

► EDITORIAL



Klaus Konrad
GSM-R Project
Manager.

Dear reader,

This is the first issue of the new UIC Focus on GSM-R.

Welcome to all of you, who are interested in the

progress of GSM-R within the railway community in Europe and outside Europe.

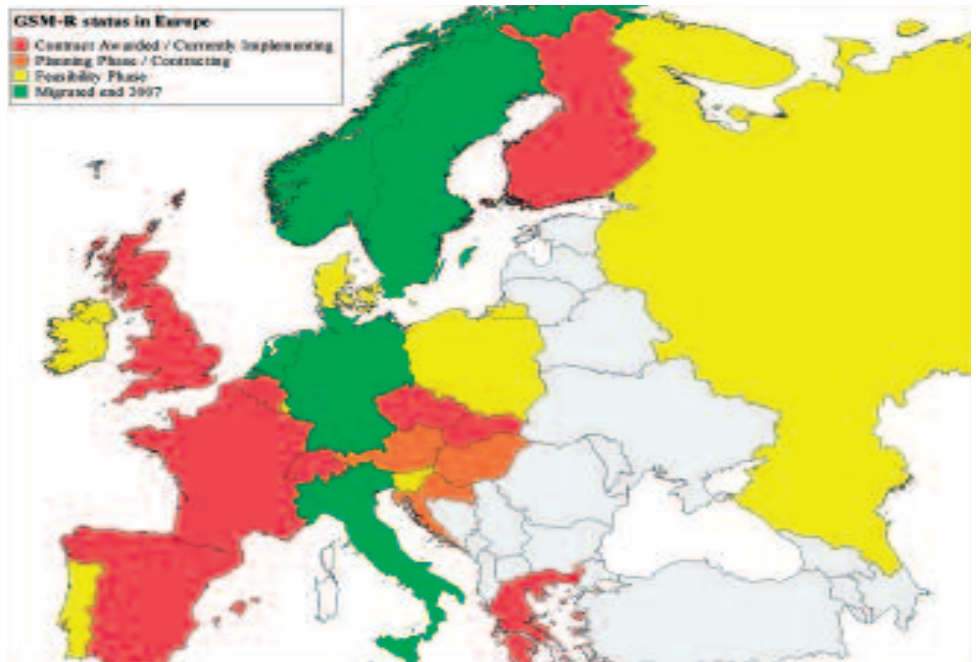
GSM-R is an important part of the ERTMS system and provides the bearer service for ETCS, the new European Train Control System.

In the late 1980's the replacement of the existing railway radio systems by a new digital system was first considered. For a long time investigations took place on whether TETRA or GSM would be the system, which suits better the need of the railways. In 1992 a decision was taken, to use the already growing GSM technology and to develop some additional features to comply with the

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➤ ERTMS/GSM PROJECT IN 2007

Dan Mandoc

With implementation of GSM-R now well underway on Europe's railways, and interest developing beyond its frontiers, the ERTMS/GSM-R project of the UIC has the task of maintaining the GSM-R specifications, developed under the earlier EIRENE project, managing the UIC roll-out plan for the system and handling issues and problems that arise as the work progresses.

The project aims also to be the technical expert group for ERA, CER, and EIM for handling the content of change request to the system. It is also the interface between the UIC and other standardisation organisations, for example ETSI, CENELEC, and JPC Rail.

Through its constituent working groups the ERTMS/GSM-R project brings together existing and future implementers of GSM-R, assisting the former in realising their objectives and keeping the latter - and the railway industry in general - informed of developments, as well as helping the GSM-R Industry to increase the market by making GSM-R a worldwide standard for railways.

There are 2 projects going on in 2007:

1. ERTMS/GSM-R and fixed network-Railway Telecom infrastructure

After the closure of the projects EIRENE and MORANE, the GSM-R activities aim to maintain and update the existing specifications and standardisations of GSM for railways.

The present objective is to monitor new and ongoing implementations, gathering information about gaps and inconsistencies while taking into account upcoming requests for improvement and new requirements, the constraint of a harmonised railway telecom network and the implementation of ETCS level 2.

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railway needs. One important reason for this decision was the need to remain close to the development of the public market and to gain from these experiences on application and product level. Negotiations with the European Frequency Authority CEPT lead then first to a recommendation and a subsequent decision to reserve a specific part of the GSM frequency band only for use of the railways in Europe.

The UIC has then set up a project with the name EIRENE. The aim of this project was, to specify the functional and system specific requirements for a new system called GSM-R.



The EIRENE working groups have created a Functional Requirements Specification (FRS) and a System Requirements Specification (SRS). Both Specifications formed the basis for another project called MORANE, which was set up between the UIC, railways in Italy, France and Germany and the interested GSM industry with financial support from the EU. The principal aim of this project was to prove, that based on the EIRENE specifications and on three pilot-lines, it is possible to set up a GSM-R network, which fulfils the requirements of the railways. Both projects were successfully closed in 2000. In the meantime the UIC had



organised a Memorandum of Understanding (MoU), which was signed by 32 railways in 1997 to state that their future communications strategies would be based on the replacement of their existing analogue systems with GSM-R. This MoU was followed in 2000 by an Agreement on Implementation (AoI), where at least 17 railways confirmed, that they will start their national implementations in 2003 at the latest.

Another group started in 1999, which was composed from the early implementers, which were Sweden, Germany, Italy and Netherlands. Other railways followed quickly. Since this time the ERIG groups meets quarterly per year and the main tasks of this group are:

- implementation reports
- change requests
- problems arising from implementations
- requirements and interpretations of common interest

- discussions on frequency matters
- proposals for a way forward

The new ERTMS/GSM-R Project started in 2000, and is now a important UIC project dealing with the maintenance of the specifications, issues arising from national implementations, preparing the ground for GSM-R in and outside of Europe and defining the next generation towards an IP-based network.

