

Rail Industry Standard
RIS-0700-CCS
Issue: One
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Rail Industry Standard for Internet Access on Trains for Customer and Operational Railway Purposes

Synopsis

This document is intended to assist in the procurement of system and services to enable Internet access on trains, and suppliers in pre-empting the likely demands of Great Britain (GB) railway undertakings in their product offerings to customers.

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This document will be updated when necessary by distribution of a complete replacement.

Supply

The authoritative version of this document is available at www.rssb.co.uk/railway-group-standards. Enquiries on this document can be forwarded to enquirydesk@rssb.co.uk.

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Part 1 Purpose and Introduction

1.1 Purpose

1.1.1 This document is a standard on Internet access on trains for customer and operational railway purposes, for members of RSSB to use, if they so choose.

1.1.2 This document is intended to assist in the procurement of system and services to enable the provision of Internet access on trains. It also assists suppliers in pre-empting the likely demands of Great Britain (GB) railway undertakings in their product offerings to customers.

1.1.3 This document sets out requirements and guidance for three options:

- a) Mobile Communications Gateway with Local Area Network (MCG-LAN).
- b) Digital Onboard Repeater (D-OBR).
- c) Femtocell.

1.1.4 This standard supports the Department for Transport's (DfT) policy to improve communications on trains for all customers.

1.2 Background

1.2.1 There are many examples of passenger Wi-Fi systems deployed to GB rolling stock. However, they exhibit the following problems:

- a) The variability of existing solutions.
- b) A lack of system integration.
- c) The conflict between personal devices (mobile phones) and shared access solutions (Wi-Fi devices).

1.3 Existing solutions

1.3.1 Existing solutions offer a very mixed on-train user experience of accessing the Internet; this varies as a result of a number of influencing factors. These include:

- a) The mode of device access (personal access via mobile network or shared access via an onboard Wi-Fi system).
- b) The impact of signal attenuation on personal devices (-5 dB to -35 dB depending on the rail vehicle profile).
- c) The cost of data connectivity for shared solutions.
- d) The MCG performance and its many factors – network coverage, antenna performance, modem connections, SIM format and data aggregation.
- e) Some systems are now several years old so that components such as wireless access points, switches and backbones cannot support the volume of traffic required.

1.4 System integration

1.4.1 Today many trains have different networks for each value added or business service and this is not necessarily viewed as abnormal. This is driven by separate business cases within operators for different 'on train' systems, a poor standard of network awareness and the different commercial aspirations and reward

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mechanisms of the train builders, maintainers, operators and owners. Concerns with Virtual Local Area Networking (VLAN) integrity is mitigated by separate on train networks. However, due to space and cost constraints where this leads to an integrated solution being implemented, the integrity needs to be robust and provided with security and privacy controls.

1.5 Mobile phones versus Wi-Fi

1.5.1 There is an increasing use of smartphones and tablets with Wi-Fi capability. A better personal connection requires improved mobile network coverage in the train, overcoming the potential for the train body to act as an attenuating screen for the mobile network radio signal.

1.5.2 The use of a D-OBR system delivers better mobile connectivity but does not support other value added services, such as Closed Circuit Television (CCTV) and Ticket Vending Machines (TVMs). Alternatively, delivering a local area network (LAN) on the train allows the capability to support two or more methods to improve mobile phone performance: Femtocells and Wi-Fi for 'Wi-Fi Calling'.

1.5.3 Resolving the problems requires a structured approach. In the future every passenger train should have an MCG delivering connectivity to a train LAN supporting a range of services that might include passenger Wi-Fi; Femtocells; CCTV systems, including Police and Criminal Evidence (PACE) compliant equipment; TVM; a retail hub; On Train Monitoring Recorder (OTMR) Energy Metering; and other systems.

1.6 The overall system and context

1.6.1 The train becomes an integrated extension of the train operator's corporate network, supporting a range of business services, one of which is passenger Wi-Fi as shown in Figure 1 *Integrating trains (and stations) into the core train operator business systems (source DfT)*. on page 8. Wi-Fi is one form of Wireless Internet Access (WIA), with Femtocells and D-OBR two other examples of WIA.

