NetworkRail

Guide to the GSM-R System

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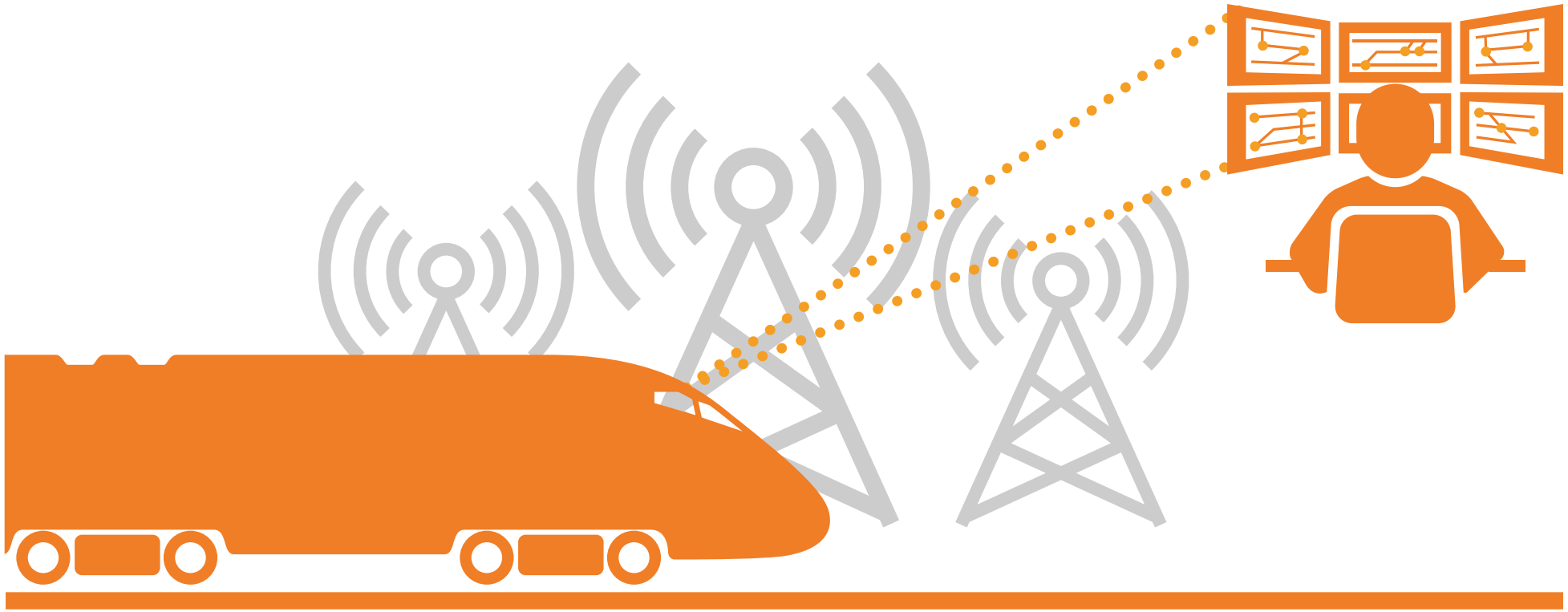
Contents

What it is

What is the GSM-R System?

Encompassing the combined resources of technology, processes and people, the GSM-R System delivers secure and reliable driver-signaller communications.

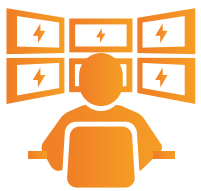
Improving safety, performance and passenger experience, it also provides the foundation for building a modern, sustainable, digitally-enabled railway network with increased capacity and lower running costs.



The GSM-R System

Route control manager's fixed terminal

Signaller's fixed terminal



Electrical control operator's fixed terminal

Mobile switching centre

Base station controller

GSM-R mobile technology

In-cab radio

The GSM-R System

In-cab radio

GSM-R mobile technology

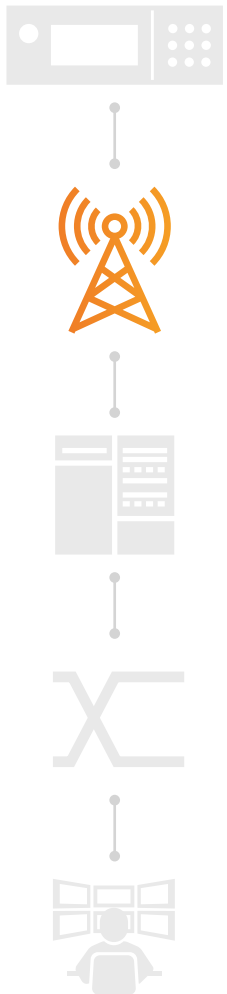
Base station controller (BSC)

Mobile switching centre (MSC)

Fixed terminal

Provided in each driving cab for use by competent members of the train crew who are authorised (such as drivers), this enables the driver and signaller to communicate with each other.