One important work package is to seek additional frequencies to support GSM-R and future technologies, because railway

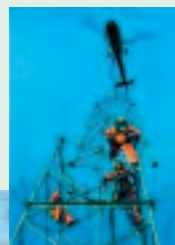
business will grow and telecommunication-needs will increase.

The ERTMS/GSM-R Project is delivering well and the many requests for information and

collaboration from all over the world demonstrate that the GSM-R standard

is well accepted and used. ■

Klaus Konrad
GSM-R Project Manager.



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The major activities for 2007 are:

• **European Radio Implementation Group (ERIG)**

ERIG is the forum where railways, involved in GSM-R implementation share information on progress and discuss associated issues; **ERIG** is also a channel for informing the members about the activities of the other GSM-R working groups as well as about new developments and requirements; there are 4 meetings by year.

• **GSM-R Functional Group (FG)**

FG is a working group that maintains the EIRENE specifications – mainly the FRS- and protects against developments that may jeopardise interoperability, and monitor new requirements. In this respect; **FG** is the first group to discuss implementation reports and is also the interface towards operational matters; there are 4 meetings per year.

• **GSM-R Operators Group (OG)**

OG is focused on maintaining the specifications (SRS) for interoperability based mainly on problem reports from implementers, working on improving harmonisation, ensuring follow up of specifications for optional features and providing the interface to ETSI Group TC-RT and GSM-R IG. There are 4 meetings per year.

• **ETSI Rail Telecom (TC-RT)**

ETSI-RT (TC-RT) follows the need of railways to upgrade of standards, it influences and follows the standardisation work and specifies the necessary change requests to ETSI standards.

• **ERA CCM/CCB**

The activity of this organisation is to evaluate and check change requests to the TSI and TSI related specifications and prepare a proposal for decision in CCB including an economic evaluation and a time plan.

• **Investigation of specific issues arising from actual implementations**

This activity consists of analysing problem



reports from implementers, finding solutions, according to standards for interoperability and presenting them to members together with proposed solutions.

- **Support to new implementation railways**

The activity provides support to new implementing railways, including MoU follow up.

- **Interoperability issues**

Interoperability issues work includes undertaking Interoperability Tests (IOT) follow up and subsequent follow up, Border Crossing, International Roaming, Numbering Scheme and EIRENE networks interconnection.

- **Common railway telecom network**

Integration of Fixed and Mobile Railway Network, preconditions for a future railway IP network.

- **Support to Industry Group**

Close cooperation is maintained with the GSM-R Industry Group; PM, HQ and OG chairman regularly attends their meetings, to give advice on future work, to take notes on actual status.

- **GSM-R Website and Extranet maintenance.**

This activity consists in checking the actual content and continuously update it; of GSM-R website, and Extranet.

2. Advanced GSM-R (A-GSMR), Frequency Management

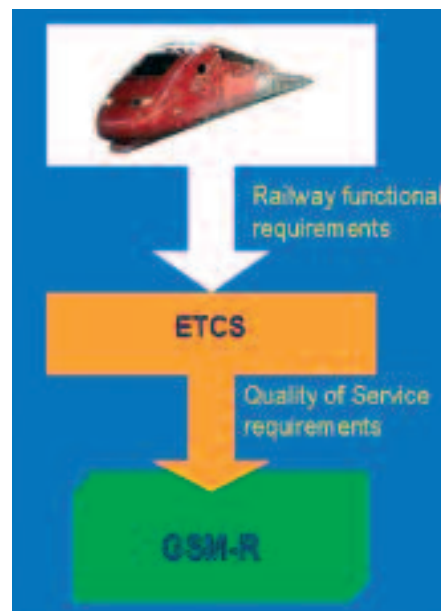
The European Train Control System (ETCS) at Level 2 will replace lineside signalling, and will provide a full automatic train protection including train supervision. In order to achieve these goals, there is a need for a data service, which will help to overcome future restrictions especially in dense area.

Following this line, A-GSMR will assess the readiness of GPRS or other IP-based solutions to be available for ETCS level 2. A-GSMR will also gather and manage the frequency needs for railways, related to all frequencies and the common needs. The A-GSMR will act as an interface between railways and European frequency authorities and as the centre of competence in the field of telecommunication for railways.

The major activities for 2007 will be:

• **GPRS**

This activity is on specifications development, finance or co-finance a GPRS/GSM-R for ETCS Quality of Service (QoS) field test measurement campaign, work plan underway within ERA for finalizing the cost benefit analysis, reaching an efficient solution. The measurement campaign should result in the definition of achievable QoS parameters. If reasonable there should also be a project-proposal in accordance with GSM-R and ETCS Industry to reach the goal of having products and an update of the ETCS application available in 2010 at the latest. Also in order to have the preparations started for future IP-based solutions, studies will be performed: IP addressing scheme, and a pre study for a future railway IP infrastructure.



• **Radio Frequency Group**

Support the campaign for frequency band extension, defend GSM-R spectrum against any interferences and disturbances (e.g. UMTS) and act as an interface between railways and European frequency authorities and as the centre of competence in the field of telecommunication for railways.

• **GSM-R for ETCS,**

This activity consists of observing the current status from implementers, analysing problem reports, presenting them to members, together with proposed solutions, focus on future activities that may influence and defining the way to deliver an IP-based solution for the next generation. Matters like interferences and QoS will be taken into account. ■



ERTMS/GSM-R OPERATORS' GROUP

Robert Sarfati

The **GSM-R Operators Group** is a technical group of Railway industry experts, proposed by members of ERIG and supported by the UIC. The purpose of the Operators' Group is:

- To ensure that the EIRENE System Requirements Specification (E-SRS) is harmonised with the EIRENE Functional Requirements Specification (E-FRS) and new developments in the telecommunications standards in accordance with the requirements of the Interoperability Directive (48/96/EC).
- To maintain and develop the MORANE technical solutions.
- To handle issues raised by national implementation projects.
- To facilitate interworking with the change control process as defined by ERA.

