THE INSTITUTION OF RAILWAY OPERATORS
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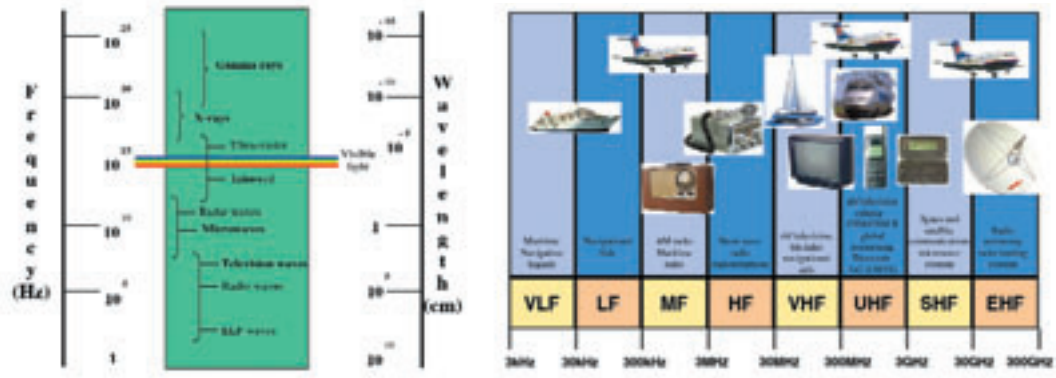
GIVING THE RIGHT SIGNALS

Clive Exley **of the Rail Safety and Standards Board explains the benefits of GSMR**



Frequency and wavelength: Which signals are used by which industries across the spectrum

WHY GSMR

Global System for Mobile communication Railway (GSMR) is the next-generation carrier for radio signals for the UK rail industry.

Work began on looking for a replacement for the National Radio Network (NRN) and Cab Secure Radio (CSR), soon after both systems had been commissioned.

The equipment used by NRN and CSR is becoming less reliable and is time-consuming and expensive to repair. Being analogue systems, they are also inflexible and unable to carry many calls.

GSMR is far more flexible. Using mobile phone technology, it can carry more channels, and offers greater reliability with off-the-shelf parts for most major components. It will also provide more services for the user than presently available with NRN & CSR.

EUROPE

The European Union wants greater standardisation of the railway and proposes to deliver this through 'interoperability'. The European Railways of the UIC produced the EIRENE (European Integrated Railway Radio Enhanced Network) specifications that now form an important part of a Technical Specification Interoperability (TSI) for Command and Control. They had been working toward a radio that would be common to all EU railways.

Seeing benefits in reliability and economies of scale, the UIC also produced a technical requirement for manufacturers. This took notice of the rise in availability of GSM technology, something we all take for granted every day when we use our mobile phones. The specification formed a strong case that GSM technology should form the basis of the replacement for all the different legacy radio systems across Europe.

The UIC permanent radio working group, with delegates from most European rail operators, recognised the need to improve mobile communications between trains and signal or control centres. This is particularly true in two cases:

- The ability to transmit voice and data reliably between train and control/ signalling centres, is particularly important when introducing in-cab train control systems and in-cab signalling that can bring train safety benefits.
- When trains travel across borders there is a need to reduce and standardise the fixed equipment in the cab to minimise the level of driver distraction.

Therefore the EU set up drafting groups to introduce in-cab train control and signalling equipment and remove obstacles to cross-border services. It consulted the member-state railway authorities and, after full consideration, issued a TSI.

THE NEED FOR GSMR

NRN and CSR are restricted to handling one call at a time in each area. But, because GSMR uses cellular technology, it can handle more simultaneous calls (ranging from seven to 23) and has more channels in each cell.

Everything we see, hear or transmit is actually analogue, travelling in a waveform composed of peaks and troughs. The number of peaks in a measured time span is known as frequency. The length from peak to trough is known as wavelength. Wavelengths of very short length are gamma and x-rays. As these waves get slightly longer we come to ultra violet, then visible light on to infra red, and then microwaves (which is where mobile phones work), up to high frequency and to long wave where domestic radios and televisions work. Sound travels in the form of longitudinal waves and to travel it has to make the air vibrate. The energy of light, radio and x-rays all travel the same way and at the same speed irrespective of the presence of air or a vacuum. The electrical and magnetic components travel at right angles to each other.