The GSM-R System



In-cab radio

GSM-R mobile technology

Base station controller (BSC)

Mobile switching centre (MSC)

Fixed terminal

There is a network of radio base stations at the side of the track at regular intervals. These provide radio coverage for the in-cab radio and people using the GSM-R System. This coverage includes tunnels, cuttings and station areas.

The GSM-R System

In-cab radio

GSM-R mobile technology

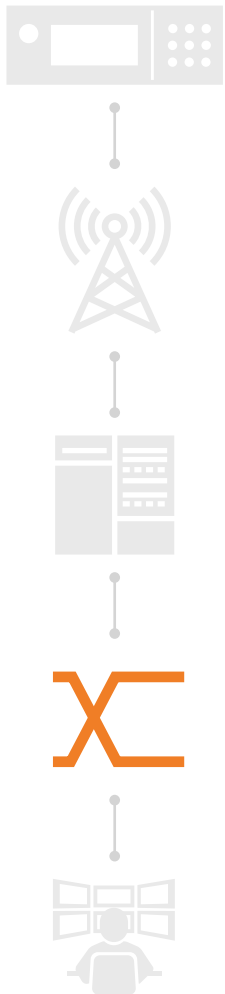
Base station controller (BSC)

Mobile switching centre (MSC)

Fixed terminal

This is a network element that controls and monitors a number of base stations while also providing the interface between the cell sites and the mobile switching centre.

The GSM-R System



In-cab radio

GSM-R mobile technology

Base station controller (BSC)

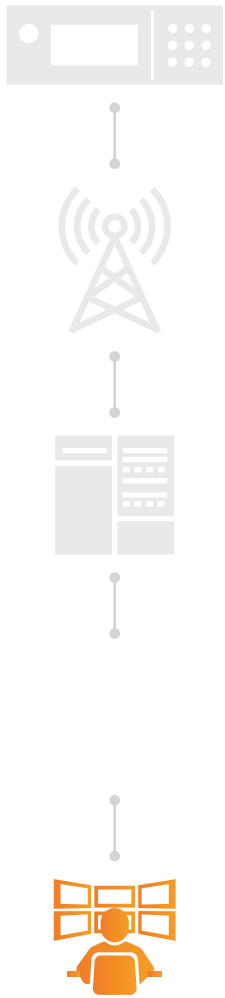
Mobile switching centre (MSC)

Fixed terminal

This central call-routing switch links together and connects to the base stations. The MSC confirms that users are authorised to use the system, connects calls between system users, and provides access to other networks if allowed.

It also receives information from other systems (such as the signalling system in areas where this is available), providing an accurate source of train location information that the MSC uses to route calls to the appropriate signaller/controller.

The GSM-R System



In-cab radio

GSM-R mobile technology

Base station controller (BSC)

Mobile switching centre (MSC)

Fixed terminal

Connected to the mobile switching centre (MSC) via our fixed telecommunications network (FTN), this allows calls and predefined text messaging between the operator and the in-cab radio.

Featuring a handset, PTT button, loudspeaker and display, it also gives the operator a list of all the users registered in each signaller's area of control.

Route control manager's fixed terminal

Signaller's fixed terminal

Electrical control operator's fixed terminal

What processes does the GSM-R System support?

Registration

Driver enters journey details into in-cab radio, enabling GSM-R System to track train's position, and displays head code to the signaller.

Operational messages

Driver can send signaller a standard message ('standing at signal') while signaller can send driver a 'contact signaller' message.

Call signaller

Driver can make a standard priority point to point call to the lead signaller for the train position.

Caution Acknowledge

Signaller can record a warning message to drivers about a trackside hazard. Each train reaching a particular signal section will receive the broadcast message and can acknowledge receipt and understanding by pressing a button on the in-cab radio (without having to stop and talk to the signaller).

Urgent call

Driver can make a point to point call to the signaller which takes priority over any existing but lower priority call currently in progress. Used when there is an immediate risk to one train.

Railway Emergency Call (REC)

Driver can make a high priority call to the lead signaller in the event of a grave and immediate risk of a safety incident involving a number of trains – call is also broadcast to adjacent signallers, Route control and all trains in a pre-defined area.

?

Why it's needed

Why was it introduced?