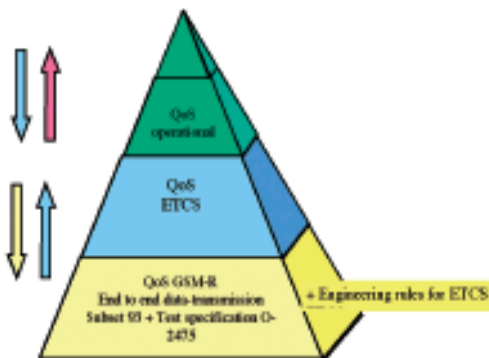
The principal activities of the group are:

- Maintaining specifications for interoperability (system requirements specifications, quality of service requirements, interoperability tests, interface specifications, etc.) based on reports from national implementers, spectrum management issues and wider developments in telecommunications technology and standards.
- Working on improving harmonisation through optional solutions (enhanced Local Dependent Addressing, enhanced Railway Emergency Calls, User to User Signalling field content, etc)
- Ensuring that GSM-R supports the needs of ETCS.

The preparative work is made in ad-hoc groups; in 2006, we had a sum of such activities:

1. Quality of Service (QoS) specifications – ETCS & Voice

This group is responsible for defining GSM-R



QoS parameters, requirements and testing conditions for ETCS and voice aspects. This will be accomplished through the following:

- Finalised test specifications agreed with users and with GSM-R Industry.
- Change requests for the finalisation of Subset 093 and following procedures to be included within the E-FRS and E-SRS.
- All party approval of the change requests and test specifications is ongoing.

2. FFFIS for SIM cards

The objective of this group was to produce an updated FFFIS for SIM cards, v3.0, addressing the identified issues, and for industry to revise this document. The task is now complete.

3. Sub-Group on Interoperability Tests (IOT)

The purpose of this subgroup is to monitor the interoperability tests made between the Nortel and Siemens GSM-R network equipment. The tests have been programmed in four phases, and the group is responsible for accepting the results of Phases 1 – 3 on behalf of the UIC. Phase 3 is in terminal stage. For Phase 4, the UIC acts as an observer.

4. GPRS working group

This group was tasked with assessing the potential use of GPRS as a means of providing communications for ETCS as well as the general applicability of GPRS to the railway environment. It had participation from National Railways, GSM-R Network & Mobile Equipment Suppliers and fully supported by the UIC ERTMS/GSM-R Project. UNISIG representatives attended working group meetings as observers and provided valuable input material and comment. Its key output was the GPRS White Paper, which summarises the results, presents the conclusions and makes recommendations

for the way forward. The GPRS work is now being taken forward within ERA.

5. ETCS data only radio (EDOR)

The objective of the group is to review and specify generic GSM-R mobile radio equipment to support ETCS, based on existing specifications. The work was completed by FG/OG and is under review from the Industry Group.

6. Ad-hoc shunting group

The newly formed ad-hoc group is responsible for liaison with the Functional Group and the Shunting User Group (SHUG) and to ensure completion of the following deliverables:

- Change request to the shunting requirements in the E-FRS
- Change request to the shunting requirements in the E-SRS
- Revision of the FFFIS for Shunting



7. International numbering

The objective of this group is to review and specify a generic scheme for number formats needed for international interconnection. Its key activity is to review the existing numbering requirements in the EIRENE Specifications in the context of international interconnection.

8. Border crossing

The Border Crossing Group is responsible for reviewing and specifying recommendations for Border Crossing from a GSM-R point of view. The first draft of the FFFS for Border Crossing was issued at the end of January 2007. The work continues as the group awaits industry clarification on solutions to reduce the duration of the period



for which the radio is unavailable to make and receive calls during border crossing.

9. Common set of cab radio test cases

The UIC has made a contract with GSM-R Industry to develop a common set of cab



radio test cases based on the existing test cases. This is now ready in draft form and should be finalised soon.

10. Morane document updates

In a significant programme of work, the principal Morane FIS's and FFFIS's were updated in conjunction with GSM-R Industry and uploaded on the UIC's GSM-R web site.

11. eLDA

This group is responsible for specifying the requirements for enhanced Location Dependent Addressing (eLDA) from a functional and system perspective. Implementation of this functionality is optional, but if they do choose to implement it, railways will be required to follow the eLDA specifications.



12. eREC

This group is responsible for specifying the requirements for enhanced Railway Emergency Call (eREC) from a functional and system perspective. Implementation of this functionality is optional, but if they do choose to implement it, railways will be required to follow the eREC specifications. ■

➤ GSM-R FUNCTIONAL GROUP

Kurt Andersen

The GSM-R Functional Group (FG) is a working group which aims to protect the EIRENE specifications – mainly the FRS (Functional Requirements Specification) – against requirements that may jeopardise interoperability and also monitor new requirements from the Railways for inclusion in the FRS.

The FG is a small working group - 6 members - with different backgrounds and from different countries. FG has, with minor changes in its composition, been responsible for drafting the GSM-R (EIRENE) FRS, having the document approved by the UIC and having it included in the CCS TSI for High Speed and Conventional Rail – including the approval of the Article 21 Committee – as the requirements for voice

and data communication for the Railways. FG represents the first stage in the discussion of Implementation Reports and is also the interface to operational matters.

It is not the task of the FG to create new requirements: these are for Railways, Notified Bodies or the Industry Group to raise, through Implementation Reports or Change Requests. These will then be discussed and, if approved, a FRS Change Request will be introduced into the ERA Change Control process. Matters arising from other GSM-R working groups are also studied.

Implementation Reports

Implementation Reports cover issues from implementation of GSM-R networks. There are clear benefits for other Railways and

GSM-R Industry companies in sharing the information/observations.

