RSSB is a not-for-profit company supported by major rail industry stakeholders.

RSSB facilitates the resolution of difficult cross-industry issues and builds consensus.

RSSB delivers a unique mix of products and services to the industry – supplying knowledge, analysis, technical expertise, and information and risk management tools.

RSSB and the rail industry work together to:

- Continually improve the level of safety in the rail industry
- Drive out unnecessary costs
- Improve business performance

The company is limited by guarantee and is governed by its members, a board, and an advisory committee. It is independent of any single railway company and of its commercial interests.
A key part of RSSB’s product range is the research and development (R&D) programme that it manages on behalf of the rail industry. The programme is funded by the Department for Transport (DfT) and aims to assist the industry and its stakeholders in achieving key objectives:

- **Improving performance in terms of health and safety, reliability, and punctuality**
- **Increasing capacity and availability** Reducing cost
- **Integrating all of these to compete effectively with other transport modes (or complement them as appropriate)**
- **Delivering a sustainable future for the railway**

R&D supports industry’s needs in a wide range of areas, from tactical incremental innovations, to long-term step changes in technology. It includes strategic research aimed at helping achieve the industry and government’s long term goals for the railway. The programme addresses:

- **Interface issues**: engineering and operational interfaces within the railway, and interfaces with other parts of the community and society
- **System issues**: improving understanding of how the whole railway behaves and the interactions of its constituent parts
- **Strategic issues**: to support cross-industry planning and the development of the future vision and technical strategy of the railways and assess how that can and should be delivered
- **Many other issues** that individual companies cannot address on their own, for example identifying good practice
This covers five major research topics, all concerned with reducing business risk relating to the infrastructure, the rolling stock, their interaction with each other, and processes that keep the railway moving.

This research brochure focuses on the Control, Command & Signalling (CCS) area of RSSB research carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee (V/TC&C SIC) and other cross industry groups covering conventional equipment, train protection, communications technology, future technologies and data management. The aim of this brochure is to:

- Inform you about research that has been done; and show you where to find the results of the research
- Encourage you to find out more, including registering to receive the RSSB R&D e-newsletter
- Encourage you to register on RSSB’s Sharing Portal for Access to Rail Knowledge (SPARK) http://www.sparkrail.org

The R&D programme has generated substantial knowledge, information and resources – all specifically designed to support the rail industry’s day to day operations, at senior level and on the front line.

This booklet provides only a brief insight into the research projects – the best way to find out more information about each project is to go to the Research and Development section of the RSSB website – www.rssb.co.uk – where you can find more details including links to the reports and outputs.

Key Contact:
Head of Engineering Research
R&D Programme
RSSB
enquirydesk@rssb.co.uk
The cross industry groups supporting this research are the Technical Strategy Leadership Group (TSLG), Vehicle/Train Control and Communications System Interface Committee (V/TC&C SIC) and its sub-groups, the Train Control Technical Sub-Group (TCTSG), Future Communications and Positioning Systems Advisory Group (FC&PS), Driver Advisory System (DAS) Board, Train Protection Warning System Strategy Group (TPWS SG), Vehicle Communications Advisory Group (VCAG), and the Defect Recording Analysis and Corrective Action System Working Group (DRACAS). The RSSB Control Command and Signalling Standards Committee also supports research projects.
The research under the Control, Command & Signalling (CCS) topic encompasses the complete area specified in the European definition of a Control, Command & Signalling subsystem. This is defined as that set of functions and their implementation, which allow the safe and predictable movement of rail traffic in order to meet the desired operational activities. It is also concerned with communication networks and systems in the wider railway context.

Figure 1, describes the entirety of the CCS research topic area.

System Architectures and Data Management Strategies

Figure 1 – CCS Topic Scope
The scope of the CCS topic is concerned with:

- Evaluation of the existing CCS environment and the identification of cost effective solutions to the rationalisation and/or performance optimisation (including maintenance) of assets.

- Analysis of conflicts within and between existing technology and operating principles, to determine optimum and safe solutions.

- Evaluation of how improved performance metrics, derived from CCS applications, can be used to enhance real-time decision making in traffic management, train control, timetable development, maintenance planning, and possession planning.

- Promulgation of information and knowledge about advances in new technologies, their application to rail systems, and the complex interactions within the CCS environment.

- Influencing the development of products based on new technologies, in both the GB and European context, to ensure that they are fit for purpose; to provide best fit with UK renewal strategies; to provide a cost advantage; and, for the avoidance of bespoke engineering, to manage the interfaces between equipment and technologies.

- Analysis and evaluation of new technology or new applications of existing technology, to determine the feasibility of its application in the UK, and the potential benefits and costs of its adoption.
The CCS research encompasses six key areas:

**Area 1 - Research into improvements in conventional CCS equipment to make better use of existing assets**

The purpose of this area of research is to analyse or simulate existing systems or equipment. It aims to understand the parameters or interactions that affect reliability, performance or capacity and through varying these parameters, identify optimal or improved solutions for which costs and benefits can be defined.

**Area 2 - Research & Development to support implementation of train protection to reduce whole life costs**

The aim of this research area is to investigate improvements and additions to traditional train protection functionality.

This is with the intention to provide a real benefit by reducing the need for infrastructure based equipment and reducing headways; thereby potentially increasing capacity or enhanced safety for a reasonable cost.
Area 3 - Research to explore emerging & future communications technology to understand potential business & safety benefits

The purpose of this research area is to identify emerging communication needs and predict future needs. It also involves reviewing system architectures that facilitate growth or make provision for upgrade without significant cost, thereby ensuring that capabilities can be expanded. Research in this area also deals with the development of standards for communication system interfaces and protocols between railway communications systems.

Area 4 - Research into the feasibility and early scoping of future technologies for train control to prepare for implementation

In co-operation with other European railways and the rail industry, this research area ensures that the UK influences research direction to meet the needs of the UK rail industry. It is also informing the industry of advancements in order that it can take advantage of technological innovations, in terms of cost and whole rail network performance.

Area 5 - Research to explore emerging and future CCS technologies to understand potential business and safety benefits

This research area is ensuring that the UK rail industry is aware of emergent CCS technologies. If needed, it is also evaluating these technologies in terms of their potential benefits and cost, ensuring that their further development provides for fitness of purpose and best fit with UK rail industry needs.
Area 6 - Research to explore advances in data management

This is a new area of research for the rail industry and involves surveying the latest practices in data management used in other industries such as banking, national and international retailing, and aviation. A strategy for data management is being developed, based on analysis of such good practice and the rail industry’s needs.
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### Description
This project was contracted by the European Commission to a European consortium, of which RSSB is a member. It demonstrated the suitability of satellite navigation for train detection.

### Abstract
Global Navigation Satellite Systems (GNSS), or satellite navigation for short, is applicable to a range of railway traffic control functions. One of the barriers to successful implementation is the capability of GNSS to deliver dependable information on location to a high degree of precision; essential if the technology is to be used for train detection. The means to economically achieve this is therefore attracting much study. In association with other European projects, GADEROS addressed the practicalities of the use of GNSS on the railway. This project was contracted by the European Commission to a European consortium, of which RSSB is a member. Work covered: user needs, system requirements, safety analysis, on-site tests, and the demonstration of virtual balise functionality with the European Rail Research Institute’s European Train Control System simulator. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.

### Published
August 2005

### Current Position
The research found that the reliability of GNSS in a railway environment is in some instances more challenging than in maritime and aviation applications. Further research has been conducted and collectively these research projects have supported the development of the guidance note GE/GN8578 *Guidance on the Use of Satellite Navigation*.

The guidance note was published in December 2008 and provides a practical means of making use of much of the research findings. The guidance note also supports the activities of the Future Communications and Positioning Systems Advisory Group, including road mapping, that started in 2008. The guidance note is currently being up-dated.
## T042  Low cost train control using global positioning system technology (‘LOCO’)

<table>
<thead>
<tr>
<th>Description</th>
<th>This project assessed the feasibility of using global positioning systems for train control. Deployment of this technology is a significantly cheaper alternative to existing technologies, especially when considering retrofitting.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>The aim of this project was to assess the feasibility of using cost effective, state-of-the-art global positioning system (GPS) technology for train control and signalling. ERTMS is expensive to deploy and not always suited to lightly used routes. GPS technology may be able to provide a cheaper alternative (especially when considering retrofitting), but its dependability needs to be proven for this safety critical application. The research identified user needs, key applications, and the inherent safety risks in using global navigation satellite systems. The report showed that simulation would facilitate the process of design and development. Further work was carried out as part of project T350. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.</td>
</tr>
<tr>
<td>Published</td>
<td>March 2004</td>
</tr>
<tr>
<td>Current Position</td>
<td>Aspects of the proposed further work are addressed in T510 Obtaining data to assess the dependability of GNSS information and accuracy of odometry, T511 GRAIL (EU Project) - Galileo for Rail and T892 Data and analysis for a cost-effective GPS-based locator with simple augmentations. The safety analysis aspects of T042 have been developed further in the EU’s GADEROS project. T042 has also provided information for project T671 Communication and positioning systems in the GB rail industry and has supported the Future Communications and Positioning Systems Advisory Group Group T809 Development of a communications and positioning technology roadmap and action plan for GB railways.</td>
</tr>
</tbody>
</table>
### T043 Application of satellite communications (‘COMMUNE’)  

<table>
<thead>
<tr>
<th><strong>Description</strong></th>
<th>Satellite communications have potential to increase safety and reduce costs. This study reviews the operational and safety communication requirements for the rail industry and analyses how satellite communication can address them.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Abstract</strong></td>
<td>There are many potential applications for satellite communications technology, which can reduce costs and increase safety. However before any benefits can be realised, research must establish user needs and the ability of the technology to deliver those needs safely and cost effectively. This study reviewed the operational and safety communication requirements for the rail industry. It analysed how satellite communication coverage can meet these requirements and identified how it can support safety communication in Great Britain. Overall the research found that the technology is available and can complement existing rail communications, resulting in significantly reduced ground infrastructure costs. Applications were identified as a voice service and a low and high-speed data service. Costs were found to be within expectations and benefits wide-ranging. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.</td>
</tr>
<tr>
<td><strong>Published</strong></td>
<td>October 2004</td>
</tr>
<tr>
<td><strong>Current Position</strong></td>
<td>The results of this research have already been used within research projects <a href="#">T510 Obtaining data to assess the dependability of GNSS information and accuracy of odometry</a> and <a href="#">T671 Communications and positioning systems in the GB rail industry</a> and have also supported <a href="#">T809 Development of a communications and positioning technology roadmap and action plan for GB railways</a>.</td>
</tr>
</tbody>
</table>
Managing low adhesion risk in the European Rail Traffic Management System

Description
This research proposed a method by which the European Rail Traffic Management System can effectively manage the risk of low adhesion, without compromising the level of train protection.

Abstract
Poor rail adhesion is a problem that the European Rail Traffic Management System (ERTMS) will regularly encounter once it comes into operation. It could be addressed using long braking distances but these would be unnecessary when adhesion is good and would constrain track capacity. This research proposes a method by which ERTMS can manage the risk more effectively without compromising the level of train protection. It systematically examines the potential changes that ERTMS brings to the management of adhesion risk and determines the actions required to ensure that ERTMS integrity is maintained. The results are detailed in five reports including an overview. The Adhesion Working Group has provided input and reviewed the work. The National ERTMS Programme team was closely involved throughout. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.

Published
March through to July 2003

Current Position
Further work in this area has been carried out in T540 Scoping and development of an adhesion management system, a Vehicle/Track Interaction research project. This has the potential for incorporating adhesion management system functionality into a train cab. This could be an automatic update to ERTMS.
### T084 Impact of the European Rail Traffic Management System on driver workload

**Description**
This research assessed the human factors implications relating to the introduction of the European Rail Traffic Management System with respect to driver workload and human error.

**Abstract**
Investigation of human factors at an early stage in development of the European Rail Traffic Management System (ERTMS) enhanced system design understanding, specifically implications for operational use by drivers. The aims of this research were to assess the implications on driver workload of the introduction of ERTMS and, in particular, on human error. The research included analysing driving tasks for ERTMS and non-ERTMS driving, and identifying changes in workload and the potential for human error. The report found instances when comparing ERTMS and non-ERTMS driving that workload may be unmanageable and in these scenarios the issues with the Driver Machine Interface or driving procedures were identified and reported.

The results have been fed into the ERTMS project and will help to improve implementation. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.

**Published**
June 2004

**Current Position**
The findings of the research have been fed into the National ERTMS project. The research highlighted issues that will need to be addressed as ERTMS is rolled out more widely. For dual-fitted railway, where a driver is receiving dual information (via the ETCS DMI and lineside signals), the project recommended that the driver should drive to one signalling system or the other; ideally ETCS. Further work was recommended in this area to identify how drivers would operate safely and efficiently in this situation. A further project, **T906 Integration of TPWS/AWS with ERTMS/ETCS (including development of requirements for an integrated DMI)**, has now been carried out, and has considered how the Class B train protection systems can be integrated with ERTMS.
**T087 Defining a standard train control interface for the European Rail Traffic Management System**

**Description**  
The aim of this project was to define the interface between European Rail Traffic Management System equipment and existing train systems, maximising the number of trains to which a ‘standard interface’ can be fitted, thus reducing costs.