Speech is usually converted from sound to an electrical signal (via a microphone in a telephone handset, for instance) then sampled and encoded as a series of 1s and 0s, a digital signal. The resulting signal is then encrypted to ensure that it cannot be monitored. It is then transmitted as an analogue radio wave in the low intensity microwave range.

This process takes place every time we employ a digital telephone such as a GSM phone. Similar techniques are employed when transmitting digital television except that it is broadcast.

Different parts of the spectrum are allocated for different users, as the diagram above explains.

Digital technology has contributed to the explosion in mobile communication. It is also very important to the modernisation of this country's rail industry and particularly its radio communication network.

But before we get carried away with the idea that GSMR is without problems, we must not forget that microwaves lose strength travelling over great distances, becoming weak and eventually fading. They are also susceptible to reflection from any metallic surface such as building frames, vehicles and metalised glass windows, again causing signal fade. And because GSMR operates in a higher frequency band, masts must be erected closer together. However, the new system is designed to provide radio coverage over the entire railway network. At the same time we should see the installation of aerials close to tunnel entrances, helping extend radio coverage into previously uncovered areas – vital if we are to make full use of GSMR benefits.

GSMR uses the existing public GSM technology but is allotted a group of secure channels adjacent to GSM. The band of frequencies, which is not changeable, is guaranteed for

railway use within the EU only, for at least 20 years.

THE PROJECT COMPONENTS

The modernisation programme embarked upon by Network Rail and the Train Operators is made up of several different work streams:

- System engineers are adapting the parts of GSM-R that will be unique to the UK.
- Network engineers are locating and erecting masts to ensure almost complete coverage.
- Vehicle engineers are concentrating on the fitment of the radio kit to trains or other rail vehicles.
- Operations group is drafting a user specification and delivering working procedures for operators and drivers.

BENEFITS FOR OPERATORS

GSMR offers potential for significant improvements in terms of:

- Speech quality
- Call security
- Quality of reproduction
- The ability to set up a shunting group for control of movements
- The sending of pre-set text messages which will cut out the ambiguity that is a result of normal voice communication.
- The ability to deal with more than one call.
- The ability to transmit in-cab signalling information.
- The manner in which an emergency call is distributed.

EUROPEAN INTEROPERABILITY

Being able to operate trains across borders and maintain continuous communication, without the need to change to another radio in the cab forms one of the principles of interoperability.

This principle obviously has risk reduction benefits, maintenance savings and, provided the operator has the necessary language skills, a continuity of communication. This answers one of the critical recommendations from the Cullen report into the accident at Ladbroke Grove.

EUROPEAN RADIO TRAIN MONITORING SYSTEM

Most railway systems across Europe are developing GSMR to be the carrier of train control signals on high-speed lines and the EU has sponsored research into implementation. In the UK, the Cambrian line will provide the pilot scheme that may be followed by a nationwide introduction.

THE BENEFITS OF CHANGE

Changing from the present system brings many benefits including: network-wide cab to signal box communication; the ability to warn drivers of approaching danger (in compliance with one of the Cullen report's principal recommendations); modernisation of cab and lineside equipment; and the potential to improve the safety of all operational staff.

OTHER FACILITIES

Some Tocs have asked for additional applications, such as passenger seat reservations, to be introduced with GSMR. Although not impossible to achieve, it was felt that existing provision was adequate. The current development of the train control application will be very demanding of GSMR channel capacity. However, longer term it may be possible to reduce this by introduction of more efficient communications such as GPRS. Consideration may then be given to the addition of other applications in the capacity made available by GPRS.