In some instances the Implementation Reports are requests for additional information or clarification to the Requirements. In other cases it is technical points that need a harmonised solution. Often an Implementation Reports will lead to a Change Request to the FRS. Most of these are for clarification and do not lead to any changes in the technical components and do not therefore have any economic impact. Examples of Implementation reports discussed:

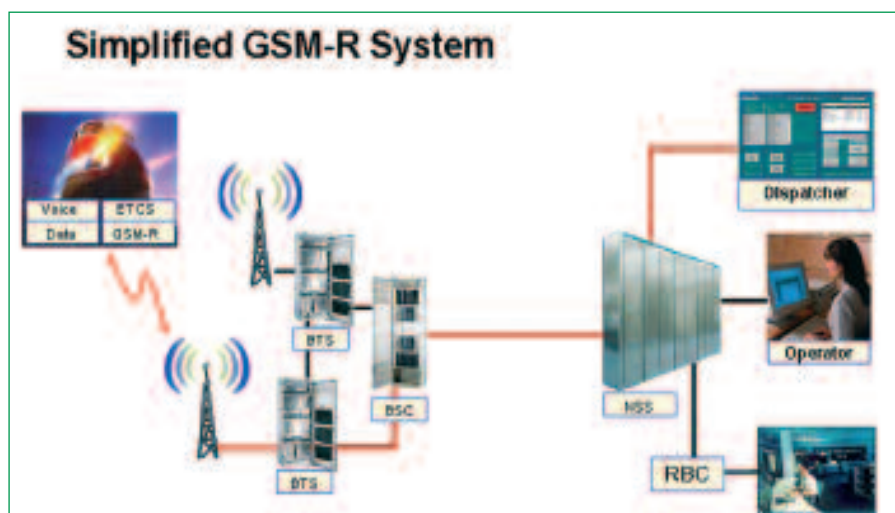
- Call arbitration table
- Increased number of drivers / members in shunting group calls
- Alerting Controller
- Direct Mode implementation
- Communication between the dispatcher and all Cab radios in the area
- Driver Safety Device Alarm Notification

Change Requests

The Shunting requirements have been discussed and modifications to the existing FRS have been proposed and have been included in a Change Request now under final discussion.

Other Change Requests discussed lately:

- GSM-R data-only cab radios (for ETCS)
- Border Crossing
- Group call issues
- Emergency Calls
- Operational Rules
- Simulators and training equipment. ■



➤ CHANGE REQUEST ACTIVITY

Dan Mandoc

GSM-R Change Request Activity

The GSM-R Project, through its constituent groups has a major activity which is the maintenance of EIRENE Functional and System specifications.

At this time, we have the EIRENE FRS v.7, and EIRENE SRS v.15 included in the TSI. The Change Control activity is organised in according to the flowchart:

• Change Request status, 31.12.2006

This report is based on the resolution date for the CRs. There were **108** change requests treated, from 1 of January 2001

• 2005 & 2006:

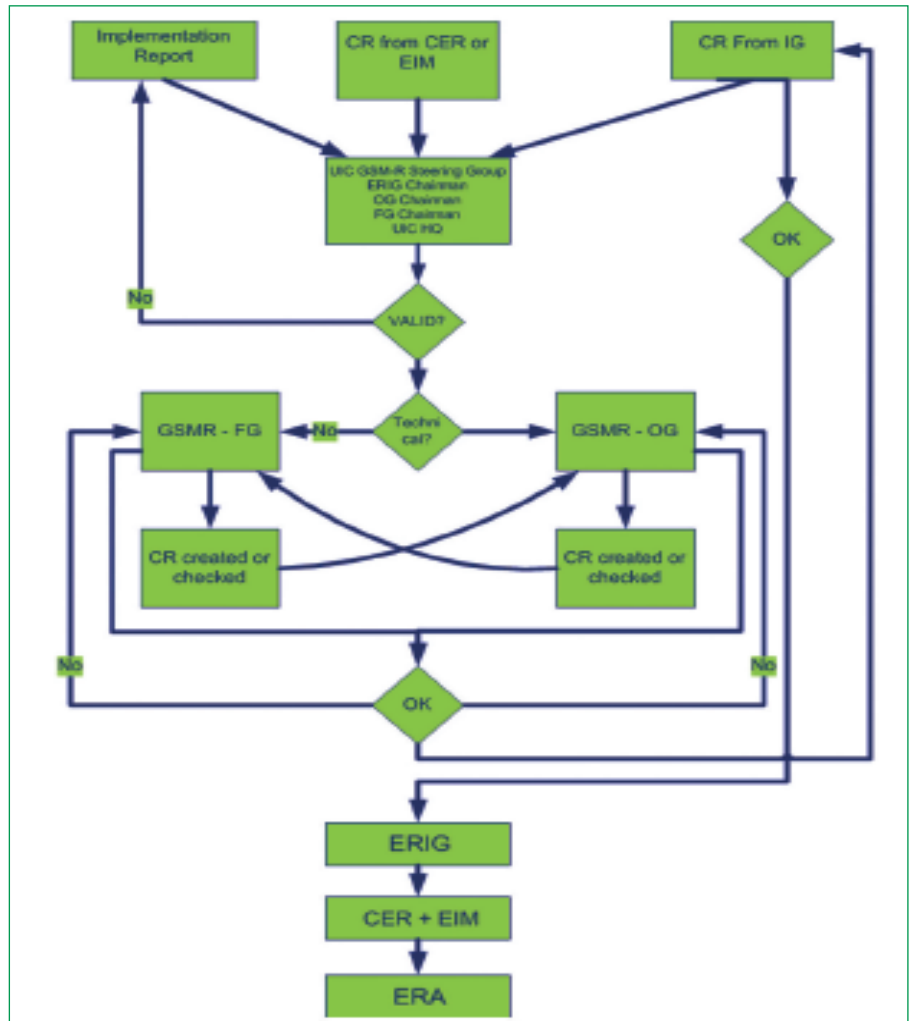
53 change requests were studied; **34** of these CRs are finalised, and are in current versions of the specifications, or in ERA change control procedures; **5** were rejected; **1** is on hold; **3** are accepted by GSM-R FG and they are with the GSM-R OG for acceptance; **10** are accepted by GSM-R FG and OG, and are waiting for IG acceptance;

• Conclusion

The UIC GSM-R Change Request activity is a well organised activity, which aims to maintain the GSM-R specifications, in the interest of interoperability, taking into account the implementation progress and the advance of the technologies.

