## National ERTMS Business Requirements

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Issue status

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Following extensive review through ERTMS Strategy Group, approved for formal issue by David Clarke, Chair of ERTMS Strategy Group on 19 April 2012 (minute 2.2 of the meeting refers).

General information

This document has been prepared by RSSB on behalf of the ERTMS Strategy Group (ESG).

ESG members wishing to use the information contained in this document as the basis for further work are strongly advised to contact RSSB for current information on status, further guidance and the possibility of additional support.

Uncontrolled copies of this document may be obtained from the Head of New Systems, RSSB, Block 2 Angel Square, 1 Torrens Street, London EC1V 1NY.
1 **Introduction**

1.1 **Purpose and scope**

1.1.1 The Great Britain (GB) European Rail Traffic Management System (ERTMS) deployment plan is endorsed by the ERTMS Strategy Group supported by the Programme Control Board. The ERTMS Strategy Group owns the requirements in this document.

1.1.2 The purpose of this document is to define the business requirements for the National ERTMS Programme. The business requirements:

a) Provide a means to contribute towards the delivery of the rail industry strategy as set out in the Rail Technical Strategy and controlled by Technical Strategy Leadership Group.

b) Provide direction to the ERTMS Programme Control Board, particularly in respect of the National Generic ERTMS Principles [RD7].

c) Provide guidance to the National ERTMS Programme and delivery projects in their deployment of ERTMS.

d) Contribute to the development of a high-technology railway.

e) Contribute to the development of a competent, appropriately skilled workforce.

1.1.3 The scope of the business requirements is the GB Mainline Railway and the requirements are applicable to any type of application of ERTMS (for example, Level 1, Level 2, Level 3 and ERTMS-Regional).

1.1.4 This document has been created to provide a stable basis for nationwide ERTMS development and rollout. It is not expected to surprise industry specialists and indeed some of the requirements might appear obvious. However, there is benefit in having a common understanding, shared expectations and having them explicitly written down.

1.1.5 The requirements in this document do not replace or contradict any mandatory European specifications, eg Technical Specifications for Interoperability (TSIs).

1.2 **Background**

1.2.1 Initially in Great Britain the principal requirement for ERTMS was to improve safety. Over approximately the last ten years, capacity became a more significant influence and then, more recently, cost reduction.

1.2.2 The business case for ERTMS is based on the opportunity to immediately reduce the cost of resignalling by 40% through implementation of ERTMS Level 2 and to open up the possibility of a further cost reduction through the development of ERTMS Level 3, to enable an overall cost reduction of 50% for new signalling in ten years time.

1.2.3 ERTMS has the opportunity to provide other benefits, including reduced disruption compared with conventional resignalling, improved safety and the potential for increased capacity. Also, it can be compatible with the introduction of a traffic management system that could enhance capacity, improve train performance and reduce energy consumption.
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1.3 Goal of ERTMS

1.3.1 The goal of implementing ERTMS onto the GB Mainline Railway is to contribute towards delivering the strategic outputs defined in the Rail Technical Strategy and the 30 year aspirational ‘stretch targets’ set by the Technical Strategy Leadership Group which are [RD1]:

a) Halving the cost of running the railway. After allowing for the increased cost of rolling stock, the ERTMS deployment plan [RD6] predicts ERTMS to be 30% to 60% cheaper to renew than conventional signalling and is also cheaper to operate.

b) Doubling capacity where required. Level 3 ERTMS can improve technical headway between 10 and 20% compared against Level 2 ERTMS depending on circumstances [RD5].

c) Reduction in customer dissatisfaction by 90%. ERTMS has the potential of supporting performance, timetable and information benefits.

d) Reducing carbon in line with Government policy (50% by 2050 at the time). ERTMS traffic management could offer optimum speed management.

1.3.2 The European Commission White Paper ‘Roadmap to a Single European Transport Area’ [RD2] lists ten goals as necessary to achieve competitive and more efficient transport. The TSLG targets appear to generally align with the goals of the White Paper. Those for rail include:

a) 30% of road freight over 300km to transfer to rail or water by 2030 rising to 50% by 2050.

b) Triple the length of the high speed rail network by 2030 with completion of an European Union network by 2050.

c) Maintain a dense railway network in all Member States with the majority of medium distance travellers (journeys up to 3 – 4 hours) using rail by 2050.

d) By 2050 connect all core airports to the railway network – preferably high speed.

1.3.3 The overall safety performance of the GB railway will be at least maintained throughout the lifetime of ERTMS as this is a requirement of the European Railway Safety Directive [RD8].