- Improve safety
- Reduce operating costs
- Move away from analogue
- More rigorous standards

As well as fulfilling the safety recommendations from major incident enquiries, the GSM-R System ensures direct driver-signaller communications at all times, even in areas – such as tunnels and deep cuttings – where this had not previously been possible.

Why was it introduced?

- Improve safety
- Reduce operating costs
- Move away from analogue
- More rigorous standards

By replacing the patchwork of increasingly inefficient and expensive legacy systems, the GSM-R System reduces ongoing maintenance costs while improving reliability and delivering the foundation for building a digitally-enabled railway network.

Why was it introduced?

- Improve safety
- Reduce operating costs
- **Move away from analogue**
- More rigorous standards

Previous driver-signaller communications relied on analogue radio networks – such as National Radio Network (NRN) – which had limited functionality and had become increasingly expensive to maintain and ever more unsustainable.

Why was it introduced?

Improve safety

Reduce operating costs

Move away from analogue

More rigorous standards

The requirement to comply with the European common standard for interoperability of digital data and voice communications in railway applications, plus Ofcom regulations for the withdrawal of NRN frequencies, were direct drivers for the introduction of the GSM-R System.

Benefits

Benefits at-a-glance

Increased safety

Improved performance

Digital future

Enhanced passenger experience

Increased safety

Increased safety

GSM-R

Railway Emergency Call (REC)

Driver can notify signaller and nearby drivers immediately of observed risks (e.g. obstructions), ensuring faster and more effective response.

Reduced maintenance

Because the system is remotely managed, communications can be more easily restored – reducing the need for maintenance teams to be trackside.

In-cab radio

Enables driver to communicate with signaller without having to step off the train in the event of a problem, reducing risk.

Improved performance

Reduced delay time

Caution Acknowledge feature enables reduction in train delays caused by, for example, poor rail adhesion – a 30% reduction in delay is forecast.

Improved performance

Improved diagnostics

When delays do occur, the system enables better understanding of the causes, which leads to remedial action that ensures incidents are not repeated.

Greater coverage

Radio coverage across Britain's network, including tunnels and cuttings, enables potential delay-causing problems to be pinpointed and addressed faster.

Digital future

Digital railway

The system's new telecoms infrastructure provides the foundation for a modern, digitally-enabled railway network with increased stakeholder value.

Reduced operating costs

By replacing a patchwork of legacy systems – including analogue radio networks – the system has reduced ongoing maintenance costs.

Foundation for ERTMS

The system's Mobile and Fixed Telecoms Networks will support the European Rail Traffic Management System, which will replace traditional railway signals.

Digital future

Enhanced passenger experience

Better communication

Driver can communicate instantly with the signaller, which ultimately enables passengers to receive more accurate information more speedily.

Up-to-date information

Driver can keep passengers better informed in the event of delays, reducing frustration and risks of passengers attempting to disembark.

Enhanced passenger experience

Where we are now

The journey so far

- System phased into service across Britain's GSM-R radio network by the FTN GSM-R programme between 2007 and 2014
- Implementation has included the renewal of the entire line side Fixed Telecoms Network (FTN)
- Responsibility transferred to Network Rail Telecom in June 2014
- Now operational across 100% of Britain's GSM-R network
- Future enhancements include a software upgrade supporting the roll-out of ERTMS (European Rail Traffic Management System)

The GSM-R System in numbers

30%
forecast reduction in delays

4,056
connected trains

15,000km+
Over 15,000km of railway lines covered

£1,860,000,000
£1.86 billion investment

21,200
drivers and signallers trained

100%
radio coverage across the GSM-R network

2
switching centres

900
signaller terminals

2,500
GSM-R telecoms masts

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Project Artemis

Introducing Project Artemis

- Project Artemis is a performance improvement programme focused on reducing train delay incidents attributed to the GSM-R System
- Initial roll-out of the GSM-R System had led to a number of issues that adversely impacted operational performance
- The formation of Project Artemis was one of a number of initiatives that were launched in response to these issues – another being an upgrade of the in-cab radio software

Who is involved in Project Artemis?