We are now in a full implementation stage, with most national railway administrations being in an advanced stage of GSM-R network implementation.

2 countries, Sweden and the Netherlands, can now be considered to have fully migrated to GSM-R and have both switched off



their analogue radio networks. The end of 2007 will find Sweden, Germany (First Stage), Italy (Conventional Lines), and Norway migrated, or first stage migrated. Furthermore, most of the other administrations are planning to complete their migration by 2012.

Implementation Reports will continue to be produced in the next few years and will need to be dealt with by the ERTMS/GSM-R project. The continuation of the GSM-R Change Requests Activity is therefore necessary and central to the continued success of GSM-R migration in Europe. ■

➤ GPRS - A NEW BEARER SERVICE FOR ETCS ?

Klaus Konrad

Since the beginning of the ERTMS Project, circuit switched data was the preferred solution for the data transmission foreseen for ETCS. The main reasons for this were the desire for a permanent link between the train and the RBC and the requirement for fast call set-up and high availability of the connection. The UNISIG Specifications for ETCS are currently based on the use of circuit switched data. However, during mid-2005, there were concerns, that in dense areas it might not be possible with the existing GSM-R frequency allocation, to support all of the communica-

tion needs of the railway, (e.g. train-radio, shunting-radio) alongside ETCS.

The UK has undertaken a study which, in dense areas, indicates that serious capacity issues would arise if ETCS were used over circuit switched data.

A similar investigation has been carried out in Germany, where the result was, that in some congested areas there would be a need for up to 10 additional frequencies.

These serious investigations encouraged the UIC to set up a working group dealing with possible solutions to overcome this lack of



resources.

The aim of this working group was:

- to investigate and to quote the possible existing solutions
- to discuss advantages and disadvantages



- to propose a way forward
- to initiate a Change Request to the actual ETCS specification
- to present the results in a workshop
- to eliminate solutions, which are not feasible in the future
- to initiate a new project taking into account the results of the working group

After more than nine months of intensive discussions and investigation, where the possible solutions have been elaborated and checked, there were only a few candidates remaining.

One of them is GPRS, which is already a proven technology within GSM and GSM-R. Studies have shown, that with GPRS most of the problematic locations could be covered, but that ETCS in full swing would need additional frequencies. GPRS with its follow up technologies EDGE, WIMAX and others would allow a technology path for railways to enter into the IP-world. The pre-conditions are already there, because most of the GSM-R networks already include GPRS. GPRS is already used for a number of applications, which are not safety relevant

but already provide experience about the applicability of the technology. UIC, CER and EIM have therefore submitted a change request to ERA, to change the existing ETCS specification to allow IP-based solutions alongside the circuit switched data. The first one would then be GPRS. In the near future, the UIC will start a measurement campaign in two GSM-R networks to see whether the QoS parameters required by ETCS can be met with GPRS. Alternatively, this exercise will determine whether another IP-based technology, would be a better solution. ■

➔ SHUNTING WITH GSM-R

Klaus Konrad

Shunting with GSM-R, a dream, or becoming reality?

Since beginning of the railway world, shunting has always been a difficult and dangerous subject. A lot of different rules and regulations and also methods have been implemented to make shunting useable. Nevertheless there was never any idea to harmonize shunting.

Therefore the status today is, 20 railways, twenty different procedures for shunting. With GSM-R, everything should change, also shunting.

The EIRENE FRS and SRS describe the requirements for shunting, that have to be implemented in cab-radios as mandatory, and functions, that shall be available in the network, if shunting is transferred into GSM-R.

Shunting as an application is not mandatory for interoperability, but cab-radios have to have the shunting application as a mandatory feature.

When creating the EIRENE documents FRS and SRS the authors have tried, to find a compromise between the different existing shunting methods, but also to integrate additional features to make shunting more safe and viable.

Some of these additional features were LAS (link-assurance-signal) and protected group-calls, as well as a shunting emergency call.

Features are important, but the most important part is the shunting radio device,



which should be robust and easy to use and also being able to work under extreme environmental conditions. These vital requirements were one of the important obstacles to have shunting already widely in use within the railways. The OPS (operational handheld for shunting), which was derived from a normal OPH (operational handheld) was tested in the field and did not completely cover the needs of the users. Therefore only partial field-tests could be carried out. These field-tests have shown, that the application as such is accepted, but some modifications have to be implemented.

This was the reason, why a smaller adHoc working group, formed by shunting experts from several railways have created a modified document, which describes the functional requirements for a new OPS and also some additional shunting requirements as the result of the field-tests. Aim of this document is mainly to convince the GSM-R mobile suppliers, that the development of a

new OPS shall cover the needs of the users. In the meantime the adHoc-group had worked together with the EIRENE FG to raise a Change request to the EIRENE FRS. Result of this CR will also be an update of the SRS and of the FFFIS for shunting. This work will be finalized shortly and the relevant CR's will then be addressed via CER and EIM into the ERA Change control process.

Finally these CR's will be incorporated into new releases of the EIRENE FRS and SRS after approval in ERA.

This process is now necessary to have new products for shunting available, when the application is implemented widely in Europe.

Beside this update the UIC is also in close contact with railways outside Europe to take also their requirements related to shunting into account. A first requirements document is at moment under review by FG. Further discussions will follow. ■

➔ GSM-R FREQUENCY MATTERS

Klaus Konrad

Frequencies are part of the most valuable products within telecommunication business. This is also valid for the railways. Railways have since long time a permanently growing need for mobile communication. This started very early with the first shunting communications to allow a more fluent shunting operation.

In the early seventies of the last century train radio was introduced and implemented to allow having communication from and to the trains and to open the way to send and receive railway emergency calls. This was also the starting point to look for harmonized frequencies in railway environment.



A number of frequencies are therefore negotiated and gathered with the help of the UIC. One of the most important ones is the frequency allocated to analogue train radio, which is widely used within the railways. A big portion of the 0,7 meter band is allocated to the railways and frequently used.