1.3.4 There will be a single automatic train protection system for the GB railway.

1.3.5 The safety risk associated with the operation of ERTMS on the GB railway will be maintained and where reasonably practicable, reduced, taking into account the competitiveness of the mode in accordance with the European Railway Safety Directive [RD8] and reduced to a level that is as low as reasonably practicable (ALARP) in accordance with the Health and Safety at Work Act.
1.4 Assumptions and constraints

1.4.1 The requirements in this document assume that:

a) ERTMS continues to be the long-term system of choice, ie no other superior or cheaper system, compliant with the CCS TSI under the Interoperability Directive [RD11], emerges that renders ERTMS obsolete.

b) The proposed National ERTMS Deployment Plan [RD6] is consistent with these business requirements, noting that application of ERTMS may not be the first intervention in the plan.

c) The proposed National ERTMS Deployment Plan [RD6] is approved through industry process separately to these business requirements.

1.4.2 The requirements in this document have the following constraints:

a) The overall cost of introducing ERTMS, including transitional arrangements for rolling stock, is no worse than the equivalent cost under a conventional renewals and/or enhancements plan.

b) The application of ERTMS is compliant with the CCS TSI under the Interoperability Directive [RD11].

1.5 Context

1.5.1 These business requirements have been developed to support the specification of ERTMS for National Deployment and in particular to be a ‘parent’ for National Generic ERTMS Principles and the National ERTMS Deployment Plan.

![Outline context of Business Requirements](image-url)
1.6 References

1.6.1 The following documents provide supporting information and were used to develop these ERTMS Business Requirements:

[RD1] TSLG “route maps” (Technical Strategy Liaison Group), Autumn 2010


[RD5] ERTMS Level 3 Risks and Benefits to UK Railways Final Report, September 2010


1.7 Business requirement format

1.7.1 Paragraphs in this document that are enclosed by a solid line are requirement statements. For example:

```plaintext
<Business Requirement Title>
<Principle Text>
Rationale: <Rationale Text>
Guidance: <Guidance Text>
```

1.7.2 Bold text enclosed by the solid line includes the title (Business Requirement Title) of the statement, and the unique identifier (Source ID) of the statement which is prefixed with BUS (Business Requirements).

1.7.3 Non-bold text enclosed by the solid line is the normative text of the statement itself, that is the part of the statement that must be complied with wherever possible given the other practical constraints and requirements of a given project.

1.7.4 Each Business Requirement is accompanied by the following attributes:

a) Rationale describes why the Business Requirement is needed or explains particular ‘design’ choices that have been made in writing the text of the Requirement itself (eg why X is specified instead of Y).

b) Guidance provides informative, background information that is relevant to the business requirement and may provide details of indicative solutions.
2 Business Requirements

2.1 Cost

<table>
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<th>Bus: Reduce cost</th>
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<tr>
<td>The implementation of ERTMS on the GB Mainline Railway shall reduce costs and in so doing contribute to a reduction of capital expenditure costs and operational expenditure costs by at least 50% by 2035.</td>
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**Rationale:** To contribute towards delivering industry cost saving and capacity targets set by Technical Strategy Leadership Group (TSLG).

**Guidance:** The ERTMS programme needs to continuously improve and reduce cost throughout the life cycle of ERTMS. The basis for the 50% reduction is the cost during the 2010/11 financial year.

After allowing for the increased cost of rolling stock, the ERTMS deployment plan [RD6] predicts ERTMS to be 30% to 60% cheaper to renew than conventional signalling and is also cheaper to operate. ERTMS Level 3 is capable of delivering further cost reductions and ERTMS regional does not require continuous GSM-R coverage thus making it even more cost effective.

ERTMS Level 3 or ERTMS regional are the long term solutions because they both provide the best option for capital expenditure and operational expenditure cost savings. This is because lineside signals and train detection can be removed from, or not provided on, the trackside infrastructure. ERTMS Level 3 is suitable for application on high density routes and ERTMS regional is suitable for application on low density routes.

ERTMS Level 3 is capable of delivering further infrastructure cost reduction of around 25% on top of the 40% already identified by the ERTMS Programme Team as available for ERTMS Level 2 without lineside signals. Both figures use Network Rail’s SEU-based cost model to compare ERTMS with modern aspect signalling [RD5].

Multiple barriers to adopting ERTMS Level 3 exist, eg the requirement for an enhanced radio system (beyond GSM-R), and a solution for train integrity [RD5]. The ERTMS programme should plan carefully and manage the risks prior to the introduction of ERTMS Level 3.