**Abstract**  
Train control systems have many common features. Successful implementation of the European Rail Traffic Management System (ERTMS) will need interfaces with these systems and identification of a ‘standard interface’, common to as many vehicles as possible. This will also reduce the cost and complexity of implementation. This research defined the interface necessary between ERTMS train-borne equipment and existing control systems on trains. As well as helping to maximise the number of trains to be fitted with a ‘standard interface’, it also informed emerging Railway Group Standards. The research considered the operational environment as well as electrical and mechanical interfaces on 13 classes of vehicle. It found that a common interface could be defined, though some mechanical interfaces would need to be carefully addressed at the design stage. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.

**Published**  
July 2004

**Current Position**  
The research considered the operational environment, electrical interfaces, and mechanical interfaces for the on-board elements of ERTMS. The electrical interface design was reviewed for 13 classes of vehicle, and a small number of tests were done on older rolling stock types to determine the characteristics of available power supplies and signals.

The research, as part of the ERTMS national programme, resulted in the Train Function Application Specification which has been developed and published in the Rail Industry Standard *RIS/0340/CCS RIS for ETCS Onboard*, which is available at [www.rgsonline.co.uk](http://www.rgsonline.co.uk).
## T091 Identification and management of European Rail Traffic Management System train parameters

<table>
<thead>
<tr>
<th>Description</th>
<th>This project identified the train parameters required to enable the European Rail Traffic Management System to understand the physical characteristics of the train to which it is fitted, and hence the train’s performance.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>In order that the European Rail Traffic Management System (ERTMS) can recognise and accurately predict train performance, parameters are required that accurately describe the physical characteristics of the train to which it is fitted. This project identified these parameters and how they should be collated and managed to ensure that ERTMS can deliver safety, capacity, and performance benefits in the required timescale. In collaboration with the ERTMS equipment suppliers, the required train parameters have been identified and the means of managing and controlling the definition of these parameters with respect to Group Standards, Rolling Stock Library, and VAB issues have been recommended. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.</td>
</tr>
<tr>
<td>Published</td>
<td>July 2004</td>
</tr>
<tr>
<td>Current Position</td>
<td>This work has been used to support the development of the new Railway Group Standard GE/RT8408 ERTMS-ETCS Variable and ID Management. The drafting of the ERTMS Operational Concept includes consideration of data entry and the enforcement of route suitability. Through ATOC/CER representation, the ERA drafting group for the ETCS Driver/Machine Interface has been influenced to include the use of pre-configured data sets to simplify data entry.</td>
</tr>
</tbody>
</table>
Description
This work identified appropriate systems to ensure that satisfactory levels of integrity are achieved for data used for the European Rail Traffic Management System throughout its lifecycle.

Abstract
Robust operation of the European Rail Traffic Management System (ERTMS) is highly dependent upon the integrity of a large volume of data, much of it safety critical. Data is distributed across different equipment types and duty holders, but it is vital that there is consistent and reliable capture and management of the data throughout. This research has identified appropriate procedures and systems to ensure ERTMS data is not compromised throughout its lifecycle of design, data capture, implementation, and maintenance. The research included consultation with ERTMS suppliers and users (including operators on the continent) to understand the data needs, and then to identify systems and procedures that will deliver the required system integrity. The principal recommendations relate to the establishment of an ERTMS data management group, and processes to control the data. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.

Published
June 2004

Current Position
This work has been used to support the development of the new Railway Group Standard GE/RT8408 ERTMS-ETCS Variable and ID Management.

As part of the ERTMS programme, a Data Management and Configuration strategy has been developed.

Two related projects T754 Development of an industry defect recording and corrective actions system for control, command and signalling and T957 The development of a Costed Business Model for DRACAS have been completed, and T960 Specification of a defect recording and corrective actions system architecture and process framework is also supporting this area.
<table>
<thead>
<tr>
<th><strong>T093 Development of national values for European Rail Traffic Management System train control parameters</strong></th>
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<tbody>
<tr>
<td><strong>Description</strong></td>
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<tr>
<td><strong>Abstract</strong></td>
</tr>
<tr>
<td><strong>Published</strong></td>
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<tr>
<td><strong>Current Position</strong></td>
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</tbody>
</table>
**T274 Human-centred junction signalling**

**Description**
The project reviewed signalling requirements at junctions to identify one set of principles that can be applied consistently to all junctions and offer improvements in performance and capacity.

**Abstract**
Present signalling methods at junctions have evolved due to particular needs rather than a generic consistent set of principles. Consequently, current methods do not meet all the requirements for signalling of junctions, this complicates the tasks of both driver and signaller. The risks are adequately controlled, but only at the cost of traffic performance, because they do not represent a human-centred, and therefore efficient, approach to the research, which included a review of the present junction signalling arrangements. The research report recommends that junction signalling adopts preliminary route indicators with critical speed dynamic speed indicators. The former has had some use in recent years, and the latter is a new form of indicator. The next step is to validate the recommendations through the use of computer simulations. The work also makes recommendations to help mitigate the risks arising from misrouting. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.

**Published**
January 2005

**Current Position**
This work has been followed by project **T669 Drivers’ response to junction signalling: a simulator study** (published in March 2009). A physical trial of dynamic speed indicators is recommended in support of a possible change to the Railway Group Standard and is being considered by stakeholders.
### T309 A single Automatic Warning System receiver for DC and non-DC operation

<table>
<thead>
<tr>
<th>Description</th>
<th>This project assessed the feasibility of a single automatic warning system receiver for vehicles operating on DC and non-DC lines. Currently, different receivers are required.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>Due to the extraneous electromagnetic fields that can be created on DC electrified lines, a less sensitive automatic warning system (AWS) receiver is used on trains that are constrained to these lines. Dual voltage electric trains use two receivers for operation on AC and DC electrified lines with automatic switching between the two receivers depending on the power supply. Railway Group Standard GE/RT8035 specifies this arrangement for all trains operating over DC electrified and non-DC lines. However, diesel trains currently operating over DC and non-DC lines have a single standard type receiver. This research sought to establish if a single receiver is viable that can operate effectively on both DC and non-DC lines. The research was completed in March 2005 and was reviewed by the AWS Working Group, a sub-group of the Vehicle Train Control and Communications System Interface Committee. The research has shown that cross-track DC feeder cables can create magnetic fields of similar strength to standard AWS magnets. The research concludes that a single receiver is possible, but not without a more sophisticated design than the current receiver. The working group saw difficulties with this. They recommended that the theoretical approach taken in this research project should be supplemented by practical field measurements.</td>
</tr>
<tr>
<td></td>
<td>In addition to the assessment of the use of a single receiver on both DC and non-DC lines, this research provided a substantial amount of data on the magnetic fields produced by various types of AWS track magnets. The project also provided an analysis of the effect of traction cables and other factors on the magnetic flux density seen at the AWS receiver. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.</td>
</tr>
</tbody>
</table>
The AWS Working Group recommended that further research should consider the likelihood and consequences of magnetic fields caused by power cables affecting the performance of the train-borne AWS. This should include how these levels vary with time, so that a realistic measure of the probability of false AWS operation can be obtained, together with a review of the consequences. This was undertaken as part of research project T804 Automatic Warning System infrastructure characterisation which completed the characterisation work to include types of track magnet not included in T309, and reviewed the conclusion of T309 to take account of the additional factors identified.

Further related work was also carried out in T638 Development of test equipment to characterise the performance of automatic warning system equipment on vehicles. This was developed further in T808 AWS testing – the way forward, and has been used to inform amendments to GE/RT8035 Automatic Warning System (AWS).
<table>
<thead>
<tr>
<th>T326</th>
<th>Human factors good practice guide to managing alarms and alerts</th>
</tr>
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<tbody>
<tr>
<td><strong>Description</strong></td>
<td>This project has developed a human factors alarms and alerts good practice guide and a guidance and evaluation software tool for use in the rail industry.</td>
</tr>
<tr>
<td><strong>Abstract</strong></td>
<td>When designed appropriately, audible and visual alarms and alerts can be very effective. However, if designed poorly, without consideration of the operator’s needs and abilities, or their relationship to other alarms and alerts within the environment, they can be overwhelming, confusing, and annoying. A review by human factors (HF) experts in the rail industry identified no specific guidelines for the design and fitting of alarms and alerts in the rail industry. Following stakeholder consultation, this project was carried out with a view to addressing that gap. Based on a review of the available academic literature, a review of existing industry standards and guidelines, and observation of current alarm and alert usage in a number of train cabs, the project developed an HF alarms and alerts good practice guide and a guidance and evaluation software tool for use in the rail industry. The tool comprises three main areas: a good practice guide on the design of alarms and alerts environments, a sounds library, and a checklist tool to evaluate a systems compliance with good practice. These serve to provide a wealth of information on good design principles at a working level, and are based on practical trials experience. The tool is intended to be of particular benefit to train designers for future systems and those needing to modify or up-grade existing trainborne alarm and alert systems. The guidance within the tool has already been applied in a case study, where it was used to evaluate the design of a number of auditory alerts for the GSM-R in-cab radio. This could equally well be applied to be used for ERTMS or within any existing or future train design environment. The tool has been developed on behalf of the Vehicle/Train Control and Communications System Interface Committee and is available on the RSSB website.</td>
</tr>
</tbody>
</table>
The outputs of this project have been published on the RSSB website and are available for use by human factor specialists, academics, train designers, and manufacturers. The good practice guide is also included in the human factors online library (www.rssbhumanfactorslibrary.co.uk). The tool has been presented at a number of industry forums and publicised across the railway industry. This project has been referenced in Appendix G of Issue 3 of GE/RT8030 Requirements for the Train Protection and Warning System (TPWS) as providing guidance on Cab Audible Alerts. Feedback and suggestions from users are welcome.
**T347  Failure management of the rail traffic control system**

**Description**
This project investigated how to improve overall service provision through the better management of failures, by helping the industry to consider the potential benefits and drawbacks of a range of future rail traffic control options, and the potential impacts of a number of societal trends.

**Abstract**
When the system governing rail traffic movements fails, disruption ensues and safety risks increase. Management of the rail traffic control system is a combination of automatic features and decisions by operating staff. During failure conditions operating staff experience a significant increase in their workload as the level of manual intervention rises. This project reviewed traffic control arrangements to investigate how dependability can be improved. It reviewed failure modes and the levels of degradation that result. It investigated how future technology could assist in dealing with failures, including a projection into the longer-term future of external trends that may affect rail systems. This project delivered better ways of limiting the effects of failure and of managing the consequences with potential to reduce the associated safety risk and network disruption. The findings of this work should be integrated into the industry’s long-term vision. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.

**Published**
August 2007

**Current Position**
This work is providing input to the Network Rail Future Train and Operational Control Systems Group. The Technical Strategy Leadership Group and the Department for Transport are also considering the issues in the context of their work on interfaces with other transport nodes, station design, information data transfer, and the need for ‘Integrated Passenger Information’.
T349 Electromagnetic Compatibility (EMC) at the infrastructure/train interface

Description
This project provides a greater understanding of the real mechanisms and associated risks at the infrastructure/train interface from Electromagnetic Compatibility and will reduce uncertainty and facilitate the approval processes.

Abstract
This research project sets out to propose the replacement of the current complex route-based Electromagnetic Compatibility (EMC) compliance process with a generically applicable and consistent process and included modelling of the EMC interface between the infrastructure and the train.

The project investigated the levels of risk, the principal EMC interfaces, and the susceptibility of track circuit operation. Means to protect against track-circuit interference/malfunction were also considered. The results demonstrate the potential for a practical methodology for streamlining and rationalising the compliance process, which will provide greater clarity and justification when agreeing interference specifications and procedures, and hence reduce the associated costs and time within the approval processes. With the rail industry also spending approximately £50,000 a week on testing, any time savings could have considerable associated cost savings.

The project results will form the basis of a comprehensive standard methodology for compliance demonstration and support a future update of GE/RT8015 Electromagnetic Compatibility between Railway Infrastructure and Trains. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.
## T349 Electromagnetic Compatibility (EMC) at the infrastructure/train interface cont.

<table>
<thead>
<tr>
<th>Published</th>
<th>July 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Position</strong></td>
<td>The GB representatives on CENELEC Working Group WGA4-2 (Traction/Train Detection Compatibility) for the development of EN50238 worked to ensure that the findings of T349 were taken into account in technical specifications TS 50238-2 and TS 50238-3 published in 2010. The principles identified in T349 have also informed subsequent European work on EMC, in the new standards developed by the CENELEC Working Group specifying the basic parameters of trackside train detection systems – prEN 50617-1 for track circuits and prEN 50617-2 for axle counters (drafts of these were circulated by CENELEC for comment in July 2013, and the final version should be issued for voting before the end of 2014), and in the EMC requirements in the CCS TSI which have been developed through the ERA EMC Working Group.</td>
</tr>
</tbody>
</table>
The aim of this project was to investigate the design of a suitable display that can adequately give advance notice of four-aspect signalling in places of poor sighting. The current banner repeater signal in operation was designed to repeat a two-aspect signal.