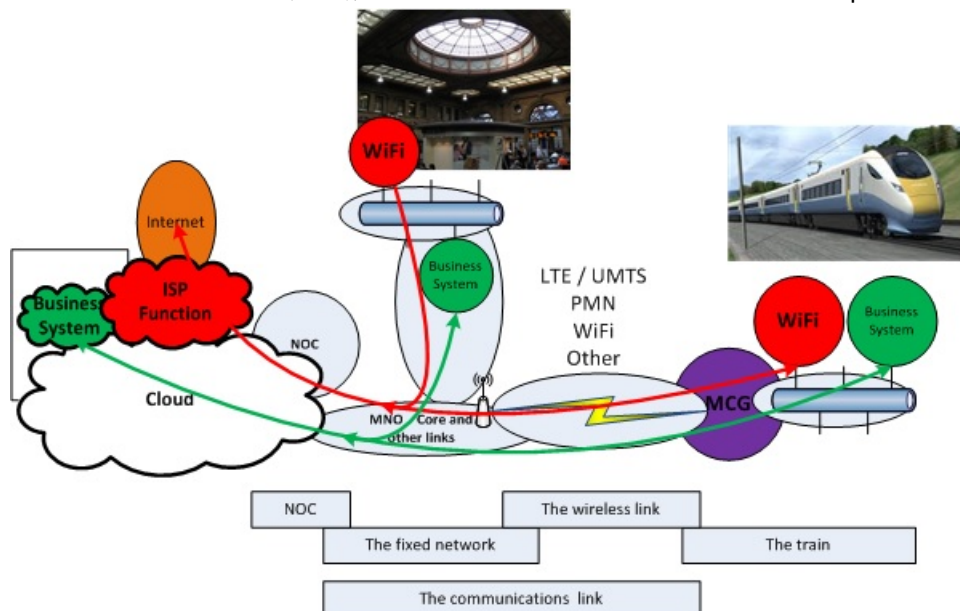


Figure 1: Integrating trains (and stations) into the core train operator business systems (source DfT).

Note: This RIS addresses the train part of the diagram

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Note: Key= LTE/UMTS – Long Term Evolution (4G) / Universal Mobile Telecoms System (3G), PMN – Private Mobile Network, MNO – Mobile Network Operator, ISP – Internet Service Provider, NOC – Network Operations Centre, MCG – Mobile Communications Gateway.

1.6.2 A universal access (Wi-Fi) system is predicated on a data connection on and off the train delivered through an MCG connecting to the Internet via an efficient external mounted antenna farm. The wireless link is capable of being delivered by a number of potential bearers, as shown in Figure 2 [Data connectivity to train \(source DfT\)](#) on page 9. The bearer links may be one or more MNO, Wi-Fi at stations, PMN or satellite connections.