Examples for other frequencies are those for remote control of shunting engines, balise-frequencies, local-channels, maintenance-

radios and an endless number of others.

UIC has in the past gathered the requests from the railways and negotiated with the European frequency authority CEPT.

One of the last projects, which lead at the end to a great success was to negotiate the frequency allocation for GSM-R, the new digital bearer service for mobile railway telecommunication. The negotiations have taken more than 5 years and have lead at the beginning to a recommendation from CEPT to the national frequency regulators to make this bandwidth free for railway use only.

This recommendation was then later on converted in to a decision to have these frequencies free in 2005 at the latest.

As GSM-R is now on a good way to be implemented all over Europe the railways and also the UIC are now in a position to see if this relatively small portion of the GSM-band allocated to the railways is sufficient for the future, to allow continuously evolving traffic to be handled. This bearing in mind those also safety-critical applications have to use GSM-R.

First investigations in some railways have lead to the transparent result that in the foreseeable future there will be a need to have more frequencies and to allocate them to the railways. First negotiations have already started with national frequency authorities and also with CEPT. Preferable frequencies would be within the GSM-band, because the mobile equipment is capable to

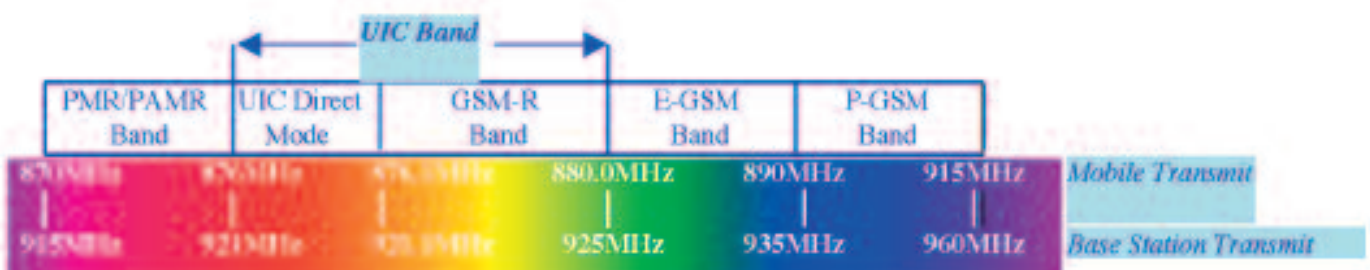


work there without any change. There is also a possibility to have a look on the TETRA -band, which would allow, to move the filter within the BTS and BSC into this area without changing the whole hardware. Mobile equipment would be capable to work there also.

All these activities have started, because it is clear, that these negotiations and actions will take a lot of time.

Beside these activities we also have to make sure, that GSM-R is protected against a new enemy, which is GSM in air-planes. The impact from this new regulation and possible interferences have also to be taken into account.

As a result it can be stated, that the railways as one of the most important traffic partners will need more and more frequencies and that the allocation of these frequencies to railways will never be an easy task. Therefore the UIC as a representative of the railways is in charge, to undertake all efforts to make this possible. ■



PRO RAIL EXPERIENCE

Chiel Spaans

Netherlands has switched-off the Telerail on 2nd of January 2007

• History

In 1998 ProRail, responsible for the railway infrastructure in the Netherlands, decided to start the tendering process for a GSM-R network, covering all the 2800 km of tracks. A feasibility study had showed that the end of life of the analogue UIC radio system was expected around 2004 and the introduction of ETCS on some lines was planned.

In 2000 MobiRail, a joint venture of Siemens and KPN, started to build the network. Mid 2003 the radio network was ready for use.

• As an important milestone, on January 2nd 2007: Telerail (the analogue radio system) was switched off, and started art of dismantling.

The GSM-R network consists of 1 MSC, 7 BSC's and about 320 BTS. The fixed network part of GSM-R is a mixture of leased 2Mb lines and microwaves for redundancy purposes. All more or less standard elements were included, like VRRE (voice logging), AckCentre (for data logging of emer-



Overview of the migration

- 2001 - 2003: squash of nationwide GSM-R network
- 2003 - 2004: connecting GSM-R and Telerail to upgraded dispatcher systems
- August 2004: approval from Safety regulator to use GSM-R and Telerail in parallel
- Sept 2004: first train on GSM-R network
- Dec 2006: last train on Telerail network
- January 2007: Telerail off-line and start of dismantling.

gency calls), IN, etcetera. Also GPRS (packet switched data) was installed from the beginning.

The network is monitored by a Network Control Centre, located in the neighbourhood of Rotterdam.

Between 2004 and 2006 two important extensions of the GSM-R network has been realised for the new High Speed Line between Amsterdam and Brussels and for the Betuweline, the cargo line from the Rotterdam harbour to the German border. This brings the total coverage to over 3000 km.

The ProRail GSM-R network is directly connected to the public telecom networks and national roaming with one public GSM provider is possible. Interconnection and roaming with the German and Belgian GSM-R networks is fully operational. In 2007 also roaming for French and Swiss GSM-R users is planned.

• Applications

One of the main applications of GSM-R in the Netherlands is the railway safety voice communication between train driver and traffic control. This application went into operation mid 2004. After a migration period of 2,5 years, in which the analogue network and GSM-R were working in parallel, all 2500 train cabins in the Netherlands are equipped now with GSM-R radio's, as well as all foreign trains crossing the borders.

End 2006 the analogue network was switched off, giving the Netherlands the status of being the first full GSM-R country in the world.

The dispatcher systems are in fact an upgraded version of the existing telephone arbitration system, installed on all 13 traffic control centres. These systems got facilities for train number based calling, group communication and a priority mechanism for railway emergency calls.

Although Cell dependent routing is configured for calls from driver to controller, a more refined Location Dependent Addressing mechanism is realised by using train position information from the signalling system. All relevant train movements are sent to the IN system, responsible for call routing.