The aim of the research was to investigate the feasibility of providing drivers with an advance indication of the main signal aspect, thereby supporting them in appropriately controlling the train’s speed. This could avoid the use of speed restrictions in places of poor sighting because signal sighting committees would then have a device to extend the viewing distance of signals with obscured sighting. The work considered options for both lineside signal repeater devices and those for an in-cab application; however it concentrated on the former as stakeholders believed this to be the more viable option. Network Rail is using the findings of this research to develop a repeater based on the existing banner repeater, which incorporates an additional green display to produce a cost effective, practical, three-aspect repeater that could provide both a high-speed first caution function and a low-speed hurry up function. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.

Green banners are being used at Rugby and form a fundamental part of the overall design. The use of the green banner has also enabled faster movements and greater train throughput in the Hillmorton area, when bi-directional signalling is introduced during periods of perturbation or planned engineering works.
T351 A strategy to develop future railway communications systems

Description
This project established a long-term view of the railway's communications needs in the context of emerging technologies. It provides the foundations of an industry strategy to remove the need for bespoke railway systems.

Abstract
This project assists the industry in establishing a strategy to ensure that commercially available communications equipment is adequate for the railway. This will ensure that special developments are not required, which should allow the cost of providing communications systems to be substantially reduced. The project examined the current communications systems used by track workers, drivers, signallers, and control room operators. The implications of migration from fixed-wire to wireless-based systems have been considered, and the functionality, the hazards, and associated risks re-assessed. The manner in which excess capacity can be safely used for commercial benefit has also been investigated. The project findings have been considered by the Vehicle/Train Control and Communications System Interface Committee. The findings of this project fed into the development of Rail Technical Strategy by the Department for Transport published in the middle of 2007. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.

Published
April 2007

Current Position
This project has provided an input into project T671 Communication and positioning systems in the GB rail industry and has supported the T809 Development of a technology roadmap and action plan for GB railways research which has had a strong influence on the actions of the Future Communications and Positioning Systems Advisory Group. Both projects have been fundamental in the development of the recently published Rail Technical Strategy.
| **Description** | Systems based on satellite navigation are being considered for safety-critical transport applications. This project investigated the hazards to such systems arising from railway infrastructure. The project focused on the effect of railway foliage, the influence of overhead equipment, and the problems that could be caused by the canyon effect of high-rise buildings and cuttings along the railway. |
| **Abstract** | Systems based on global navigation satellite systems are providing increasingly accurate data to determine position and velocity. RSSB research has demonstrated that such systems have the potential to be applied to railway traffic control and signalling. The results of this research provide initial information that will help establish the foundations of a safety case for the use of satellite navigation in the railways. The work was undertaken on behalf of Control, Command and Signalling Standards Committee by University College London, Department of Geomantic Engineering through a CASE Studentship. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee. |
| **Published** | May 2009 |
| **Current Position** | This research project delivered a PhD Thesis: Contributions to the foundations of a safety case for the use of GNSS in railway environments. The Future Communications and Positioning Systems Advisory Group has assimilated these research findings, together with those of other relevant projects T510 Obtaining data to assess the dependability of GNSS information and accuracy of odometry, T511 Global navigation satellite systems (GNSS) - Galileo for rail (EU Project: GraIL), T740 Global navigation satellite systems data coverage analysis for railway operations, and T892 Data and analysis for a cost-effective GPS-based locator with simple augmentations to build understanding in this area. |
T510 Obtaining data to assess the dependability of GNSS information and accuracy of odometry

Description
This research investigated global navigation satellite system technologies, such as GPS, to assess whether they can provide dependable train position information that meets the standards for the management of rail safety.

Abstract
This research, carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee (V/TC&C SIC) focused on collecting and analysing data to assess the dependability of global navigation satellite system (GNSS) technology and the accuracy of modern odometry systems.

The key outputs of the research are a recommended specification for GPS equipment on trains and a database of raw GPS and odometry information.

The research involved the design of a GNSS data collection system that could be installed on a train in normal revenue service. This equipment collected GPS and odometry data over a 12 month period on a Class 323 operating in the Birmingham area. The collected data was processed and analysed and the dependability of the position and velocity obtained was assessed. A sub-set of this equipment was fitted to an additional train, a Class 170 operating within East Anglia, with different wheelslip/slide protection and odometry systems. This train was used to collect odometry data during a three month period in the leaf fall season. This data was analysed to assess the performance of the odometry systems during their most challenging periods of operation using the same techniques as used for the main data collection. The findings of the research provide an assessment of GNSS performance for the railways and have enabled recommendations to be formulated to suggest the manner in which this technology could be introduced.

Alone, this research provides reassurance that GNSS information and odometry accuracy is a reliable means of determining speed and positioning of trains on the GB rail network. The V/TC&C SIC has now agreed that further trials will be progressed by Network Rail as part of the LiveTrain project. In the meantime, RSSB will use the research to review the guidance for Class B and C locators as part of the next revision of GE/GN8572, Guidance on the Use of Satellite Navigation.
Work in this area has been further progressed as part of project T892 Data and analysis for a cost-effective GPS-based locator with simple augmentations. RSSB will use the research to review the guidance for Class B and C locators as part of the next revision of GE/GN8578 Guidance on the Use of Satellite Navigation.

Sample site photographs and signal to noise ratio data charts from the T510 research.
T511  GRAIL (EU Project) - Galileo for Rail

Description  This project sought to make firm recommendations about the safety issues relating to Global Navigation Satellite System (GNSS), and provides a definitive European context in which GNSS can be applied to the railways.

Abstract  The introduction of Global Navigation Satellite System (GNSS) technology to the railway domain requires a common European approach to obtain the advantages of a standard technological basis. GRAIL (a European FP6 project) had three main objectives: to produce a common specification, to develop and test a prototype of the GNSS in laboratory conditions and on an ETCS test train, and to gain a better understanding of the best way to introduce GNSS in the rail domain.

The research has produced a set of agreed specifications for the use of GNSS in enhanced odometry, train awakening and cold movement detector, absolute positioning, and train integrity. The research has demonstrated that, with a train running in ERTMS/ETCS full supervision mode on a commercial line whilst using GNSS, this technology has the potential to support ETCS. The research has established that enhanced odometry, train awakening and cold movement detection functionality could be accommodated within existing ETCS specifications in the short-term. The additional functionality of absolute positioning and train integrity would require new ETCS specifications along with ETCS level 3 and are therefore longer-term.

The research has identified further work towards full integration of GNSS in rail safety applications. As well as additional safety analysis, more detailed economic evaluation and assessment of local elements as complementary sensors, the European rail industry and European GNSS Supervisory Authority will now need to consider the justification for more full scale demonstrations; the definition of standard digital maps for GNSS based railway applications; and specifications for low density lines.
### Abstract
On behalf of the UK GRAIL Steering Committee, RSSB has led work package 2, Safety Critical Application Definition, and contributed to the majority of the other work packages. In addition to a detailed report on the RSSB contribution to the project, RSSB has produced an overall GRAIL summary report that details the consortium deliverables. Some of these are public documents and on behalf of the consortium, RSSB has volunteered to host these deliverables once the GRAIL website is withdrawn at the end of June 2010.

### Published
February 2010

### Current Position
All GRAIL public deliverables are available through SPARK under T511. The research has identified further work towards full integration of GNSS in rail safety applications. As well as additional safety analysis, more detailed economic evaluation and assessment of local elements as complementary sensors, the European rail industry and European GNSS Supervisory Authority have continued to promote the need for more full scale demonstrations; the definition of standard digital maps for GNSS based railway applications; and specifications for low density lines.
## T512 Optimising controls to mitigate collisions at buffer stops

<table>
<thead>
<tr>
<th>Description</th>
<th>The project undertook a risk-based assessment of buffer stop protection to assess the roles of train protection, rolling stock protection, buffer design, and terminal design.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>Trains running into buffer stops is a hazard on the railway which, on occasions, can have severe consequences. The associated risks are controlled by the design of buffer stops consistent with the design of the rolling stock and the terminal environment. In addition, train protection has been installed on the approach to buffer stops to further control the risk. However, the application of train protection on the approach to buffer stops has compromised traffic performance. The research considered how the impact on traffic performance could be addressed, and examined the various configurations of train protection brake intervention curves, as well as other non-train protection options such as the design of the buffer stop. The ultimate objective was to identify mitigation options that reduced risk to a level that is as low as reasonably practicable whilst not resulting in disproportionate performance losses. The work shows that certain European Rail Traffic Management System brake intervention curves do appear to provide a reasonably practicable means of reducing the risk at buffer stops whilst attaining significant performance benefits. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.</td>
</tr>
<tr>
<td>Published</td>
<td>May 2007</td>
</tr>
<tr>
<td>Current Position</td>
<td>The research has been published on SPARK and has been used further within the ERTMS project. Areas of interest include the coding of the ETCS onboard braking model and design of the signalled stopping positions for compatibility. These issues are constrained by fixed-mass buffer stops and buffer/train compatibility.</td>
</tr>
</tbody>
</table>
# T513 Feasibility of head-up displays in driving cabs

## Description
The purpose of this project is to consider the deployment of head-up displays in driving cabs and whether there is justification for practical trials.

## Abstract
One of the primary duties of a train driver is to survey the line ahead. Indeed, the observation of the adjacent lines is one of the mitigations of the risk of a train colliding with an obstruction on the track. A concern over the increased use of in-cab signalling is the implication that the driver will spend more time looking down at the controls and less time looking straight ahead. This project identified the benefits to be obtained from the application of head-up displays in driving cabs and the issues that must be addressed to enable the use of such devices; it also developed a cost-benefit model over the life-cycle of a cab-fitment. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.

## Published
June 2007

## Current Position
The railway industry has agreed that any physical trial of this technology would be led by the ERTMS Programme – however no trials are currently planned. Issues to be resolved include the need to further consider the Safety Integrity Levels to support the use of these displays.
T573  Rationalisation of drivers’ warnings in the cab

Description
This small project reviewed past and on-going work relating to in-cab warnings received by drivers and identified issues for consideration in designing future cabs.

Abstract
A number of systems used in driving cabs present warnings to drivers either for advice or to indicate a need for specific action. This small project reviewed past and on-going work relating to these warnings with a view to identifying issues for consideration in designing future cabs, in particular their rationalisation. The research reviewed relevant literature and ongoing projects such as the European Rail Traffic Management System (ERTMS). A survey of warnings in several cabs was undertaken in order to develop a baseline of current systems.

The research confirms the importance of a system-based approach to provision of drivers’ warnings. As devices are added to cabs, the impact on the driving task must be considered in conjunction with the impact of other existing devices so as to minimise the risk of driver distraction and service disruption. The emergence of interoperability legislation means that rationalisation needs to be progressed within a European context and RSSB is working with key stakeholders to achieve this. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.

Published
January 2005

Current Position
The research initially supported revisions to GM/RT2161 Requirements for Driving Cabs of Railway Vehicles, before being transferred to the Euronorm development.

The European Rail Agency issued a request for a CEN (European standard) to cover this topic and to support the development of CR RS TSI. The new Euronorm on cab design will be the common standard across Europe.

Work on the revision to GM/RT2161 had significant input from the RSSB human factors team and included a requirement to address alarms and alerts philosophy as part of basic cab design requirements.
T575 An assessment to improve the performance of legacy train radio systems

**Description**
This research has studied available data relating to National Radio Network and Cab Secure Radio train radio systems, to determine the root causes of system underperformance and to produce recommendations regarding corrective action for the industry.

**Abstract**
The research has reviewed and analysed fault and performance data relating to train radio systems and the track-side infrastructure. The analysis has matched incidents in train radio systems to incidents in the infrastructure, and vice versa. The findings from this analysis have led to recommendations for improved data collection practices, fault analysis, and rectification procedures. The benefits of this project are the facilitation of targeted improvements in legacy train radio system performance and reliability, recommendations to allow continuous improvement policies to be applied and identification of which equipment to retain for spares as the European Radio System for Railways (GSM-R) is rolled-out. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.