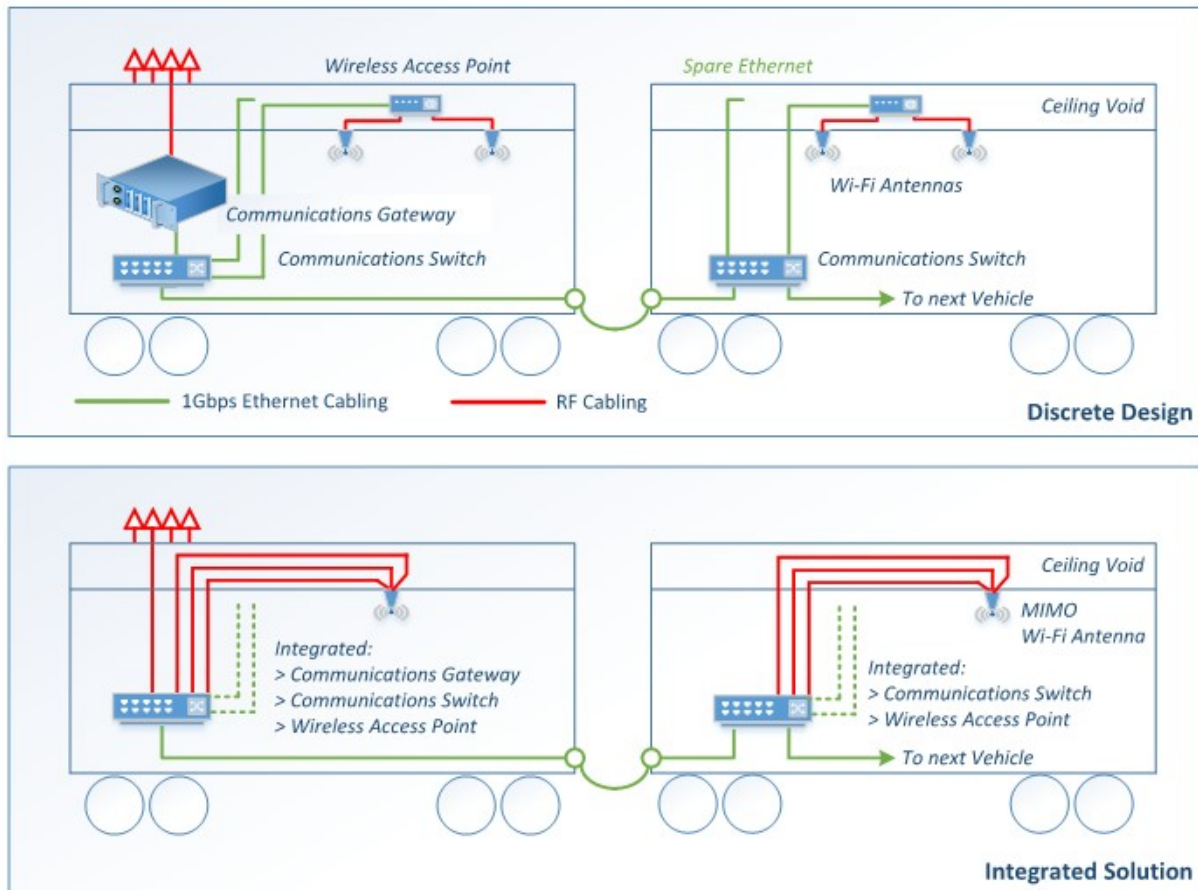


Figure 2: Data connectivity to train (source DfT)

1.6.3 Voice connectivity can be delivered by the following three mechanisms:

- Wi-Fi calling.
- D-OBR.
- Femtocell.

Note: The D-OBR solution is a separate and additional cost to an MCG-LAN-based solution.

1.7 Application of this document

1.7.1 A member of RSSB may choose to adopt all or part of this document through internal procedures or contract conditions. Where this is the case the member of RSSB will specify the nature and extent of application.

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1.7.2 Therefore compliance requirements and dates have not been specified since these will be the subject of internal procedures or contract conditions.

1.7.3 The Standards Manual and RGS Code does not currently provide a formal process for deviating from RISs. However, a member of RSSB, having adopted a RIS and wishing to deviate from its requirements, may request a Standards Committee to provide opinions and comments on their proposed alternative to the requirement in the RIS. Requests for opinions and comments should be submitted to RSSB by e-mail to proposals.deviation@rssb.co.uk. When formulating a request, consideration should be given to the advice set out in the 'Guidance to applicants and members of Standards Committee on deviation applications', available from RSSB's website.

1.8 Health and safety responsibilities

1.8.1 Users of documents published by RSSB are reminded of the need to consider their own responsibilities to ensure health and safety at work and their own duties under health and safety legislation. RSSB does not warrant that compliance with all or any documents published by RSSB is sufficient in itself to ensure safe systems of work or operation or to satisfy such responsibilities or duties.

1.9 Structure of this document

1.9.1 This document is set out as a series of requirements, in some cases followed by relevant guidance.

1.10 Approval and Authorisation

1.10.1 The content of this document was approved by Control Command and Signalling (CCS) Standards Committee on 14 April 2016.

1.10.2 This document was authorised by RSSB on 29 April 2016.

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Part 2 Requirements for Internet Access on Trains for Customer and Operational Railway Purposes

2.1 Service Requirements

2.1.1 Wi-Fi provision

2.1.1.1 Wi-Fi shall be provided to all customers for onboard use.

Rationale

G 2.1.1.2 With the wide use of the Internet, both for leisure and business purposes, there is a customer expectation that a connection to the Internet will be available on trains.

Guidance

G 2.1.1.3 Where a railway undertaking (RU) already runs a Wi-Fi service (for example at stations), the RU may choose to permit customers to use the same credentials between services, subject to any privacy or existing service provider restrictions.