Includes stakeholders from across all of Britain's rail industry

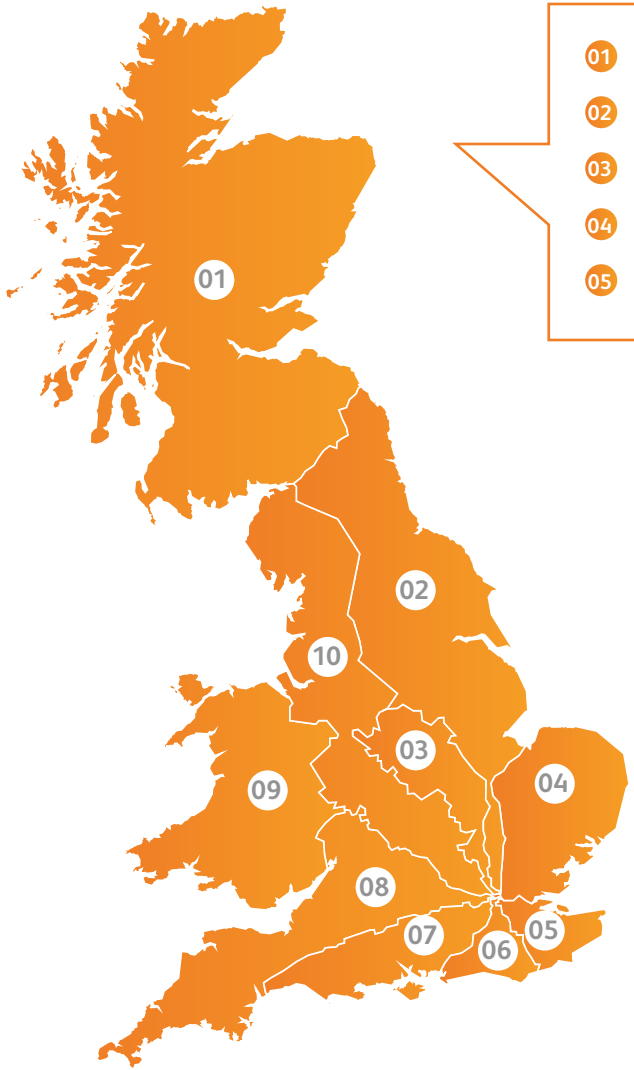
Cross-functional

- Asset Management
- Design
- Network Operations
- Project Delivery
- Performance
- Communications
- Delay Attribution

Multidisciplined

- Network Rail Operations
- Train Operators
- Freight Operators
- ATOC
- RSSB
- Route Maintenance

The Project Artemis team



01 Scotland
02 London North Eastern
03 East Midlands
04 Anglia
05 Kent
06 Sussex
07 Wessex
08 Western
09 Wales
10 London North Western

NRT (Route)

- Customer Service
- Asset
- Performance Relationship

Network Rail Route

- Route Asset
- Route Communications Engineering
- Local Operations

TOC/FOC

- Cab Fitment Project
- Operations
- Driver Standards
- Fleet Maintenance

Our approach for success

Delivering actionable results

Real-life understanding

Collaboration

Supporting ‘business as usual’

Continuous improvement

Reduced train delay incidents

Our approach for success

Delivering actionable results + Real-life understanding + Collaboration + Supporting ‘business as usual’ + Continuous improvement = Reduced train delay incidents

To understand what’s actually going wrong, data has to be extracted from a large number of different systems. Each system provides a different piece of the puzzle. Our skilled analysts combine and interpret this data, piecing the puzzle together to deliver actionable insights which can drive real performance improvements.

Our approach for success

Delivering actionable results + Real-life understanding + Collaboration + Supporting ‘business as usual’ + Continuous improvement = Reduced train delay incidents

The causes of a delay incident are often complex, involving a chain of causes and effects that are not just technical. We make a broad evaluation of each incident – including real-life system and user behaviour to understand the interactions between software, hardware and users – ensuring the underlying causes can be identified.

Our approach for success

Delivering actionable results + Real-life understanding + **Collaboration** + Supporting 'business as usual' + Continuous improvement = Reduced train delay incidents

With many current issues caused by the interaction between people, technology and processes, achieving success means working collaboratively with Routes and Operators – bringing together their local knowledge and expertise with our technical analysis and system understanding to jointly drive performance improvements.

Our approach for success

Delivering actionable results + Real-life understanding + Collaboration + Supporting ‘business as usual’ + Continuous improvement = Reduced train delay incidents

Project Artemis is not intended to take over responsibility for existing ‘business as usual’ processes. The team will identify issues and make recommendations about how to fix them, and the existing operational teams will then carry out the fixes.

Our approach for success

Delivering actionable results + Real-life understanding + Collaboration + Supporting 'business as usual' + Continuous improvement = Reduced train delay incidents

We operate in a constantly changing environment, so Project Artemis is designed to be agile and responsive, able to react quickly to new issues and changing circumstances in order to deliver sustainable, continuous improvement. There are few quick fixes – successfully addressing the issues requires sustained effort and constant management.

Our approach for success

Delivering actionable results + Real-life understanding + Collaboration + Supporting 'business as usual' + Continuous improvement = Reduced train delay incidents

Performance improvement programme focused on reducing GSM-R System attributed train delays.