**Published**
August 2007

**Current Position**
The Vehicle Communications Advisory Group concluded that as the research demonstrated that the most reported faults on Cab Secure Radio and National Radio Network cab mobiles were ‘no fault found’, and that equipment serial numbers were not recorded and tracked, it was currently not possible to link cab and infrastructure performance issues. To address this, the group embarked upon a supplementary piece of work to specify a cross-industry defect reporting and corrective action system (RSSB Project **T754 - Development of an industry defect recording and corrective actions system for command, control and signalling equipment** refers), which could support performance improvements for all control and communications systems which involve a train/infrastructure interface.
### T629 Whether to transfer lineside telecommunications from a fixed infrastructure to radio-based solutions

<table>
<thead>
<tr>
<th><strong>Description</strong></th>
<th>This research investigated the issues and benefits of the transfer from lineside telecommunications infrastructure to radio-based solutions.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Abstract</strong></td>
<td>The provision of GSM-R train radio systems has renewed the debate about migrating lineside communications from fixed infrastructure to radio-based solutions. In consequence, the Vehicle/Train Control and Communication Systems Interface Committee requested research to provide a full understanding of the implications of such a change, including due consideration of safety and commercial justifications. A wide range of options has been identified, including prioritised removal of selected types of telephone (such as point zone, automatic signals, and ground frames), along with the costs and risks associated with each. The research conclusions provide sufficient information for the industry to determine if it is ‘reasonably practicable’ to withdraw some or all lineside telephones as GSM-R is rolled out and proven to be reliable. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.</td>
</tr>
<tr>
<td><strong>Published</strong></td>
<td>August 2007</td>
</tr>
<tr>
<td><strong>Current Position</strong></td>
<td>The industry working group has made use of the findings in preparing guidance note GO/GN3677 <em>Operations Criteria for the Provision of Lineside Telephony Following GSM-R Introduction</em>, which came into force in December 2010. In parallel with this, Network Rail is currently implementing the results of this research through an active trial of a GSM-based level crossing phone and a GSM-R crossing phone trial. These have uncovered some voice quality issues that are currently being assessed by the Fixed Telephone Network (FTN) project.</td>
</tr>
</tbody>
</table>
### Development of test equipment to characterise the performance of automatic warning system equipment on vehicles

<table>
<thead>
<tr>
<th>Description</th>
<th>This project has provided the rail industry with the equipment and test methodology necessary to characterise the Automatic Warning System, both on existing train fleets and on new trains under development.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>The Automatic Warning System (AWS) provides a simple, robust and reliable safety control to reduce the risk of signals passed at danger (SPAD). It has performed well for over 60 years, however changes in train technology (such as the increase in electrification and the use of new materials, both trackside and on train), and the demand from passengers for a smoother ride, have meant that the operational environment of the system is changing. Although intrinsically simple in concept, the physics of ensuring accurate operation of the AWS in a dynamic environment is quite complex. For this reason, and to assure safety, it is necessary to test each system for correct operation in its actual environment. This research has developed a characterisation test, and provided the equipment necessary, and an associated instruction manual, to perform this test on existing train fleets and on new trains under development. The project was initiated by the AWS working group, a sub-group of the Vehicle/Train Control and Communications System Interface Committee.</td>
</tr>
<tr>
<td>Published</td>
<td>February 2009</td>
</tr>
<tr>
<td>Current Position</td>
<td>This project provided the TY309 AWS characterisation test unit and supporting documentation that has been used to help assess the suitability of the TY287 AWS Tester as part of follow on project <strong>T808 AWS Testing - the way forward</strong>. These test units are available for use by RSSB members.</td>
</tr>
</tbody>
</table>
T669  Drivers’ response to junction signalling: A simulator study

Description
This project used simulation techniques to understand the use of preliminary route indicators and dynamic speed indicators by drivers when negotiating junctions. This research has the potential to improve the overall operational performance of the railway when considering the re-signalling of junctions.

Abstract
The conclusions in RSSB research project T274 Human-centred effective junction signalling, recommended the use of preliminary route indicators and dynamic speed indicators for all junction signalling, as there was a recognised possible benefit to optimise journey time through junctions, reduce driver error, and therefore improve the overall operational performance of the railway.

Given that these displays can be applied in several ways, the aim of this project was to assess the relative effectiveness of different applications, principally in terms of the ease with which a driver can respond to the indications given. The research was progressed in three stages, with the support of simulations and train drivers. Low-fidelity simulation was initially used to reduce the number of junction signalling arrangements assessed to three, the maximum that can be realistically assessed by the high-fidelity simulation. Driver performance was then compared against a baseline of existing conventional signalling arrangements. The preferred option was evaluated to consider terms such as engineering feasibility, cost benefits, and maintenance.

The output consists of a detailed assessment of drivers’ reactions to junction signalling in the conditions simulated, such that choice of arrangement can be based upon a scientific assessment. Implementation would require changes to Railway Group Standards and then implementation as part of future signalling schemes. The research failed to identify a single practical, cost-effective junction signalling arrangement as, statistically, the three options were rated in the same way by drivers. However, there is still the potential to optimise journey time through junctions, reduce driver error and therefore improve the overall operational performance of the railway.
**Abstract cont.**  
CC&S Standards Committee, as the client group, has agreed to consider submitting a further research idea based on the next steps identified in the project and the subsequent paper submitted by the RSSB technical specialist. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.

**Published**  
March 2009

**Current Position**  
The CC&S Standards Committee submitted a research idea to address the next steps towards possible industry implementation of primary route indicators and dynamic speed indicators.  

This was reviewed in early 2010 when it was noted that *GK/RTLineside Signals, Indicators and Layout of Signals* had been published and adequately addressed high-speed junctions. Network Rail has also confirmed that the priority is to focus upon network optimisation rather than junction optimisation. No further research is expected at present.
T671 Communication and positioning systems in the GB rail industry

**Description**
This research determined the standardisation and methodology needed for the future fitting and use of satellite positioning and digital communications technology within the railway environment.

**Abstract**
The availability of cheaper and more integrated satellite and digital communication systems is offering more operational and commercial opportunities. However, lack of standardisation and product awareness have historically prevented the railway industry from being able to take advantage of these systems. Current satellite applications are disparate systems, resulting in numerous antennae on each train. Manufacturers and customers alike could benefit from standardising systems and making them more commercially viable. This project explored the current satellite and digital communication systems being developed commercially and matched developments to the needs and ambitions of the GB Rail industry. The knowledge gained from this research project was used to develop RSSB Guidance Notes, which will provide product details and best practice guidelines with which the industry can make informed buying decisions. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.

**Published**
January 2009

**Current Position**
Guidance Note GE/GN8579 *Guidance on Digital Wireless Technology for Train Operators* has been published and can be found on [www.rgsonline.co.uk](http://www.rgsonline.co.uk).

Guidance Note GE/GN8578 *Guidance on the Use of Satellite Navigation* has also been published on [www.rgsonline.co.uk](http://www.rgsonline.co.uk).
T683 Research to investigate and advise on optimisation of close and long range viewing of signals

Description
The physical nature of signal optics and the design of rolling stock cabs influence the driver’s ability to observe signals at close range. Conversely, the compromises made to ensure that signals are visible at close range affect the visibility of signals and directional information at long range.

Abstract
There are a number of inconsistent parameters within Group Standards and train operating company driving policies, which may affect the driver’s ability to view and discern the aspect of a signal and any associated directional instructions. Furthermore, rolling stock design and ergonomics are designed to ensure maximum visibility of signals but may, as a result of the physical need to provide roof supports have blind spots affecting the close viewing of signals. The purpose of this study was to undertake a review of the standards and physical attributes of signals to develop a preferred compromise between close and long distance viewing and provide guidance on the optimum position for a train to stand back from a stop signal. This compromise was analysed, taking into account the risk factors arising from the need to have a safe, capable, and economic system. A standardised stopping range of 20 to 25 metres is recommended for current trains, and 20 metres is recommended for future trains. During the course of the study, certain deficiencies and observations were made concerning existing Standards, and certain shortfalls or gaps in knowledge were detected. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.

Published
May 2008
<table>
<thead>
<tr>
<th>Current Position</th>
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<tbody>
<tr>
<td>V/TC&amp;C SIC accepted the results of the research and requested four recommendations to be pursued:</td>
</tr>
</tbody>
</table>

1. Harmonise RGS and operational documentation (defensive driving policies) so that a single point is used as both the distance from the driver to signal for the stopping distance, and the distance for which sightlines are specified. A comprehensive review of *GK/RT0045 Lineside Signals, Indicators and Layout of Signals*, and some modelling has been carried out in support of this.

2. Review specification NR/SP/SIG/10062 for the beam viewing angle requirements corresponding to the range of recommended stopping distances.

3. Any updates to RGS GM/RT2161 or other relevant standards should include the implications of cab design for sightlines, safety, and performance.

4. Any changes to the design of train driving seats should refer to the recommendations in T683.

These areas have all been progressed and continue to be monitored.
### T686 Guidance on the use of selective door operation in the GB rail industry

**Description**
This project has produced a Guidance Note on the use of selective door operation (SDO), which supports the development of a standard method of introducing SDO across the rail industry.

**Abstract**
This project has provided an overview of selective door operation (SDO) systems, focusing on the operational principles of these systems. It has identified the functions and interfaces of SDO systems in relation to the train crew, passengers, and infrastructure that need to be considered in the selection of specific system architectures. It has also provided information relating to the system architectures that satisfy the functional and interface requirements. Specific technology and design information to facilitate the installation and operation of the architectures, and potential design solutions, have been identified. Further work is being carried out under two new projects T771 and T769 to investigate the potential use of radio frequency identification in an SDO application and the operational performance and safety risk that may be introduced by SDO systems. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.

**Published**
Guidance Note published during May 2008

**Current Position**
This subsequent work has been completed:

- Definition of the criteria for the application of selective door operation; RSSB Project [T769 Criteria for the application of selective door operation](#).
- A risk analysis of selective door operation systems from a human factors perspective.

- An RFID trial for selective door operation; RSSB Project [T771 Trial of radio frequency identification for selective door opening systems](#).

Following industry consultation, issue 3 of GE/GN8577 *Guidance on the Application of Selective Door Operation Systems* came into force in September 2013.
**Description**  
This research aimed to develop and assess an integrated engineering and operational approach to improve railway traffic regulation to reduce energy usage and increase network capacity without reducing the service quality, by providing advisory information to drivers.

**Abstract**  
The research developed and analysed the generic functionality of a driver advisory system (DAS). In addition to engineering considerations and analysis, the work was underpinned by risk assessment to ensure safety would not be compromised, and human factors assessment to ensure that information would be provided in a user-friendly way. This analysis considered the factors that would need to be included to produce a robust and detailed business case that estimates the costs of implementation and the potential for reduced energy consumption and potential traffic performance improvements.

The work supports the Department for Transport’s Rail Technical Strategy and has been carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee,

Stage 1 of the research involved information gathering on existing systems, a review of human factors principles, train driving task analysis, a hazard and operability study and Operations workshops, train performance analysis and driver interface options analysis. Stage 2 activities have provided a more detailed evaluation of the options and benefits of a proposed system using simulation software, a review of the national timetable for operational factors such as allowances and hidden slack, and assessment of alternative system architectures building upon previous research.

The benefits from implementation of a DAS include reductions in energy consumption by avoiding unnecessary braking and running at reduced speed whilst maintaining on-time arrival. A rough estimate of the financial benefit that this would achieve could be in the region of £20m over the lifetime of its application across the main line UK network. Operational benefits would include reduced train delays and better utilisation of track capacity by running through junctions and station approaches at higher speeds whilst also reducing maintenance costs as a result of reduced brake wear.
### Abstract
Follow-on research has been proposed to take this work further. This will include a short-term engineering project focusing on train to shore communications when operating DAS, and a longer-term strategic project that will pick up on issues such as energy efficient timetabling and traffic management.

### Published
February 2010

### Current Position
The Technical Strategy Leadership Group has established a programme of research in project **T952 Future traffic regulation optimisation**. A standalone DAS has been developed and introduced into operational service across several areas of the railway network. A *GB Operational Concept for a connected DAS (C-DAS)* was published in June 2013.
### T739  Train roof antenna positioning and performance study

<table>
<thead>
<tr>
<th><strong>Description</strong></th>
<th>The objective of this research was to explore potential good practice solutions to provide safe and effective optimisation of the train antenna design and installation practices.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Abstract</strong></td>
<td>The train roof is increasingly becoming an area of positional and technical conflict, where the installation of a wide variety of transmitter and receiver antennas, along with other equipment such as air conditioning, is not necessarily conducted with a view to the relative technical, operational, and safety requirements of the respective communication systems. This study sought to identify current and future requirements with regard to the installation and positioning of antennas in the train rooftop environment. It sought to quantify any potential conflict with regard to radio frequencies and provide clear guidance and rules for installation. This research was supported by the Vehicle/Train Control and Communication Systems Interface Committee. The results of the research were used by RSSB to support the production of a new guidance note GK/GN0602 <em>Guidance on Train Roof Antenna Positioning</em>.</td>
</tr>
<tr>
<td><strong>Published</strong></td>
<td>September 2009</td>
</tr>
<tr>
<td><strong>Current Position</strong></td>
<td><em>GK/GN0602 Guidance on Train Rooftop Antenna Positioning</em> has been developed and came into force in December 2010.</td>
</tr>
</tbody>
</table>
Description
The aim of this project was to define the contribution required from hybridisation (use of inertial components) to maintain accurate positional information for trains, in areas where GPS coverage is intermittent or non-existent.