G 2.1.1.4 DfT policy is to improve Wi-Fi communications on trains for all customers and proposes to achieve this by making access to on-train Wi-Fi an obligation for all new and future franchise awards.

2.1.2 Onboard availability

2.1.2.1 Internet access shall be provided subject to the availability of external (to the train) signal coverage along the rail corridor.

Rationale

G 2.1.2.2 This allows more productive use of time when travelling by rail.

Guidance

G 2.1.2.3 Internet access and customer Wi-Fi may not be possible at all times in a journey due to local infrastructure; for example, tunnels and deep cuttings blocking the signal coverage along the rail corridor.

G 2.1.2.4 When a Wi-Fi or WIA system is introduced, a one-off signal-strength / bandwidth load test can be undertaken to determine the likely performance. This will only be an instance in time view of the performance, but provides a benchmark. Items to consider in the survey include:

- a) Per customer data connection speeds.
- b) Latencies.
- c) Number of simultaneous connected customers that can be supported.
- d) Additional base stations, tunnel repeaters and leaky feeder antenna systems.

G 2.1.2.5 There is a risk that any signal coverage enhancements may interfere with the operational railway and only be implemented with the agreement of the infrastructure manager (IM).

2.1.3 Local on-train content via Wi-Fi

2.1.3.1 Local, on-train content services to customers via the Wi-Fi shall be provided for when coverage to and from the train communications link is not available.

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Rationale

G 2.1.3.2 A limited Wi-Fi service to customers will be possible, even when an Internet connection via the MCG is not available on board.

Guidance

G 2.1.3.3 If more than one user requests the same popular information, data can be cached for a period of time to avoid it being sent again over the train-to-shore communication link, thereby saving bandwidth.

G 2.1.3.4 To prevent interruption of service, update and cache content where internet connectivity is available along the rail route. This process will not work with some Smartphone and phone apps which use client-to-server dynamically generated type methods of connectivity, rather than static web pages.

G 2.1.3.5 The updated and cached content may include data such as information services, retail announcements and popular Internet sites (for example, news, weather, travel and entertainment channels).

G 2.1.3.6 TV shows or movies, as part of an infotainment solution in partnership with advertisers or production companies and acting as a form of in-vehicle media library, could be considered.

G 2.1.3.7 Web content from key media outlets (for example, the BBC or commercial local radio / media sources) that has been already actively packaged for offline access may also be appropriate.

G 2.1.3.8 Locally stored content includes licensing or copyright implications.

G 2.1.3.9 On-train media content is different to standard Wi-Fi. The hardware required needs more consideration and a different subscription regime.

2.2 Minimum onboard Wi-Fi service requirements

2.2.1 Minimum Wi-Fi bandwidth and connection speed

2.2.1.1 Each customer shall be provided with a minimum suitable Wi-Fi bandwidth and speed of connection in order to:

- a) Browse popular webpages on the Internet and access social media.
- b) Send and receive emails.
- c) Access other services that the RU may wish to provide to the customer; for example, Virtual Private Network (VPN) and connections for business applications.

Rationale

G 2.2.1.2 This is the minimum Wi-Fi, to enable customers to receive a basic Internet service.

Guidance

G 2.2.1.3 Keeping the Wi-Fi service customer interface simple throughout the life cycle promotes a positive user experience.

G 2.2.1.4 A minimum of 512 kbit/s will satisfy the needs of most users to select or receive emails. This is not a continuous data flow and therefore the long-term average will be significantly less than 512 kbit/s.

G 2.2.1.5 Subject to the minimum onboard Wi-Fi service requirements, as set out in the requirement above, additional bandwidth could be used for differentiated services such as in First Class.

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2.2.2 Wi-Fi restrictions on trains

2.2.2.1 It shall be possible to:

- a) Dynamically allocate, and restrict, the available bandwidth of an active user or select vehicles, in order to balance the bandwidth load throughout the train, based on a fair usage policy.
- b) Filter and restrict the type of services permitted.
- c) Redirect customers to another portal webpage to permit access to any additional services.

Rationale

G 2.2.2.2 In order to provide an acceptable, reliable non-discriminatory service to customers via the train-to-Internet connection.

Guidance

G 2.2.2.3 The data rate available to a moving train will vary throughout its journey, as will the number of customers wishing to use the Wi-Fi service. Therefore, in order to provide a reliable non-discriminatory service, certain high bandwidth applications, such as video and audio streaming services or peer-to-peer file sharing, may need filtering and restricting, together with restricting excessive usage.