The other main application of GSM-R is



Technical Data:

Installed BTS	320
Installed MSC	1
Installed BSC	7
Total Network (Km)	2800
Network constructed	2800
Network ready for service	2800
Network in operation	2800
Installed cab radio	2500
Start of Implementation	2000
Ready for Operation	Q3 2004
End of Migration	Q1 2007
Mobile subscribers	6000

ETCS on the High Speed Line and the Betuweline. Both lines are equipped with ETCS level 2. At the moment extensive testing is ongoing, not only the GSM-R network and ETCS infrastructure, but also train equipment. Because of the fact that the Betuweline is part of the TEN freight corridor A, open access is a key to success. This implies that a lot of locomotive manufacturers and the ETCS industry are using the Betuweline for testing their interoperable solutions. The experiences will be used all over Europe.

The third railways specific application, shunting communication, is not operational yet in the Netherlands. After some pilots, ProRail decided to delay the introduction of shunting communication and to wait for the next generation of the GSM-R shunting application. As soon mobiles and network facilities are upgraded, the migration of shunting communication will be facilitated. Other voice applications, like (group) communication for trackside workers, are introduced

on a small scale. The expectation is that within a few years all trackside communication will be facilitated by GSM-R.

Besides these more common applications, a lot of national or even local applications are operational in the Netherlands. A very interesting one is the use of GSM-R for information and emergency phones for passengers on the platforms. Over 600 robust "two button devices" are installed, giving the possibility to have direct answers on questions about time table, delays or call for help.

Monitoring the status of a lot of railway infrastructure elements is essential for a high availability of the railway system. ProRail has installed a lot of monitoring systems for switch heating, power supplies at level crossings, etcetera. These local telemetry signals are transported to the

central computers via GSM-R modems. A mixture of circuit switched (call based) and GPRS modems are used. At the moment some hundreds of modems are operational and the amount is increasing every week. The advantage of GSM-R for on-site infrastructure monitoring is the fact that it is easy to install, no fixed lines are needed (so installation is cheaper than wired systems) and it is independent of the public networks.

Because of the fact that in the Netherlands five public GSM operators gives a very good coverage in trains, the need for using GSM-R for standard communication facilities (staff, train personnel) is relatively low. Only a hundred of mobiles are used for these purposes. ProRail does not expect any change in this situation, but GSM-R was not intended to compete with public GSM.

After a couple of years experience with



GSM-R the conclusion is that the GSM-R technology is a mature standard, very robust and reliable. The overall availability of the network is over 99.95%, on ETCS lines even higher. For the users a variety of cab radio's, handhelds, and modems is available. The GSM-R era has begun. ■

➔ RFI EXPERIENCE

Carlo Caputo

Ferrovie dello Stato GSM-R Infrastructure and Services

RFI - Rete Ferroviaria Italiana (Company of Ferrovie dello Stato corporation entitled for the rail infrastructure) is the owner of the GSM-R service provider license. RFI is currently caring out the installation and deployment of a mobile network infrastructure purposely for railway service, which will be integrated with new functionalities exclusively developed for railway software applications.

The actual status of GSM-R project deployment

• On The Conventional Lines:

Roll Out: GSM-R Network + Improvement of SDH Transport Network + Operation and Maintenance.

7500 Km (Main Routes) were finalised.

• On the High Speed Lines:

Roll Out: Line by Line (Construction and new lines).

Roma - Naples: Dec. 2005

- Total line length: 204,6 km

- 186 km in commercial Operation

- 18 km towards Naples under construction.

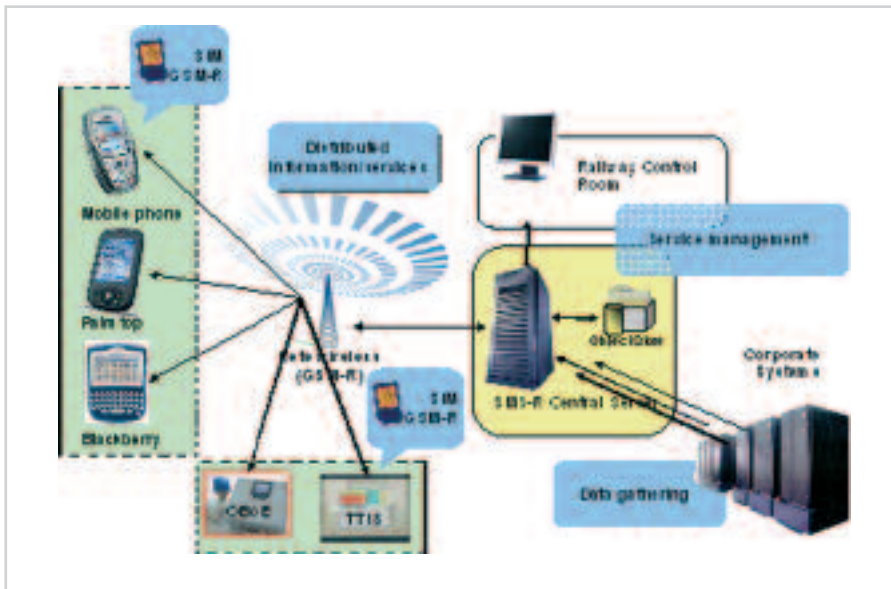
Turin-Milan : Feb. 2006 between Turin and Novara

- Total line length: 125 km

- 85 km in operation

- 40 km toward Milan: under construction.





Milan-Bologna: 2008
Line length: 182 km.

Bologna-Florence: 2009
Line Length: 78,5 km-including 73,3 km in tunnels.

Milan-Verona: 2013 final design approved.

Verona-Venice: Verona-Padua: 2013 preliminary design approved.

Milan-Genoa: 2013 final design approved.

Naples-Bari: under study.

RFI roll out plan for primary network radio tunnel coverage taking into decision the coverage for the railway tunnels with length more than 250 meters is now completed, covering a distance of 855 Km of railway distance. As for the secondary network, the coverage is estimated to be completed in 2009;

As key points for GSM-R network summary report:

- GSM-R coverage on primary FS railway network;



- National roaming on GSM Public operator for secondary FS railway network;
- Close integration between GSM-R coverage and radio extension on tunnels;
- Increasing of transmission network capability;
- Close integration between fixed phone network and GSM-R.