Abstract
GPS coverage across the railway network is intermittent or non-existent in some areas. Data collected since 2000 has been analysed to identify where these problem areas exist in order to quantify and qualify the effective coverage. In addition, a real-time positioning system was deployed on the Network Rail infrastructure monitoring fleet and this system has captured real-time differential GPS data which was also used as an additional GPS data source.

This research has provided information on the areas of poor coverage, known as black and grey spots, and information on possible causes. The black and grey spots lasting more than 150 metres collectively cover 10.5% of the British rail network and are categorised by strategic route. More detailed information with each recorded black and grey spot plotted has been made available electronically as KML files that may be displayed as geographical data in publicly available mapping applications, such as Google Earth Pro.

The use of GPS in the future will allow accurate real-time information and train-tracking to improve customer communication and faster incident response. The findings of this research may be used by the infrastructure manager or railway undertakings to identify ways of improving the accuracy of positional information in problem areas. This project was carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee.

Published
July 2008

Current Position
Some of the information from T740 has been used by project T510 Obtaining data to assess the dependability of GNSS information and accuracy of odometry.

Network Rail is already using the tool and the research results as a cross-reference for its own studies.
This research has delivered a suite of commercial options that have supported a decision by Network Rail on the most appropriate approach to the continuing availability of Radio Electronic Token Block cab display units (CDU) in the GB rail industry.

The manufacture of Radio Electronic Token Block (RETB) cab display units (CDU) ceased some time ago. The existing availability of these units was a cause for concern to the industry as an increasing number of components have become obsolete. This impacts on both the repair process and demand for new units.

On behalf of the RETB Working Group, a sub-group of the Vehicle/Train Control and Communications System Interface Committee (V/TC&C SIC), this research focused on three options:

1. Extending the life of the existing units
2. Like for like replacement
3. Development of a new CDU design

The project was proposed to be undertaken in two phases. Phase 1 considered each of the three options with a view to proposing possible solutions. Three suppliers provided feasibility reports that included outline designs, estimated reliability projections and development quotations. As they contain commercially sensitive information they will not be published.

Phase 2 was proposed to develop these solutions to prototype stage, then later to testing and eventual manufacture. A key factor was that the rail industry should not be limited to one supplier in the future, which was in itself a concern. After reviewing the results from phase 1, Network Rail concluded that the research should be taken forward as part of the overall ERTMS strategy. In light of this, the V/TC&C SIC agreed that this research project could be closed at the end of phase 1.
### Abstract cont.

As a result of this research, the industry, through Network Rail, will now be in a position of owning the IPR for any new CDU design whilst having the ability to ensure future reliable operational performance for all train operators on RETB lines, as well as having sufficient additional units to attract new entrants to the freight market on the RETB lines in Scotland.

### Published

February 2010

### Current Position

This project was terminated at the end of the feasibility stage following a decision by Network Rail to incorporate the work into the larger RETB CDU/TRU upgrade project led by themselves. There will be no further work necessary by RSSB.
T754  Development of an industry defect reporting analysis and corrective action system for control, command and signalling equipment

Description
The development of a customer requirements specification for a defect recording and corrective actions system for control, command and signalling systems.

Abstract
The Southall and Ladbroke Grove inquiries recommended that the rail industry needed to develop a system to track Automatic Warning System (AWS) and Train Protection and Warning System (TPWS) components. ATOC responded to this requirement by developing the Component Tracker application, which is used by some train operating companies as a means of managing traceability for trainborne control, command and signalling (CCS) components.

Railway Group Standard GE/RT8106 Management of Safety Related Control, Command and Signalling (CCS) System Failures places a requirement on the infrastructure manager and all railway undertakings to share information about failures of all CCS systems, which includes both trainborne and infrastructure subsystems. For new CCS systems (typically ETCS and GSM-R), GE/RT8106 requires implementation of a defect recording and corrective actions system (DRACAS) to provide for the required information sharing.

In support of this requirement, the first stage of this research project has been to develop a customer requirements specification. This has involved discussion with a large number of company and stakeholder representatives across the railway industry and will now be used to support a period of further consultation across the railway industry. Further deliverables have included an interim report, which outlines the research methodology and results; and a high level strategy document, that assesses the overall rationale for a DRACAS, and the potential for its application and roll-out across the railway industry.

The Vehicle/Train Control and Communications Systems Interface Committee (V/TC&C SIC) recognises the potential of a DRACAS system for CCS equipment to improve overall CCS system performance, including possible application to all of the legacy CCS systems within the scope of GE/RT8106 Appendix A.
### Abstract cont.

The next steps for this research are intended to be the publication of the customer requirements specification on the RSSB website, with a view to supporting a period of further formal consultation with industry stakeholders; the use of the Stage 1 deliverables to support the preparation of an overall business case for DRACAS for the railway industry, possibly to include legacy system data; and for the preparation and agreement of an outline system architecture. The next steps of the industry’s plans to develop and implement DRACAS are to use the findings from this research to support adopting the recommendations and proposed development path outlined within the High Level Strategy document.

This research has been carried out on behalf of the V/T C&C SIC, supported by the DRACAS Working Group.

### Published

July 2010

### Current Position

The customer requirement specification is now completed and published. Two further supporting projects T957 The development of a costed business model for DRACAS and T960 Specification of a DRACAS system architecture and process framework have now progressed this work further.
T769  Criteria for the application of selective door operation

**Description**

This research project has established the human factors issues and criteria that need to be considered prior to the introduction of selective door operation.

**Abstract**

The objective of this research has been to understand the human factors issues associated with the introduction of selective door operation (SDO), through an evaluation of the costs, business benefits, safety and operational performance issues. This is intended to identify the point at which the potential business benefits of adopting SDO are outweighed by the safety and operations performance issues, in favour of other potential solutions, including platform extension.

On behalf of the Vehicle/Train Control and Communications System Interface Committee, two output deliverables have been produced: a research report, identifying the issues and benefits associated with the use of SDO; and an assessment tool to allocate cost, risk, and benefit values. The tool can be used by railway undertaking and infrastructure managers to support the preparation of an overall business case or risk assessment for evaluation purposes.

The research comprised: a literature review; interviews with HM Railway Inspectorate, Department for Transport, station managers, and the current users of SDO (train crew, station staff, and passengers); and trials in a working railway environment using data for three identified stations (including terminus stations, through platforms, and interchanges).

The output of the research is available for immediate use by the train operating companies and infrastructure managers responsible for services on the Thameslink, Crossrail, and the Glasgow to Ayr routes, where it is intended to introduce SDO in the near-term. In the longer-term, the outputs are available to support the roll out of the Intercity Express Programme, initially on the East Coast Main Line.
### Abstract

The research contributes to the implementation of best practice on the railway, through improved station design, improved passenger communication, and the maintenance of the required safety levels, whilst ensuring that cost and operational performance issues remain central to the decision-making process. RSSB will be using the research results to support an update to Guidance Note GE/GN8577 - Guidance on the Application of Selective Door Operating Systems.

### Published

- **Stage 1** - February 2009
- **Stage 2** - January 2011

### Current Position

The stage 1 and 2 study assessment reports have been published on the RSSB website. A copy of the SDO assessment tool is available on request from RSSB.
T771  Trial of radio frequency identification for selective door opening systems

Description
This research project has trialled two radio frequency identification (RFID) technologies to understand their ability to support the railway industry and its use of automatic selective door operation (SDO). RFID has the potential to provide a cost-effective and standardised technology solution to support future SDO applications.

Abstract
Automatic selective door operation (SDO) requires an accurate station and platform identifier. Radio frequency identification (RFID) is unproven in this application; however, it has the potential to provide a cost-effective and standardised solution for the railway industry.

On behalf of the Vehicle/Train Control and Communications Systems Interface Committee this research has included both a preliminary (proving) trial at Ashford depot and then a full six-month operational trial on the railway using both AC and DC traction power supplies. Output reports have been provided for each of these trials, which are available on the RSSB web site.

RFID ‘readers’ were mounted on the side of the train and ‘tags’ were mounted on the platform invert in a configuration that sought to avoid the need to install equipment in the four foot, as recommended by previous RSSB project T686 Guidance on the use of selective door operation in the GB rail industry.

The current research considered one product in each of two frequency ranges, 860-868MHz and 125KHz/2.4GHz with a view to assessing their performance. Unfortunately, the only available 860-868MHz product was still undergoing development during the trial and performed poorly under this configuration. The more mature 125KHz/2.4GHz product performed well and confirmed its potential suitability for the SDO application. The output report for the trial has also considered alternative viable options for reader and tag positioning, and the overall reliability and robustness of the technology.

The trial was intended to support future SDO design decisions and a common trackside approach to the use of RFID. The recommendations will be used to update Guidance Note GE/GN 8577 Guidance on the Application of Selective Door Operation Systems.
### Published
January 2011

### Current Position
After this research had been completed, the Future Communications and Positioning Strategy group decided to progress some work to ensure that there is a single national RFID tag data format structure and communications protocol that can be incorporated into a new Rail Industry Standard.
### T795  Proof of concept trial demonstrating 900 MHz wireless Internet protocol connectivity

<table>
<thead>
<tr>
<th><strong>Description</strong></th>
<th>A trial of 900 MHz wireless technology, using the existing GSM-R infrastructure, to provide operational lineside Internet protocol connectivity.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Abstract</strong></td>
<td>This research involved a physical lineside trial of 900 MHz wireless technology using three built but inactive GSM-R masts and the fixed transmission network. The trial was designed to assess the technical feasibility of an overlay wireless network within the existing infrastructure, to establish the technical requirements for operational trackside wireless communications coverage and capacity, and to determine if the existing GSM-R network could tolerate an acceptable level of cross interference within safe limits. This research project was sponsored by the Vehicle/Train Control and Communications System Interface Committee. Because of commercial sensitivity, the results from this project are not being published until the completion of the OFCOM auction of frequency bands around the 900 MHz frequency.</td>
</tr>
<tr>
<td><strong>Published</strong></td>
<td>Not published</td>
</tr>
<tr>
<td><strong>Current Position</strong></td>
<td>The results from this research have been used in T911 Development of a cross-industry business case and spectrum valuation for wireless telecommunications.</td>
</tr>
</tbody>
</table>
T804  Automatic Warning System infrastructure characterisation

Description  A review of the performance of Automatic Warning System (AWS) receivers, and the magnetic field characterisation of AWS track magnets not measured previously.

Abstract  Following recent performance experience of single strength Hall effect receivers, this project was needed to review the conclusions of previous project T309 A single Automatic Warning System receiver for DC and non-DC operation which, owing to the presence of spurious magnetic fields on the railway infrastructure, because of traction cables and other high current devices, had recommended the need for dual detectors or differential receivers to be fitted to diesel multiple units travelling over both types of infrastructure. This project was also required to measure the magnetic field characterisation for the AWS track magnets that had not previously been measured as part of project T309.

This work has been carried out on behalf of the AWS Working Group and Vehicle/Train Control and Communications System Interface Committee (V/T C&C SIC). Two reports have been produced. The first details the AWS characterisation of the magnets not measured previously; characterisation of the TY287 and TY309 test units; and the magnetic effects of impedance bonds and track circuit assisters on the railway infrastructure. The study found that most existing magnets provide a significant safety margin over and above that specified within RGS GE/RT 8035. However, there was a concern that the new, smaller, ‘rare earth’ magnets could fail to be detected as a result of their ‘roll off’ characteristics, if they are manufactured ‘just to comply’ with the standard, and operated with the train receivers as currently mounted. The second report includes the characterisation results for all magnets; these have been provided to a standard format, in the form of a point field interpolator or dataset. The measured data and mathematical modelling from this second deliverable will continue to be held as reference data by RSSB, for use by the rail industry. The second report also includes a review of the conclusions of project T309, and has concluded that there is no definitive answer which would provide technically verifiable support for the universal use of single receivers. The analysis did show however, that within the areas studied, the probability of false detection of unintentional magnetic fields is low.
<table>
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<th><strong>T804 Automatic Warning System infrastructure characterisation, cont.</strong></th>
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<tbody>
<tr>
<td><strong>Abstract cont.</strong></td>
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<td><strong>Current Position</strong></td>
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**Description**

Automatic Warning System receiver testing equipment; providing an improved understanding of the use of the TY287 testing unit.

**Abstract**

On behalf of the Vehicle/Train Control and Communications Systems Interface Committee, this research intended to simplify the use of the TY287 ‘depot tester’ AWS testing equipment. This is currently perceived to be difficult to set up and use by depot maintenance staff. This project therefore aimed to provide clear written instruction on how to determine whether the AWS receiver is operating within its required limits.

Ten trains offering a representative combination of AWS receiver types have been tested using both the TY287 testing unit and the TY309 ‘characterisation tester’ under a range of operating conditions. The results have been analysed and compared for accuracy and repeatability, and compared with theoretical predictions based upon a magnetic field distribution model. An interim report based upon the first five trains has already been published and the final report detailing the results of the testing for all trains is now ready for publication. The research has investigated the changes needed to support an updated version of the TY287 testing manual to ensure ease of use and has prepared an updated draft of this for further consideration by the railway industry.