What Project Artemis is not

- Project Artemis is not intended to replace the people, processes or responsibilities that will be expected to manage this in the BAU state
- While we are looking at all delay incidents attributed to the GSM-R Systems to identify root causes, we are not taking ownership of Network Rail Route, TOC/FOC responsibilities – we are here to help them to help themselves
- We are not here to enhance the network
- We are not here to provide desired/added features
- We are not here to pick up on other past or present project responsibilities

Case Study: Northern Rail leads the way in improving the GSM-R System

Challenge: Lack of visibility of signals at platforms

Quite often, due to the varying length of trains, drivers can't see the relevant signal and have been either relying on pocket reminders, memory or using the wildcard to register the GSM-R in-cab radios.

Solution: New repeater signals

Northern Rail has made good progress in supporting drivers with the GSM-R radio registration process through the tactical placement of small blue and white signs on platforms, which means the signal number will now be much easier for drivers to read. These repeater signs have been implemented successfully at Carlisle, Sheffield, Hull and Bradford Interchange so far.

Lesson learnt: Importance of cooperation

Northern Rail have been able to effectively prioritise the implementation of these new signs where they are most needed, thanks to feedback directly from drivers. Northern Rail has communicated the initiative on their employee Facebook page and are encouraging feedback via Driver Training Managers, meaning that everyone is working together for a better GSM-R System.

Collaboration is key. Everyone has a role to play in continuing to improve the GSM-R System.

Case Study: Merseyrail GSM-R registration problems at New Brighton station

Challenge: GSM-R registrations failing due to multiple symptoms

The initial introduction of GSM-R in Merseyside highlighted an urgent requirement to identify and resolve the fundamental reason for frequent GSM-R related train delays at New Brighton station. GSM-R registrations were failing due to: in-cab radios attaching to a wrong cell, driver initiated GSM-R registration attempts occurring before the requisite signaller initiated TD interpose and in-cab radios were locking up.

Solution: Driver and signaller briefs GSM-R network optimisation

Collaboration between Merseyrail, Network Rail Operations and NRT resolved GSM-R registration rejections through: a reduction of transmitted radio power by two interfering Public Mobile Network Operators, physical changes being made to the serving GSM-R mast antenna orientation, software configurable parameters being modified and signaller and driver briefings on GSM-R registration and implementation of Bulletin 21.

Lesson learnt: Collaboration, teamwork and creation of a new GSM-R Bulletin

Empowering Merseyrail to take the lead on this cross industry collaboration to improve GSM-R performance resulted in a very strong sense of ‘we are in this together’. Trustworthiness allowed trusting relationships to develop, enabling participants to communicate openly and honestly without the fear of reprisals. It was this specific development that enabled the team to rapidly identify, develop and deliver its action plans to improve GSM-R performance at New Brighton station. An initiative by Merseyrail drivers to recover the GSM-R network via their in-cab radio menu resulted in the national introduction of GSM-R Bulletin 38.

Spreading the word

We have a positive story to tell

- The GSM-R System is already bringing benefits to the industry and we are making good progress in our efforts to reduce delays
- By delivering secure and reliable driver-signaller communications, the GSM-R System is increasing safety, improving performance and enhancing the experience of passengers across Britain's rail network
- We are also creating the foundation for a modern, sustainable, digitally-enabled railway network delivering increased capacity and lower running costs
- Project Artemis is successfully reducing train delay incidents by working collaboratively with all stakeholders to identify and eliminate the causes of delay

Collaboration is key

- The GSM-R System matters to all of us
- All NRT employees have been briefed about the importance of the GSM-R System being regarded positively across the industry
- Reducing train delay incidents attributable to telecoms is featured on the NRT and Group Digital Railway performance scorecards. It also feeds into the Composite Reliability Index aspect of Network Rail's corporate scorecard and so clearly impacts personal bonuses
- Please join us in working together to roll-out the initiatives detailed in this guide, to enable us to deliver higher performance for the GB Rail Industry

Help us communicate the right message

- We need your help to communicate a consistent message to our colleagues within the Routes and the broader industry
- We must ensure everyone has an accurate understanding of what the GSM-R System is, how it's performing and how we need to work together to drive improvements
- Many of the issues we need to address are behavioural rather than technical, requiring a collective effort across the wider industry to deliver the behavioural changes needed
- Please take time to ensure that you understand the full story on the GSM-R System and keep up-to-date with the work of Project Artemis
- When communicating with your colleagues, please find opportunities to update them on the progress we are making with the GSM-R System and educate them about their role in delivering a more effective system

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