); Global System for Mobile communications (GSM); Usage of Session Initiation Protocol (SIP) on the Network Switching Subsystem (NSS) to Fixed Terminal Subsystem (FTS) interface for GSM Operation on Railways”
EN 300 019	ETSI EN 300 019-1-4 V2.1.2 (2003-04), “Environmental conditions and environmental tests for telecommunications equipment”  Part 1-5: ‘Classification of Environmental Conditions; Ground vehicle installations’ V2.1.4 (2003-04)  Part 1-7: ‘Classification of Environmental Conditions; Portable and Non-Stationary Use’ V2.1.4 (2003-04)

ETS 300 086	ETS 300 086 ed.1 (1991-01) Addendum 1 ed.1 (1996-11) and Addendum 2 ed.1 (1997-03), 'Radio Equipment and Systems, Land Mobile Service, Technical characteristics and test conditions for radio equipment with an internal or external RF connector intended primarily for analogue speech'
EN 301 515	ETSI EN 301 515 v2.3.0, "Global System for Mobile Communication (GSM); Requirements for GSM operation on railways", Indexes [1] to [36] inclusive plus all of the changes identified in ETSI TS 102 281 v2.2.0, "railways Telecommunications (RT); Global System for Mobile communications (GSM); Detailed requirements for GSM operation on Railways".

Specification	Title
EN 301 489	ETSI EN 301 489, 'Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: 'Common technical requirements v1.8.1' Part 7: 'Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS) v1.3.1.' Part 8: 'Specific conditions for GSM base stations v1.2.1'
EN ISO/ IEC 17025	'General requirements for the competence of testing and calibration laboratories': 2005
EN 50121	'Railway applications – Electromagnetic compatibility' Part 1: 'General':2006 Part 2: 'Emission of the whole railway system to the outside world':2006 Part 3-2: 'Rolling stock Apparatus':2006 Part 4: 'Emission and immunity of the signalling and telecommunications apparatus':2006
EN 50124	'Railway applications – Insulation co-ordination' Part 1: 'Basic requirements – Clearances and creepage distances for all electrical and electronic equipment':2001 Part 2:'Overvoltages and related protection':2001
EN 50125	'Railway applications – Environmental conditions for equipment' Part 1: 'Equipment on board rolling stock':1999 Part 2: 'Fixed electrical installations':2002 Part 3: 'Equipment for signalling and telecommunications':2003
EN 50129	'Railway applications – Communication, signalling and processing systems – Safety related electronic systems for signalling':2003
EN 50153	'Railway applications – Rolling stock – Protective provisions relating to electrical hazards':2002
EN 50155	'Railway applications – Electronic equipment used on rolling stock': 2007, including corrigendum of May 2010
EN 60068	'Environmental testing' Part 1:' General and guidance':1994 Part 2: 'Tests'– Date Reference for the Individual sub-parts shall be as required by other standards listed in this table

<b>Specification</b>	<b>Title</b>
EN 60529	'Degrees of protection provided by enclosures (IP Code)':1991/ A1:2000
EN 60950	'Information technology equipment – Safety' Part 1: 'General requirements':2006
EN 61000	'Electromagnetic compatibility (EMC) Part 4-3: 'Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test':2006 Part 6-1: 'Generic standards – Immunity for residential, commercial and light-industrial environments':2007 Part 6-2: 'Generic standards – Immunity for industrial environments':2005 Part 6-3: 'Generic standards – Emission standard for residential, commercial and light-industrial environments':2007 Part 6-4: 'Generic standards – Emission standard for industrial environments':2007
EN 61508	'Functional safety of electrical/ electronic/ programmable electronic safety-related systems' Part 1: 'General requirements':2010 Part 2: 'Requirements for electrical/ electronic/ programmable electronic safety-related systems':2010 Part 3: 'Software requirements':2010 Part 4: 'Definitions and abbreviations':2010 Part 5: 'Examples of methods for the determination of safety integrity levels':2010 Part 6: 'Guidelines on the application of IEC 61508-2 and IEC 61508-3':2010 Part 7: 'Overview of techniques and measures':2010
ISO 9001	'Quality management system – Requirements':2008

## A.2 List of informative references

Specification	Title
1999/ 569/ EC	European Commission Decision 1999/ 569/ EC “Commission Decision of 28 July 1999 on the basic parameters for the command-and-control and signalling subsystem relating to the trans-European high-speed rail system.”
CEPT 25-09	CEPT Recommendation T/ R 25-09 E (Chester 1990, revised at Budapest 1995), ‘Designation of frequencies in the 900 MHz band for railway purposes’
ECC(02)05	Electronic Communications Committee of the CEPT ECC(02)05 “ECC Decision of 5 July 2002 on the designation and availability of frequency bands for railway purposes in the 876-880 and 921-925 MHz bands”
Subset-093	Subset-093 issue 2.3.0 “ERTMS/ ETCS – Class 1, GSM-R Interfaces Class 1 Requirements”
eLDA FRS	‘Functional Requirements Specification for enhanced Location Dependent Addressing’, eLDA FRS v4.0
eLDA IRS	‘Interface Requirements Specification enhanced Location Dependent Addressing’, eLDA IRS v5.0 ‘
eREC SPECIFICATION	Part 1. O-3151-1.2 eREC specification Part 2. O-3152-1.1 Definition and structure of eREC parameters
ERTMS COMMS	‘Summary of ERTMS communications requirements’, EEIG document number: 97E7377-v7, 31 July 1998
EN 301 515	ETSI EN 301 515 v2.3.0, “Global System for Mobile Communication (GSM); Requirements for GSM operation on railways”, Indexes [37] to [50] inclusive.
ITU-T E.164	‘The international public telecommunication numbering plan’, November 2010
ITU-T Q.731.3	‘Stage 3 description for number identification supplementary services using Signalling System No. 7 : Calling line identification presentation (CLIP)’, March 1993
ITU-T Q.850	‘Usage of cause and location in the Digital Subscriber Signalling System No. 1 and the Signalling System No. 7 ISDN User Part’, May 1998, including Addendum 1 (June 2000) and Amendment 1 (July 2001)
MORANE FFFIS MTI	‘FFFIS for Mobile Terminal interface of the EIRENE Mobile Station’, MORANE F 12 T 7003 2
O-2475 v3.0	‘ERTMS/ GSM-R Quality of Service Test Specification’:2007

<b>Specification</b>	<b>Title</b>
UIC 438-1	'Standard numerical marking of hauled passenger stock', UIC Fiche 438-1, 2nd edition, 1 January 1988, one amendment included.
UIC 438-3	'Identification marking for tractive stock', UIC Fiche 438-3, 1st edition, 1 January 1971, three amendments included.
UIC 558-1	'Remote control and data cable – Standard technical features for the equipping of RIC coaches', UIC Fiche 558, 1 <sup>st</sup> edition, 1 January 1996
UIC 568-3	'Loudspeaker and telephone systems in RIC coaches – Standard technical characteristics', UIC Fiche 568, 3 <sup>rd</sup> edition, 1 January 1996
UIC 651	'Layout of cabs in locomotives, railcars, multiple units and driving trailers', UIC Fiche 651 (1 <sup>st</sup> Edition), January 1986

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