G 2.2.2.4 Throttling the maximum data rate per customer (for example 2 Mbit/s) of the available bandwidth to the train will help to provide a uniform service to all customers.

G 2.2.2.5 It is not possible to filter and restrict services via a VPN. Customers can be advised by the terms and conditions of the service that it should not be used for unlawful or inappropriate purposes.

G 2.2.2.6 The latency per customer will vary up to several hundred mS depending on the location of the train and the connection to the train; however, aggregation algorithms are available which will mitigate the issue.

G 2.2.2.7 Where there are restrictions and time limits imposed on using the Wi-Fi service, these could be displayed on the train operator's website and log-in page.

G 2.2.2.8 An example script for the restrictions is provided as follows: 'The Company operates a "Fair Use Policy" whereby it reserves the right to restrict the User's Wi-Fi Service connection speeds or even terminate the session if excessive usage is incurred during a session. The Company currently defines "Excessive Usage" as being transmitting and receiving greater than xxxxMbytes per hour of connected time. The Company reserves the right to modify its definition of Excessive Usage in future revisions to this Agreement.'

G 2.2.2.9 When bandwidth is limited, Appendix A provides a method of prioritising services.

2.2.3 Wi-Fi service capability for customers

2.2.3.1 The Wi-Fi service shall be capable of supporting on per vehicle basis a minimum of 20 simultaneously active customers in each vehicle.

Rationale

G 2.2.3.2 This is the minimum Wi-Fi service specified by the DfT provided per vehicle, in order to provide Internet access to customers.

Guidance

G 2.2.3.3 The on-train bandwidth will vary depending on the number of active Wi-Fi customers. This is likely to increase in the future as customers become aware of Wi-Fi availability and therefore additional bandwidth will be required.

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G 2.2.3.4 Trend analysis predicts that bandwidth requirements may double every few years. Smart device penetration within society is expected to reach 90 % by 2017 with many customers having more than one active device. It is anticipated that each customer may wish to access 8 Mbit/s in order to achieve the experience they desire by 2018.

G 2.2.3.5 The use of day-to-day technology used by customers may be very different in the future, with the introduction of wearable computing, the Internet of Things, IPv6 and heads-up display technology all increasing the use of the Internet. 12 Mbit/s to each customer may be required by 2022.

G 2.2.3.6 The limiting factor in any WIA system is likely to be the bandwidth requirements, which may have to be shared throughout the entire train. Data compression technology is a method of reducing the bandwidth requirements.

2.3 Operator services

2.3.1 On-train Mobile Communications Service provision

2.3.1.1 The On-train Mobile Communications Service shall be provided for the connectivity of on-train operational and retail equipment with the Internet, subject to security provisions.

Rationale

G 2.3.1.2 Connecting the on-train operational and retail system will help inform key operational management decisions and enhance operational and retail efficiency.

Guidance

G 2.3.1.3 Preventive maintenance is vital for both the IM and RU to enhance operational efficiency. By permanently and remotely monitoring the status of key elements of the rolling stock and infrastructure maintenance, actions can be planned in advance upon detecting a fault before a failure occurs. Remote interventions may also be possible.

G 2.3.1.4 Separate communication networks may be provided for customer and on-train operational and retail use, but these will be more expensive and take up more space than a single communication network solution. A single communication network will need to be provided with security and privacy controls, as set out in [2.9.1 Wi-Fi or WIA security](#) on page 26.

G 2.3.1.5 Examples of operational and retail applications, together with typical bandwidth requirements, are set out in [Appendix B Target Bandwidth Requirements](#) on page 37.

G 2.3.1.6 Virtual machines are isolated operating systems on a host system. They can be used to run small software tools which could be used to process data from sensors before sending the information over the Internet connection, thereby saving data bandwidth on the train-to-shore Internet connection.

2.3.2 On-train Mobile Communications Service for train control movement authority fallback connections

2.3.2.1 The application of the On-Train Mobile Communications Service shall assess the potential for connectivity to enable train control movement authority fall-back communications, taking into account security provisions.

Rationale

G 2.3.2.2 To provide a future capability for a method of keeping trains moving when the main data communications system for train control authority movement has failed.