AUTHOR PROFILE
CLIVE EXLEY

Clive Exley has worked in the rail industry for 30 years. He began his career as a driver's assistant-second man at the Neville Hill depot in Leeds. He became a driver trainer and finally operations training manager for Arriva Trains, before joining the Rail Safety and Standards Board. He has developed an industry best practice safety briefing system for drivers and produced video training programmes to train drivers.

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PROFESSIONAL QUALIFICATIONS FOR RAILWAY OPERATORS

Have you got experience of operating the railway? Would you like professional recognition, development and qualifications? The Institution of Railway Operators has been established to provide a professional structure and qualifications for people with knowledge and experience of operating the railway, at all levels. An information pack is available for anyone interested in finding out more about the Institution and its education programme. Please contact Claire Wickes at the above address if you would like a pack for yourself or colleagues.

MEMBERS' NEWS

The following employers operate a Corporate Membership scheme, by paying a one-off annual fee that covers all their employees' Affiliate or Associate membership subscriptions:

Network Rail, Eurostar, ScotRail, Central Trains, EWS Railway, Northern Ireland Railways, Freightliner, Virgin Trains, First North Western, South Eastern Trains, Corus Rail Consultancy, Iarnród Éireann, Go-Ahead Group (Southern, Thameslink), Transport for London/London Underground Ltd/Docklands Light Railway, Arriva Trains Wales (formerly Wales and Borders), Stagecoach Rail (South West Trains, Island Line, Sheffield Supertram), GB Railways (GB Railfreight, Hull Trains), First Great Western and First Great Western Link (formerly Thames Trains), London Lines (c2c, Great Northern and Silverlink Trains), One (formerly Anglia Trains, First Great Eastern and West Anglia).

Those with full Membership will continue to pay their subscription personally, irrespective of whether they can subsequently claim it back. As IRO subscriptions are tax-deductible, a receipt will be issued for all payments, whether by cheque, standing order or web payment.

DIARY OF EVENTS

NORTH WEST AREA

Tuesday 7 December. 18:00 for 18:30hrs, Manchester Cathedral Visitor Centre. Joint meeting with CILT, speaker Stuart Baker, West Coast Route Modernisation Director, SRA. 'West Coast Route Modernisation story'.

Tuesday, 25 January 2005. 18:00hrs for 18:30hrs at offices of Merseytravel, Hatton Garden, Liverpool. Joint meeting with CILT. Mr Patrick Verwer, MD Merseyrail and Mr Rudi Boersma, Concession Development Manager, Merseyrail. 'Merseyrail: a model railway?'

Call Clive Evans on 01270 629009 or e-mail: northwest@railwayoperators.org

MIDLANDS AREA

Monday 18 October. Visit to Oxley Depot (transport will be arranged from Wolverhampton Station at 18:00). An opportunity to find out more about the Rail Gourmet Service Centre.

The following dates have been provisionally booked for further events:
Monday 22 November – visit to a local freight depot
Monday 24 January 2005 – presentation on the Cherwell Valley resignalling project
Monday 21 February 2005 – provisional
Monday 21 March 2005 – provisional
Monday 25 April 2005 – provisional
Monday 23 May 2005 – provisional
Saturday 18 June 2005 – provisional

For information on all Midlands Area events, please contact Julia Stanyard on 0121 345 5030 (NEW NUMBER) or e-mail: Midlands@railwayoperators.org

SOUTH EAST AREA

Monday 22 November Carolyn Griffiths, chief inspector, Rail Accident and Investigation Branch.

All meetings take place at the Union Jack Club, Sandell Street, Waterloo. Doors open at 18:00 and the talks commence at 18:30. To contact the South East area on any subject please e-mail: Southeast@railwayoperators.org

NORTH EAST AREA

North East Area meetings normally take place at 17:30 for 18:00, at York. For further news, contact us by e-mail at Northeast@railwayoperators.org

SCOTTISH AREA

For information, please contact Scottish@railwayoperators.org or phone Jim Summers on 01324 625284.

SOUTH WEST AREA

For information on all South West events and matters, contact Lawrie Hall, internal 07 79307, mobile 07771 827797 or e-mail us at Southwest@railwayoperators.org