Onboard applications of such technologies facilitate crew communications and tasks and also support different services for passengers. In order to reduce costs and gain competitive advantages, **Trenitalia** (company of **Ferrovie dello Stato corporation** entitled for railway transport service) and RFI are cooperating in developing hardware infrastructure, applications and web services that enable operational information to be accessed.

In the following lines, there is a brief description of **Trenitalia** and **RFI** current mobile services and potential enhancements proposed for future implementations.

GSM-R Services

The joint effort of **Trenitalia** and **RFI** has developed a basic architecture - the NB3 Platform that defines the technological

solution and the service infrastructure. It provides the technical framework for all future service developments and is the key enabler to FS service vision, networks and systems.

SMS-R

The SMS-R system is a SMS gateway connecting two networks: the Trenitalia intranet (supporting the pool of business applications) and the GSM-R provider network. It offers a simple and low-cost interface that allows the current and future IT systems to have high-level functionalities for dispatching and receiving SMS messages.

The current SMS-R average traffic is more than 40.000 SMS messages a day.

SMS-R application supports several B2B (and eventually B2C) mainly services in the following areas:

- Traffic Control Rooms
- Information for public
- Onboard applications

Infotren/OBoE

“**Infotren/OBoE**” solution is primarily used is to supply dynamic audio and video information to passengers onboard; it is based on the collection of all information about schedules and operating conditions of running trains (train localization, diagnostics of onboard systems, train composition, comparison between theoretical and real time schedules, traffic monitoring, etc.).

The hardware component (OBoE: **On Board Equipment**) is a computer installed on the train (but it could be fitted for any type of vehicle) equipped with a local memory storage, a GPS receiver and a communication device for connecting to ground systems via GSM/GPRS mobile network. Basically communication is used to receive and process commands, send data and real-time onboard voice announcements. The OBoE main activity is use data received from the ground system (Infotren) in order to manage public information and other onboard services throughout audio and video train system, wireless communication, power line communication, etc.

OBoE receives commands, mp3 audio files and other data when connected (push/pull) to the Infotren ground system through the mobile network. In specific waypoint, during the train course, the OBoE could data about delays or diagnostics to Infotren via SMS messages managed by the SMS-R infrastructure. Such information is particularly

useful for central traffic monitoring. The **Infotren/OBoE** solution generates mobile traffic of about **15.000 SMS** messages a day, managed by the SMS-R.

REM/Mosè

The **REM (Railway Event Manager)** solution is a message broker that manages information about railway traffic, acquired from various sources and distributed to recipient applications with publishes-subscribe methodology. This system is intended to supervise the entire process of information handling for an efficient monitoring and coordination of the transportation service supplied.

Profiled operators use a web console (**MOSE: Monitor Online Signalling Events**) to monitor traffic data and events. Real-time updated data can be

accessed at any time through specific searching options: from an initial traffic list, it is possible to display details of a single train and associated information.

Several warnings/alarms about delays and other traffic conditions can be set and controlled on the console, and there are functionalities that enable operators to format and send SMS messages about those events to specific distribution lists (e.g. control room Directors, operation Managers, Top Management...).

The MOSE' alert system generates about 2.000 SMS messages in a single day (up to 6.000 when critical traffic conditions or other events occur).

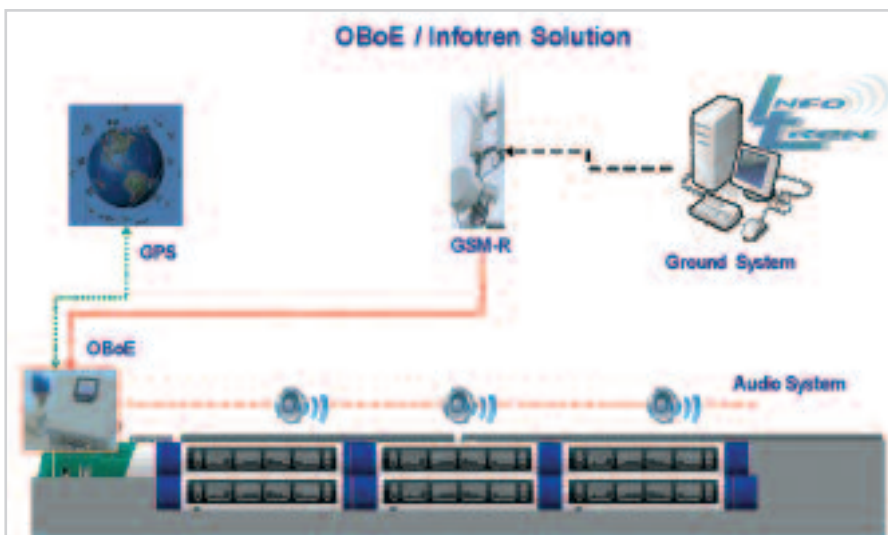


TT18 **Trenitalia** has installed about **1.600 TT18** devices in unattended railway stations. Basically they are LCD monitor controlled by a simple industrial computer with custom firmware and operating system. Such monitors convey railway transport information for public inside stations. Most of traffic information is related with real-time railway traffic, acquired remotely from ground services/applications.

Most of the unattended stations are not connected to Trenitalia geographic intranet so many TT18 are connected to the mobile network and are controlled through data-package (GPRS) sent from a central administration application.

• Pocket PC Applications

Currently there are a number of FS applications for handhelds devices, that support the work of Trenitalia and RFI personnel using the mobile infrastructure for voice call and data transfer. All onboard workers (about 10.000) have a GSM-R mobile phone or pocket PC and can interact with SMS-R service or mobile service on the company's intranet, basically to retrieve data about railway traffic, operational activities such as ticketing and OBoE settings, and to send data, alarms, messages to ground systems. ■



➔ THE GSM-R TEAM

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