Following this research, and possible further amendment to the TY287 testing manual as part of the follow on research project T975 - TY287 Design Options, the rail industry will be able to routinely use the TY287 testing unit for its intended purpose with improved understanding and confidence.

**Published**

October 2012

**Current Position**

The output from this research and follow on RSSB Project T975 - Design Options for the TY287 Automatic Warning System testing unit have been used to support an up-date to GE/RT8035 Automatic Warning System (AWS). The emerging findings from the research are also being used to develop an AWS testing strategy that is being progressed by the Train Control Technical Sub-Group.
T809  Development of a technology roadmap and action plan for GB railways

**Description**
In support of the Department for Transport Rail Technical Strategy, there is an expectation that there will be advances and greater application of existing and future communication and positioning systems. The development of a roadmap will support the industry in its deployment and management of these.

**Abstract**
The Department for Transport White Paper ‘Towards a Sustainable Transport System’ and the supporting Rail Technical Strategy set out a vision of intelligent trains operating on intelligent infrastructure. Currently the GB railway uses a range of communications and positioning technologies. These often include bespoke elements which developed in isolation and may not deliver this future vision.

This project was completed on behalf of the Future Communications and Positioning Systems Advisory Group, a sub-group of the Vehicle/Train Control and Communications System Interface Committee. The aim of this research project has been to provide guidance to the GB railways on the adoption of communication (both fixed and mobile) and positioning technologies, with a view to ensuring that, as far as possible, commercial-off-the-shelf (COTS) products can be used, reducing the need for expensive bespoke or customised equipment.

The first stage of the research involved two industry roadmapping workshops, one-to-one industry stakeholder meetings, and a review of the development of a number of technologies. This led to the production of a short-term roadmap covering the next 10 years. The roadmap identified what can be achieved based on existing technologies and standards (since there is little scope to influence the development of technologies and standards in this timeframe). The second stage of the research has now reviewed the outputs and further developed this into a roadmap to cover the longer-term (20 years).
### Abstract cont.
The outputs were checked against the four scenarios from RSSB Project T713 ‘Foresight studies in sustainable development’ and were found to be robust. The outputs of this research will support the railway industry in selecting and applying appropriate future technologies. The research will also give guidance to the suppliers of communications and positioning systems, to influence them in providing both COTS equipment and standards that meet the rail industry’s objectives. The roadmap also identifies actions for the GB railway to consider, that will influence the development of communications and positioning technologies and standards or identify the means of achieving the required benefits.

### Published
- Short-term road map published October 2010
- Long-term road map, published in July 2011

### Current Position
This project has now been completed and has been used to inform further projects **T892 Data and analysis for a cost-effective GPS-based locator with simple augmentations** and **T990 Development of a Strategy on Train Position.**
### T817 Assessing the bandwidth demand for future communications needs

**Description**
This research project has assessed the demand for communications bandwidth to meet the future need for enhanced communication facilities for passengers; (internet, mobile telephones and entertainment) with the aims of improving revenue generation, and providing additional support for operational activities; (engineering maintenance and operations scheduling) with the aims of improving efficiency and cost saving.

**Abstract**
This research has determined how improved communications provision might support greater future capacity and additional customer services on the railway. It has provided a better understanding of how communications bandwidth can be provided and how, over successive periods, the need for this provision might be expected to change. The findings have shown that over the next 10 year period, demand for bandwidth on the railway is expected to double or even triple under more optimistic scenarios.

The individual project work packages have provided information on geographic and demographic demand for services, and the estimated cost of meeting this demand. A number of possible scenarios have been developed, taking into account the commercial issues and financial risks associated with future provision. This has included desk research, mathematical analysis, and modelling.

The research has identified the communications bandwidth requirements of direct operation (train/track) and remote operation (signalling, control, electrification, and management information). This information will be used to support the formulation of a communications strategy, by providing a detailed understanding of where communications bandwidth is needed, and how this can be provided.

The benefits of this research are that it has provided a strategic understanding of the communications changes that are needed to develop a more efficient, passenger focussed and sustainable railway system. The output of this research will be taken forwards, into a new programme of work to consider how the demand for bandwidth and IT services might best be provided and the extent to which it makes economic and commercial sense to do so. Currently, it is thought that the research report summary and
### Abstract cont.

the costs model could be particularly useful in the development of future scenarios to support this work. This research has been carried out by RSSB on behalf of the Vehicle/Train Control and Communications Systems Interface Committee.

### Published

August 2010

### Current Position

The outputs of this research have been progressed further within **T964 Operational Communications - a programme of work to develop an effective strategy that supports rail innovation**, which is being sponsored by the Technical Strategy Leadership Group.
### T892 Data and analysis for a cost-effective GPS-based locator with simple augmentations

<table>
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<tr>
<th><strong>Description</strong></th>
<th>This research project has analysed and compared new and existing data collected on routes with GNSS visibility issues. The outputs are intended to validate and extend the guidance contained in guidance note GE/GN8578 for Class B and Class C locators.</th>
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<tr>
<td><strong>Abstract</strong></td>
<td>Global navigation satellite system (GNSS) technology generally gives accurate determination of vehicle position and speed, but estimates are statistical rather than deterministic, and hence deliver out-of-tolerance errors in certain conditions. GNSS estimates also suffer from reduced availability when there is no clear line of sight between the vehicle and a sufficient number of satellites.</td>
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<td>Thus, for the GNSS technology to provide sufficient performance (accuracy, continuity, integrity) to support railway applications requires a rigorous quantitative understanding of:</td>
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<td>1) The conditions in which out-of-tolerance errors in estimated position and speed are observed.</td>
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<td>2) The means by which out-of-tolerance errors can be detected and corrected.</td>
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<td>3) Supplementary techniques and inputs (augmentations) which improve performance, particularly continuity and integrity.</td>
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<td>On behalf of the Future Communications and Positioning Systems Advisory Group, a subgroup of the Vehicle/Train Control &amp; Communications Systems Interface Committee, data has been collected using slightly modified equipment already installed on vehicles, and new equipment sourced by the project. The data collected has been analysed and compared with existing data from previous projects and other sources.</td>
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<td>This research has shown that requirements for many railway applications can be met by low cost GNSS based solutions that are suitably designed and configured. The primary output of the research has been to provide detailed guidance on the design of a locator which:</td>
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<td>1) Has the technical capability to support applications which require trains to estimate position and speed anywhere on the railway, including locations without visibility of GPS.</td>
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**Data and analysis for a cost-effective GPS-based locator with simple augmentations cont.**

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<th>Abstract cont.</th>
<th>2) Supports upgrade or technology refresh with minimal re-integration effort.</th>
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<td>The research has presented 2 opportunities for further work. One is to continue using equipment already installed on vehicles which operate on routes that are particularly challenging in terms of GNSS visibility. The other is, using the software tools developed in project T510, to combine the results of analysis from previously and newly collected data to validate and extend the guidance contained in GE/GN8578 Guidance on the Use of Satellite Navigation.</td>
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<tr>
<th>Current Position</th>
<th>The output of this research has been used extensively to support follow on RSSB Project T990 - <em>Development of a Strategy on Train Position</em>. It is also intended to inform a further update to <em>GE/GN8578 - Guidance on the Use of Satellite Navigation</em>.</th>
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This research has investigated alternative solutions and emerging technologies that might be used to replace track circuit actuator interference detectors and enhance track circuit actuation performance, with and without train-borne track circuit assistors. This is part of a cross-industry track circuit actuation strategy.

Track circuit actuator interference devices (TCAIDs) have been effective in preventing wrong side track circuit failures caused by railhead contamination. However, TCAIDs have a variety of reliability issues that can give rise to track circuit right side failures. On behalf of the Train Control Technical sub-group, approximately 20 options for alternative methods of train detection using a track circuit overlay have been identified and considered during this research, by taking input from relevant technical and domain experts, and a number of technology providers. The research evaluated these and identified five options for further study.

Two deliverables have been provided by this research; a TCAID Asset Performance Review - focusing on an investigation concerning the current performance of the TCAID and an Options Review and Evaluation Report – investigating and evaluating new methods and techniques of improving train detection when the wheel/ rail interface is contaminated.

The TCAID asset performance review was based on information extracted from Network Rail’s ELLIPSE and Failure Management System together with interviews with selected Network Rail maintenance staff. Train detection options identification was performed by holding a workshop that brought together relevant stakeholders, industry experts and representatives from suppliers outside the rail industry to facilitate a ‘blue skies’ discussion and agree possible alternative train detection options. This was supplemented by technical searches and direct contact with technology suppliers.

The outputs of this initial research have been considered by Network Rail, members of the Train Control Technical Sub-Group and Vehicle/ Train Control and Communications System Interface Committee. In
view of the business case summary which was found to be strongly in favour of adopting a minimal TCAID Mk1 to Mk2 replacement approach, Network Rail has now identified that this is the course of action that they intend to pursue; all other options being considerably more expensive. This leaves unanswered questions relating to the potential need to continue to fit TCAs onto trains (following favourable analysis on related RSSB research project T579) solely to operate TCAIDs, as an issue for the railway industry to address in the medium-term. The Train Control Technical Sub-Group has agreed to prepare a Project Closure report on this basis.

The benefit of this research is that it has provided the railway industry with visibility of a number of viable alternatives to support TCAID replacement in both the short, medium and longer term, if an industry wide business case or future strategic initiative is found to be able to justify this. It has also identified areas for improvement in the existing TCAID design and maintenance processes, which if implemented could result in significant cost saving to Network Rail.

Published
August 2011

Current Position
The outputs of this research have been considered by Network Rail, and members of the Train Control Technical Sub Group and Vehicle Train Control and Communications System Interface Committee. In view of the business case summary which was found to be strongly in favour of adopting a minimal TCAID Mk1 to Mk2 replacement approach, Network Rail has now identified that this is the course of action that they intend to pursue; all other options being considerably more expensive. The research has also identified areas for improvement in the existing TCAID design and maintenance processes, which if implemented could result in significant cost saving to Network Rail.
**Description**

Ofcom is preparing to auction a parcel of the frequency spectrum adjacent to the band used for GSM-R and hence of interest to the rail industry. This research has led to the production of a cross-industry business case and spectrum valuation in support of future decisions on bidding for the frequency bands.

**Abstract**

The Department for Transport (DfT) Rail Technical Strategy sets out a vision of intelligent trains operating on intelligent infrastructure. In support of this there is an expectation that there will be major development and greater application of existing and future communication and positioning systems. On behalf of the Future Communications and Positioning Systems Advisory Group and the Technical Strategy Leadership Group, the aim of this research project was to enable informed decisions to be taken by the DfT, Network Rail and Great Britain’s rail industry in response to the forthcoming Ofcom auction.

From a review of concurrent RSSB-managed research, interviews with key industry stakeholders, and an industry workshop, the research has established levels of future demand and investigated the costs and benefits of providing mobile broadband data services to support operational applications. A business model was developed around this information and the outputs compared with business case valuations with the UK market valuation of similar spectrum parcels.

Although the main objectives of the research have been addressed, a decision on whether to bid during the auction has not yet been made, as the final dates and nature of the Ofcom auction have not been publicised. Owing to their commercial nature, the detailed results are not publicly available; but by conducting the research the rail industry was well positioned to respond to the Ofcom 2009 consultation on the proposed auctioning of the spectrum. Additionally, the research has produced a number of observations and lessons learnt that will be made available to the rail industry as best practice guidance for future cross-industry opportunities and associated business case developments.
The project successfully produced a business case and spectrum valuation. The outputs of this research have been progressed further within T964 Operational Communications - a programme of work to develop an effective strategy that supports rail innovation, sponsored by the Technical Strategy Leadership Group.
The development of a costed business model for DRACAS

Description
The development of a costed business model for a defect reporting analysis and corrective action system, for control command and signalling systems within the railway industry.

Abstract
On behalf of the DRACAS Working Group, a sub-group of the Vehicle/Train Control and Communications System Interface Committee (V/TC&C SIC), this research project has investigated the costs and benefits to the GB railway industry of a shared defect recording and corrective action system (DRACAS) for new control, command and signalling (CCS) systems. It has developed a costed business model, a supporting report, and a series of presentations that will be used by the DRACAS working group and the V/TC&C SIC in support of implementation decisions.

The research has built upon the work carried out on previous project T754, the development of a customer requirements specification for DRACAS. It has assumed a gradual implementation, based on increased investment in DRACAS, which will lead to greater benefits realisation across the railway industry.

The overall benefits of implementing an industry-wide CCS DRACASs are known to include: increased safety of the railway, including reduced on-track time; reduced risk, through the improved ability of duty holders to manage safety risk as required by ROGS; increased availability of systems, leading to improved punctuality of services; increased reliability of systems, including improved equipment design; increased accuracy of national trend analysis; increased visibility of stakeholder actions with associated accountability; and reduced whole life cycle costs.

