



GSM-R on Track for Success

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GSM-Railway inside European Rail Traffic Management System Project

Today there are more than twenty signaling and speed control systems operating at the same time in Europe =>extra cost and increased breakdown risk and rendering drivers' jobs more complicated as they have to familiarize themselves with each system.

Removing these barriers is fully in line with the Lisbon strategy since it will make it possible to increase the competitiveness and dynamism of the rail sector.

The deployment of the European Rail Traffic Management System (ERTMS) constitutes a major European industrial project just like Galileo in the field of satellite navigation.

Today this system has two basic components:

- GSM-R**, based on standard GSM but using various frequencies specific to rail as well as certain advanced functions. It is the radio system used for exchanging voice and data information between the track and the train;
- ETCS, the European Train Control System**, which makes it possible not only to transmit permitted speed information to the train driver, but also constantly to monitor the driver's compliance with these instructions

GSM-R is a vital component inside the ERTMS which is also an essential element of European Community rail project.



GSM-R Definition and Standardization

The definition and standardization of GSM-R is driven by the railways themselves and involves many organizations and entities. In 1995 the International Union of Railways (UIC) decided to use the GSM standard as a basis for future digital mobile radio standard. Within the scope of the EIRENE (**E**uropean **I**ntegrated **R**ailway **R**adio **E**nhanced **N**etwork) and MORANE (**M**obile **R**adio for Railways **N**etworks in **E**urope) projects, the requirements and specifications of this railroad specific GSM-R standards were developed with focus on interoperability and compatibility. These two projects were performed in close partnership with the ETSI-SMG (Special Mobile Group) resulting in the new **GSM - Rail (or GSM-R) standard**.

A common frequency range is used in all GSM-R networks to achieve international interoperability and spectrum efficiency (876-880 MHz Uplink, 921-925 MHz Downlink).

More and more countries are pushing towards 1800MHz (Australia, Morocco, Israel) – possible, but still some remaining issues on the terminal side (cab radios). So the frequency range is common in the EU but may be different in other countries.



GSM-Railway Services

GSM-R as a technology provides advanced voice services which have been designed and approved by the railways. As part of the managed services offer, we are able to provide a platform that can support the following features:

Standard GSM features such as point-to-point voice and Short Messaging Service (SMS) between in-cab radios, handheld radios inside trains, signalers, controllers, shunting crew, and track-side workers. In addition, the platform can also support supplementary services such as call waiting, call forwarding, etc.

Advanced Speech Call Items (ASCI): Call Pre-emption, Voice Group Calling Service, Voice Broadcast Service

Railway Specific Features: Functional Addressing, Access Matrix, and Location Based Addressing

Railway Applications: Controller-driver communications, Automatic Train Control, Remote Control Emergency, Area Broadcast, Shunting, Trackside Maintenance Communication, Train Support Communication, Local Communication, Wide Area Communication supports track side, Passenger Services Communication



GSM-Railway Network Architecture

The typical network structure of a GSM-R network basically does not differ much from a normal PLMN and its extensions in terms of Network Elements, standardised interfaces and connectivity.

Special requirements of GSM-R networks are deriving from the following demands of applications using GSM-R:

- Seamless communication for high speed lines
- Efficient usage of 5MHz spectrum and a limited number of frequencies
- 95 % Coverage for 95 % of the time in a designated coverage area with a level of above -90 dBm
- Handover success rate of above 99,5 % even between GSM-R networks
- High availability of both transmission path and network equipment dependent on the applications in use
- Coverage inside tunnels / Improved coverage in railway stations and shunting areas and bridges



GSM-Railway Mobile Terminals

For railway operations and services the railways use different types of terminals.

These various types of GSM-R terminals have to fulfill the GSM-R specific functions like ASCI and also need to work in railway specific environment which requires high speed functions, an extended temperature range, shock resistant housing, and specific Man Machine Interfaces.

General Purpose Handheld is based on a 2 Watt standard handheld which covers the whole GSM and GSM-R frequency range and which supports the ASCI features and EIRENE functions. The GPH is used as standard mobile from non-operational staff.

Operational Purpose Handheld is a GSM handheld designed for railway staff working in severe conditions.

Operational Purpose Handheld Shunting is mainly based on the OPH, but is especially designed for the Shunting application and equipped with an additional microphone, different SW and possibility to mount in a cradle.

The **CABRADIO** is mounted on the train. It is the train driver's main communication device and is also used for data transmission



GPRS in a railway environment

A technological breakthrough in GSM is the introduction of General Packet Radio Services (GPRS). With the implementation of GPRS, GSM networks will be extended for packet mode transmission and direct interworking with IP networks. GPRS network elements are built in addition to the existing network infrastructure.

Excluding real-time critical applications, all railway applications based on data transfer could be supported by GSM-R as there are:

- File transfer
- eMail system
- mobile railway intranet
- mobile office
- information broadcast
- vehicle or cargo tracking
- passenger services like on-line booking/reservation



Conclusions

With GSM-R, the European railways have definitely made the right choice. Based on ISDN, GSM is offering a wide range of services and international compatible features.

The vision of UIC to select a system which is far spread in the world market with several possible suppliers and as less as necessary modifications for the railways is already a fact.

The basic functionality of GSM-R is already implemented and has been delivered, tested and validated in the MORANE trials for use in railway networks. About 30 European railways have committed themselves to introducing this technology on their international network. The advantages of GSM-R will convince them that GSM-R is the right system for their complete networks.