The benefit of this research is to provide key industry decision makers with sufficient information to support a future, cost effective roll out and realisation of the overall benefits of a CCS DRACAS system. The V/TC&C SIC has authorised follow on project T960 - Specification of a DRACAS system architecture and process framework.
### T957  The development of a costed business model for DRACAS

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<td><strong>Current Position</strong></td>
<td>The outputs of the research have been reviewed and accepted by the DRACAS working group and V/T C&amp;C SIC. Although much work has been done on previous RSSB sponsored projects to capture the benefits of a shared DRACAS for new CCS systems, (see related RSSB project T754 Development of an Industry Defect Recording And Corrective Actions System (DRACAS) for Command, Control and Signalling Equipment) it has never before been possible to do so in a quantified way. The largest overall benefit of the research has been to show that it will prevent a substantial deterioration in overall performance across the railways that would be likely to occur were a shared DRACAS not to be used. The findings of the research and other DRACAS projects were also presented at the IRSE Aspects 2012 conference.</td>
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This research has defined an appropriate system architecture and process framework to support an incremental approach to greater convergence of existing industry systems for the development of a defect recording and corrective actions system within the railway industry.

This research follows on from previous RSSB Project T754 - Development of an industry defect recording and corrective actions system for control, command, and signalling equipment, which identified the need for an appropriate system architecture and process framework to be developed. This work was done on behalf of the Defect Recording and Corrective Actions System (DRACAS) Working Group, a sub-group of the Vehicle/Train Control and Communications System Interface Committee. The research has built upon the work of previous projects T754 and T957, The development of a costed business model for DRACAS, and has provided additional value through specialist knowledge and expertise in system architecture design. The deliverable from this research is a system architecture design document with information to support a formal proposal to amend Railway Group Standard GE/RT8106 ‘Management of Safety Related Control, Command and Signalling (CCS) System Failures’. This has specified a DRACAS architecture and framework in terms of the stakeholder interface and co-operation requirements, and has outlined the process and technical requirements that will be needed to build a DRACAS for new CCS systems. This research is available to support the implementation of a DRACAS for the railway industry and subsequent realisation of the following business benefits:

- Increased safety by reducing time on track and improving duty holders’ abilities to manage safety risk, as required by ROGS.
- Increased availability of systems, leading to improved punctuality of services.
### Abstract

- Increased reliability of systems, through improved equipment design.
- Increased accuracy of national trend analysis.
- Increased visibility of stakeholder actions and accountability.
- Reduced whole-life costs.

The next steps of implementation are being led by the ERTMS programme, with the support of the DRACAS Working Group.

### Published

January 2013

### Current Position

The output of this research is being used for the preparation of a National DRACAS prototype, presently being developed by Network Rail.
**T964 Operational Communications - a programme of work to develop an effective strategy that supports rail innovation**

**Description**
Operational Communications is a programme that supported the Rail Technical Strategy, by enabling development and implementation of communication systems to support future innovation in rail.

**Abstract**
Communication technology and service development is not a core railway business. However, a number of applications identified by the Technical Strategy Leadership Group (TSLG), while developing their technology route maps, are dependent on an effective strategy for these non-core activities.

Research carried out on behalf of the Future Communications & Positioning Systems (FC&PS) Advisory Group has confirmed the need for a single, integrated strategy for rail mobile communications. This will enable the efficient and effective delivery of both operational and passenger value-added communication services. Additionally the research confirmed the importance of commercial off-the-shelf (COTS) communication services and products, avoiding wherever possible the implementation of proprietary or outdated solutions (e.g. non-perpetuation of the R in GSM-R).

The main sources of inefficiency or additional cost in GB Rail telecoms equipment and services have been identified, and a framework developed to enable greater efficiencies to be realised through establishing policies and standards for commonly used data and services. Communication needs beyond rail operations have also been addressed.

For this reason, an integrated programme of work on operational communications, endorsed by the TSLG was implemented. The objectives of the programme were to:

- Evaluate and confirm the commercial and technology options for the delivery of mobile communications services to the railway (building on the findings of T911).
- Encourage the take up of TSLG (and T809 road map) applications to:
Abstract

- Determine an approach to data and information sharing and, developing guidance and proposing standards for use by stakeholders
- Enable the use of COTS telecoms technology within rail through the use of standard interfaces and open architecture
- Support buyers and specifiers with the procurement of services in these specialist areas
- Enable integrated communications beyond the rail sector.

Three work packages were carried out in parallel to look at:
- Strategy options and business case for rail mobile communications
- Reducing whole life costs
- Achieving a connected services framework.

Outputs include reports covering technology and commercial options, a cross-industry business case, procurement guidance, and a connected services framework.

Published

March 2012

Current Position

The outputs of this research have been used to support other projects including RSSB Project T990 - Development of a Strategy on Train Position as one of the many needed to support the implementation of the Rail Technical Strategy.
This research has assessed potential enhancements to the TY287 testing unit, to improve its measurement accuracy and to ensure its widest possible use in accordance with the proposed AWS Testing Strategy.

Previous RSSB research project T808 ‘AWS Testing, the way forward’ identified a number of areas where design enhancements to the TY287 testing unit might be possible. On behalf of the Vehicle/Train Control and Communications System Interface Committee (VTC&C SIC), RSSB has investigated these.

This research project has delivered a series of costed design proposals and options, addressing each of the areas for improvement identified within the previous research. The research has successfully:

- Designed and manufactured prototypes and carried out a small scale trial using these.
- Assessed the feasibility of carrying out minor modifications to the TY287 testing units that have already been manufactured.
- Assessed the feasibility and practicality of designing, manufacturing, and testing a modified TY287 testing unit.

For existing testing units, each of the identified design changes is relatively small, in the order of a few hundred pounds per unit, and will make each tester unit easier to use in line with the industry’s proposed AWS testing strategy. The changes will now allow improved measurement accuracy and enable wider use of the testing units in a railway or depot testing environment. The VTC&C SIC supports the findings from the research and is encouraging the industry to return existing manufactured testing units to the manufacturer for upgrade.

Published May 2014

The out-put from this research was presented to the members of the Technical Safety Review Group and Technical Standards Forum. Take up of the design options is being encouraged by the Train Control Technical Sub-Group in support of the emerging AWS testing strategy.
Description
This research identified improved methods for depot testing of vehicle-mounted track circuit assister equipment.

Abstract
The method specified in Railway Group Standard GM/RT2477 for testing track circuit assister equipment, whilst necessary for the commissioning of new-build vehicles, is considered onerous for routine maintenance testing. This research has investigated whether there is a more cost-effective and appropriate testing method for vehicles with existing TCA equipment, where a ‘fit-for-purpose’ test is all that is required.

On behalf of the Track Circuit Assistors Steering Group, a sub-group of the Vehicle Train Control and Communications System Interface Committee, the research reviewed the objectives of the existing methods of testing to understand the processes and difficulties encountered in applying them to vehicles undergoing maintenance. Then it identified the potential for improved methods that will enable testing of TCA equipment to be undertaken on vehicles undergoing maintenance anywhere in the depot, without need of the wheel/rail interface. These are capable of providing results to the same standard and integrity as the methods specified in RGS GM/RT2477.

Two deliverables have been prepared: a study report detailing the results of the research and recommendations, and a series of appendices supporting the findings and recommendations of the research. These will be used to inform a potential change to RGS GM/RT2477 and GM/GN2576.

To support industry implementation, the research has provided instructions suitable for training staff undertaking vehicle testing, for staff maintaining the test equipment and identified training requirements for selected staff. It has also provided a comprehensive list of components, identifying procurement sources and/or providing dimensioned drawings to enable any special or bespoke items that may be needed (for example the Rogowski coil).
The findings will help to ensure that the vehicle TCA testing is fit-for-purpose, in order to reduce vehicle downtime and maintenance costs. The development of a testing method that does not require use of the wheel/rail interface enables greater flexibility in testing vehicles undergoing maintenance.

The output from this research was presented to the Technical Standards Forum and copied to the depot managers who supported the research. The TCA Steering Group and Train Control Technical Sub-Group are encouraging the take up and implementation of the research findings.
**Description**

This research project has developed a process for assessing whether the vehicles currently fitted with track circuit assisters (TCAs) could be allowed to operate with a failed TCA.

**Abstract**

The rules regarding operation of track circuit assisters (TCAs) are strict and can cause significant operational delays if trains need to be taken out of service because a TCA is not working. If the rules can be reviewed and applied with regard to the risk dependent on train type, route, time of day, etc, then levels of disruption can be reduced.

On behalf of the Vehicle/Train Control and Communications Systems Interface Committee the aim of this research project was to produce a risk advisor tool that would enable train operators to assess the risk of operating specific classes of train, over a specific type of route, with TCAs not fitted or not operational. The tool supports the case for easily implemented solutions, so that existing TCA operating rules can be changed to enable trains to continue in service following TCA failure.

Validation of the tool is being carried out through a series of trials on the railway where, for short periods of time, all TCAs will be isolated. This is being done where risk is predicted by the tool to be low or moderate. The results of these trials will be used to assess areas within the Railway Group Standards and Rule Book where the serviceability and/or fitting requirements for TCAs may safely be relaxed. Some relaxations in this area have already been permitted as a result of the publication of the February 2009 Periodic Operating Notice and subsequent Rule Book amendment and are delivering significant benefits in enabling trains to continue in service following the failure of a TCA.
Abstract

The full benefits of this work are expected to be realised following the formal validation of the tool through completion of the trials. These are expected to range from allowing trains to continue in service for a short period of time following the failure of a TCA, to identifying routes and train types where a TCA is not needed on. In addition, further ‘quick wins’ may be identified during these trials. Following the completion of the first two trials with First Great Western and First Transpennine Express, it has now been possible to release an interim update to the risk advisor tool (Version 6.0) which is intended to be of benefit to the operators of heavier trains (Class 185 and above).

Published

Interim - October 2009
Initial trials report - October 2010
FTPE trials report - October 2012
ATW trials report - March 2013

Current Position

The first trial of the Risk Advisor Tool on the railway has now been completed. Following evaluation of the trial results, the TCA Risk Advisor Tool has now been updated, reviewed and made available to RSSB members for their use, such that, providing all necessary requirements are met, continued service operation with a failed TCA may be permitted. The Risk Advisor Tool is referenced in an update to the Directory of On-Train Equipment and Rule Book, which became effective at the end of 2011. Three further short trials are currently underway to complete a risk assessment that will be representative of the whole of the GB railway network.

The first of these involving First TransPennine Express Class 185 trains, has already supported an update to the TCA Risk Advisor Tool to Version 6 which is intended to be of benefit to the operators of all heavier trains, (Class 185 and above).
T906  ERTMS/ ETCS driver machine interface options for future train cab design

Description
This research has reviewed train cab driver machine interface (DMI) design proposals (for new build vehicles and retrofit) to support the planned introduction of ERTMS/ ETCS.

Abstract
On behalf of the Vehicle/ Train Control and Communications System Interface Committee, this research has reviewed the ERTMS/ ETCS driver machine interface proposals for the Thameslink project, with a view to developing recommendations for all future rolling stock projects including Crossrail, Intercity Express and High Speed 2. Retrofit designs have also been considered for existing rolling stock.

The research has considered the operations and transition needs (where transitions involve travelling between ERTMS fitted infrastructure and Class B fitted infrastructure). It has proposed solutions that seek to maximise train driver and train performance, while also considering reliability, whole life costs, and the optimised use of cab space.

The research is intended to provide information, promote uniformity of design, support design definition, and the future assessment of proposed ERTMS/ ETCS driver machine interface (DMI) designs. This is intended to provide benefit to new build trains for a number of major projects that will be planned or implemented in the near term. It will also provide design options to support the retrofit of ERTMS/ ETCS DMI onto trains for the next four or five deployments in accordance with the proposed ERTMS National Implementation Plan.

Published
Initial reports published in October 2012.

Current Position
The initial reports for this research were published during October 2012. Two follow on areas of research were then initiated by the Train Control Technical Sub-Group to further investigate the design of touchscreen, softkey and hybrid DMI displays, based initially on the proposed Class 700 Thameslink designs. The out-puts of this work are intended to further inform up-dates to GE/RT8075 - AWS and TPWS interface requirements (Appendix G).
T952 Future Traffic Regulation Optimisation

**Description**

The FuTRO project aims to promote the innovative use of technologies leading to optimised traffic management, increased network capacity, reduced energy consumption, quicker recovery from service disruption, and improved customer communications and satisfaction. It is central to the vision of a high-performing rail industry in 2040.

**Abstract**

For some years passenger traffic has been growing steadily; projecting such a trend to a 30-year horizon (recognising inherent uncertainties) would indicate the need to accommodate a very substantial increase in traffic. Simply to maintain current service levels will demand much greater efficiencies in running the railways. The Future Traffic Regulation Optimisation (FuTRO) project is looking at whole spectrum of technologies, practices, and systems that will make a substantial contribution to the railways in meeting that increase in demand. FuTRO is looking at how to achieve this increase in capacity while meeting other industry objectives of increasing customer satisfaction (the 4Cs) and reducing costs and carbon emissions.

FuTRO is an innovative, overarching programme of work that not only considers the management of the time, speed, and position dimensions, but will also look at the softer issues of railway operations that will be effected by major technical or operational change.

An integrated system of traffic operations enables optimised resource management and a more flexible response to customer demands.

This project has already identified benefits related to the industry’s 4Cs objectives. These include:

- Increased automation to reduce human activity
- Improved decision-making and control of trains to support reduction in the provision of timetable allowances to improve network capacity, reduced energy consumption and shorter perturbation recovery times.
- A comprehensive single source of data and information for better operational decisions and tailored customer information.
**T952  Future Traffic Regulation Optimisation cont.**

<table>
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<tr>
<th><strong>Abstract</strong> Cont.</th>
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<tbody>
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Outputs from this work will be implemented in the medium to long term, and will build upon the Network Rail 'Next Generation Traffic Management' system. The FuTRO Programme has a 30-year time horizon, in line with the Rail Technical Strategy, and aims to realise a step change in traffic management through the optimisation of technologies and railway operations.

Train operators and infrastructure managers will benefit from greater support for decision making, particularly during times of severe and widespread disruption. FuTRO supports: increased capacity; an integrated approach to traffic management across the network; technologies that will offer improved fuel efficiency and reduced peak power demand; real-time passenger information; and reductions in other costs.

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| **Current Position** | FuTRO is a large, on-going programme of work with several work packages. The outputs of these are published as they are produced. Whilst the overall programme is still 'in progress', please refer to the website to access published materials. |
# T990 Development of a Strategy on Train Position

<table>
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<tr>
<th><strong>Description</strong></th>
<th>Develop a high level strategy that takes account of future plans to reduce lineside infrastructure, and bring coherence to the provision of trainborne and trackside positioning capability.</th>
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| **Abstract**    | The availability of safety critical train location information derived from track-side infrastructure can no longer be assumed, as the long term ERTMS vision of the railways includes the significant reduction of infrastructure based train detection. If ‘left to the market’ appropriate integrated solutions based on GPS and other candidate technologies are unlikely to emerge.  
A high level strategy designed to address these issues is proposed, which delivers a proposal for a Train Location Service, its procurement options and a supporting business case.  
On behalf of the Technical Strategy Leadership Group, the Future Communications and Positioning Systems Advisory Group will be deciding the development of the strategy and has identified a need to engage with suppliers and users, and build upon other R&D activities. A key input is T892 ‘Data and analysis for cost-effective GPS-based locator with simple augmentations’.  
The work in developing the positioning strategy will inform the proposals for its implementation and will provide a framework for industry/supply chain to plan its provision of positioning technologies and deliver the systems necessary to support the future railway. |
| **Published**   | May 2014                                                                                                                                  |
| **Current Position** | Work is ongoing to define and agree next steps through discussion with the Vehicle Train Control and Communications System Interface Committee and members of the RSSB Future Rail team. |
T998  Non-standard 4-aspect sequences in colour light signalling areas

Description
This research is intended to provide an improved understanding of the potential benefits and risks associated with introducing non-standard consecutive cautionary 4-aspect signalling from both a train driver and CCS design perspective.

Abstract
In developing certain signalling projects (for example, Crossrail) it has not been possible to reconcile the requirements of close headway stopping services with those for non-stopping services travelling at higher speeds, and comply with the Railway Group Standard (RGS) GK/RT0045 requirements applicable to 4-aspect signalling. The industry is seeking guidance on how to address the perceived increased operational risk that arises when repeated cautionary aspect sequences (repeated as part of the signalling system rather than from following another train) are displayed.

On behalf of the Control Command and Signalling (CCS) Standards Committee, the main aim of this research is to understand how operational rules and human factors work in combination with the CCS design to support a whole system that is interpretable and driveable enough in the operational context. The first phase of the research has involved a review of relevant standards, research literature, and incident reports. It has then collected data to investigate how drivers respond to different signalling layouts. The output deliverables include a briefing note and final report. The second phase of research will review methods of mitigating the risk identified and develop a risk assessment tool.

Implementation of the research findings will be through CCS Standards project 10/017b which is developing RGS GK/RT0058 and GK/GN0658 on the basis of existing practice, to include requirements for cautionary aspects in 4-aspect Track Circuit Block signalling areas. This project will allow RSSB to:

• Deliver improved guidance to major projects
• Check that existing CCS measures are appropriate and update them if necessary (as part of project 10/017b).
### Abstract cont.
- Make better assessments of the risks and benefits of consecutive cautionary sequences to inform projects and derogation applications.
- Make better assessments of mitigation measures where consecutive cautionary aspects are proposed.

### Published
In progress

### Current Position
The output of the first part of this research has provided considerable insight into the human factors issues associated with train operations in areas where non-standard 4-aspect sequences have previously been installed. The CCS Standards Committee is currently considering whether to proceed with the building of a human factors risk assessment tool to take this work further.
Review of the braking tables in RGS GK/RT0075 Lineside Signal Spacing and Speed Signage

**Description**
Develop a high level strategy that takes account of future plans to reduce lineside infrastructure, and bring coherence to the provision of trainborne and trackside positioning capability.

**Abstract**
Railway Group Standard GK/RT0075 - Lineside Signal Spacing and Speed Signage provides a number of braking tables that are based on historic freight and passenger fleets. It is thought that many of the freight trains currently running on the national network can brake in significantly shorter distances than those shown within this standard. It could therefore help to enable Network Rail and Railway Undertakings to safely increase the capacity of the network if the braking tables were reviewed and revised to give more up to date values.

On behalf of the Control Command and Signalling Standards Committee, this research will comprise an analysis of the braking performance of all freight vehicles currently authorised to operate on Network Rail lines, to determine braking performance, variable factors including the computation of braking distances for a range of rising and falling gradients and speeds, and potentially undertaking practical trials at the Network Rail national testing facility. Consultation and co-operation with stakeholders (Train, Freight and Rolling Stock Operating Companies, Plant operators and Network Rail) will be required to establish relevant issues and to ensure a successful outcome.

A summary of findings report will detail the outcome of this research and provide recommendations for its implementation. This will include guidance on the application of signal braking distance data, speed restriction braking data, line-side signage and braking characteristics on ETCS signalled lines.

This research will help inform a potential change in Railway Group Standard GK/RT0075. Further work will be needed to take account of recommendations arising from the project on how potential benefits might best be achieved.
| **Abstract** | It is envisaged that the ultimate benefit of this research could be that it will help to enable Network Rail and the Railway Undertakings to achieve optimum distances for all trains to decelerate, leading to improved headways and more efficient operation of the national network. |
| **Published** | In progress |
| **Current Position** | Early versions of the research deliverables have indicated the possibility of some freight trains and consists, by virtue of their braking performance, being able to travel at speeds approaching those of passenger trains. This may allow the introduction of further procedural changes to railway operations that will benefit freight operators. |
## T1005 Enhancement of the track circuit actuator risk advisor tool to include on-track machines

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<td><strong>Abstract</strong></td>
<td>The movement of on-track machines can be difficult and disruptive to the operation of the railway following an on-track machine track circuit actuator (TCA) failure. This research project seeks to extend the benefits of previous RSSB Project T579 to the operators of on-track machines. Carried out on behalf of the Vehicle/Train Control and Communications System Interface Committee, the project has included a review of common on-track machine characteristics and operations data by an expert panel. The deliverables from this research include a further developed version of the TCA risk advisor tool and user guide. Implementation of the research findings will be through a further review of the Rule Book GE/RT8000 OTM and TW5 modules and DOTE, and by making the improved tool available to on-track machine operating companies. The benefits of this research will include ease of operation in the event of on-track machine TCA failure (particularly outside the area of possession), leading to a reduction in the number of service cancellations and the late release of possessions.</td>
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<td><strong>Current Position</strong></td>
<td>Early versions of the research deliverables are expected to show that for the vast majority of on-track machines, safe in service operation can be permitted following the failure of a single TCA. A review of the Rule Book is currently underway to assess how the findings of this research might best be implemented.</td>
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**T1043 - Viability of ETCS limited supervision for GB application**

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| **Abstract** | With the ETCS cab fitment timescales defined in Version 4 of the ERTMS cab fitment programme, a substantial number of traction units will be ETCS fitted by 2020. This presents an opportunity of using the onboard ETCS equipment to provide ETCS Limited Supervision (LS) based train protection on conventionally signalled lines.

ETCS LS has the capability to replicate existing AWS/ TPWS functions and potentially, for trains with lower braking capability, to provide enhanced train protection to that provided by existing AWS/ TPWS solutions.

The first stage of this research (WP01) is intended to be a high level study to state what ETCS LS is and is not; available ETCS functionality, potential benefits, how these are defined and how they can be applied.

The second stage (WP02) is intended to identify and define various ETCS LS system configurations that deliver, as a minimum, the same functionality as existing AWS/ TPWS solutions while enhancing train protection and to determine the business and safety benefits associated with the implementation of an ETCS LS solution to support the industry in deciding whether it is a viable option.

The out-put of WP01 is intended to be a high level status report based on what has already been done in Europe and how we might be able to apply this in GB. The purpose of this report will be to raise awareness and understanding of ETCS LS and its capabilities within the railway industry. WP02 will then go on to provide further deliverables in the form of a system definition report, a business case report and a summary and recommendations report.

It is intended that this research should be desk based in the first instance. If the business case supports implementation of an appropriate system configuration, then the application of ETCS LS could be achieved through the national ERTMS programme.|

**Published** | In progress |

**Current Position** | RSSB has currently invited tenders to progress the first stage of this research. |
Where can I find research?

All the research outputs that have been published since RSSB began its programme can be found at ‘Research Topics and Projects’:

http://www.rssb.co.uk/research-development-and-innovation/research-and-development/research-project-catalogue

If you know the reference number for the project – eg TXXX – you can use the Search field at the top of the projects list to find it. Alternatively enter a keyword in the Search field to find all the projects with that word in their title.

The previous pages contain listings of the published and current CC&S projects – correct at the time of publication.

We hope this helps you find the information that is most relevant to you.

If you can’t find what you’re looking for, please contact us – enquirydesk@rssb.co.uk
Each project has a research brief that provides a concise summary.

### Research Brief

**Driver advisory information for energy management and regulation**

**T724 - February 2010**

#### Background

One of the most promising opportunities for optimising railway energy consumption and network capacity is by regulating train speed to ensure timely arrival at pre-planned stopping points and by avoiding conflicts with other trains at junctions. On a highly utilised railway network it is all too common that a train approaches a station or junction at a time when its required platform or route is blocked by another train. The consequence of this is that the train has to brake to a low speed or stop on the approach to the station or junction, and then accelerate again when the conflicting train has moved away.

The reason for this stop-start running is that there is no means of advising a train driver that they are approaching a conflict point, until they reach the position at which he needs to start braking to a stop. If a means can be devised to regulate the speed of trains in advance of conflict points, this will realise benefits through a reduction in:

- Energy consumption and emissions by avoiding unnecessary braking
- Energy consumption and emissions through running at reduced speed whilst achieving arrival on-time
- Train delays and better utilisation of track capacity by running through junctions and station approaches at higher speeds.
- Train maintenance costs through reduced brake wear
- SPAD risk through fewer approaches to red signals.

A number of Train Operating Companies already have recirculating initiatives that aim to reduce energy consumption and emissions through training of drivers to regulate train speed to avoid early arrival with respect to the pre-planned timetable. However, the benefits of this approach are limited as the driver is not provided with any real time support to achieve this aim, and there is no means of informing the driver of a new target arrival time to take account of conflicts that arise when trains are running out of course.
Where can I find research?

SPARK provides a way for the rail sector and others to work together and share knowledge more efficiently on-line, with the aim of reducing duplication, speeding up innovation, and maximising value.

Researchers, innovators, and decision makers across the rail community are able to upload and share information via SPARK so other users can find out what is known and who knows it, and this creates opportunities for networking and cooperation.

In partnership with UIC, RSSB is enhancing SPARK to create an even bigger on-line ‘knowledge sharing community’, drawing on the combined wisdom from railway administrations and centres of excellence across the globe.

During this enhancement phase, access to SPARK will continue to be available to RSSB members, knowledge sharing partners and registered researchers in the Rail Research UK Association. From early 2013 new access levels will be available, including that of ‘reader’ which is open to all.

Register for access to SPARK at:
http://www.sparkrail.org
The RSSB R&D e-newsletter is an email bulletin that keeps the industry updated on the latest research projects to be started or published.

To view the most recent edition and to sign up for your own copy, visit:

http://www.rssb.co.uk/research-development-and-innovation/research-and-development/r-d-e-newsletter

If you have enquiries about research contact the RSSB Enquiry Desk – enquirydesk@rssb.co.uk, tel 020 3142 5400