Even with ERTMS Level 3, track based detection and fallback signalling may be required at critical locations [RD5]. This may also apply to ERTMS regional.

To reduce the cost of introducing Level 3, requirements should be fed into the future plans for communications upgrade beyond GSM-R, and the train integrity requirements taken into consideration for new trains [RD5].
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**Bus: De-risk implementation**
The strategy for the implementation of ERTMS on the GB Mainline Railway shall employ risk management so that new types of application do not present unacceptable risk to business.

**Rationale:** To manage risk associated with novel technology which may impact performance (including reliability, availability), safety and cost.

**Guidance:** It is highly recommended to trial a new ERTMS application type (such as ERTMS Level 3) on one route prior to further rollout. The Hertford National Integration Facility is an example of a facility to trial ERTMS so that applications can meet future needs. Optionally, technology can be trialled elsewhere providing the site is suitable and the risks have been understood and managed.

A competency framework could be developed to de-risk the implementation of ERTMS.

**Bus: Facilitate a Strong Supply Base**
The procurement and introduction of ERTMS assemblies shall take into account market resilience and sustainability from suppliers whilst maintaining competitiveness.

**Rationale:** To reduce costs by increasing competition between suppliers and to manage the risk of obsolescence.

**Guidance:** The facilitation of multiple suppliers for the same scheme is a complex challenge which introduces new interface risks. It is the role of the ERA to ensure that the specification and test requirements developed ensure that there is compatibility of the various suppliers’ systems.

**Bus: Avoidance of Historic Constraints**
The application of ERTMS on the GB mainline shall exploit the opportunities offered by ERTMS and abandon historic constraints which are no longer applicable.

**Rationale:** To contribute towards delivering industry cost saving and capacity targets set by TSLG.

**Guidance:** The complete design needs to be based on system engineering and safety principles and need not necessarily be constrained by existing practice.

**2.2 Performance**

**Bus: Maximise System Availability**
The availability of the ERTMS application shall be maximised as far as is economically justifiable.

**Rationale:** To contribute to the network objectives of improved capacity and operational performance and enhanced safety.

**Guidance:** System availability is required to meet the operational needs of both the GB Mainline Railway network and the vehicles that operate over it, taking route-specific needs into account.
Cost-effectiveness of availability is dependent on the ability to deliver equipment to the point of need in a timely manner and, where possible, maximise commonality between components.

It is expected that trackside availability can be planned at project level. Onboard availability can be determined for a particular train fitment.

**Bus: Maximise System Reliability**
The reliability of an ERTMS application shall be maximised as far as is economically justifiable.

**Rationale:** A high level of system reliability is expected to be required to meet the operational needs of both the GB Mainline Railway and the vehicles that operate over it.

**Guidance:** System reliability is required to meet the operational needs of both the GB Mainline Railway rail network and the vehicles that operate over it, taking route-specific needs into account.

It is expected that trackside reliability can be planned at project level. Onboard reliability can be determined for a particular train fitment.

This business requirement also supports BUS-04 so that the greatest abandonment of historic constraints can be achieved.

**Bus: Improve operational performance**
The implementation of ERTMS on the GB Mainline Railway shall be capable of improving existing operational performance levels where there is a business need.

**Rationale:** To provide improved services under perturbed conditions and to minimise the impact of engineering work.

To contribute towards delivering industry customer satisfaction targets set by TSLG.

**Guidance:** This is related to providing the ability to maximise performance and therefore lead to an improvement in system availability and train punctuality. There is likely to be a need to improve performance where justified in a business case.

Examples of this can include:

- Providing facilities so that perturbation can be recovered quicker, eg facilities for bi-directional operation.
- Implementing ERTMS so that it is more reliable, eg removing trackside train detection equipment and using train position reports with onboard train integrity systems to detect trains.
- The ability to apply and remove speed restrictions quicker.

There is a potential trade off between performance and capacity. Traffic management systems can improve performance; this is the subject of requirement BUS-09.
2.3 Capability

**Bus: Ensure ERTMS is widely applicable**
The implementation of ERTMS on the GB Mainline Railway shall be capable of application on all types of routes, with their different service patterns and types of traffic, throughout the service life of ERTMS.

**Rationale:** To provide technical and operational consistency to mitigate the risks associated with non-consistency.

**Guidance:** ERTMS design needs to be adaptable to the needs of lines with different speeds (eg high or low speed), traffic densities (eg low-density rural or high-density urban) and traffic mixes (eg passenger, freight or mixed). During the expected long service life of ERTMS operational needs may evolve significantly, eg resulting in much higher linespeeds than in GB today.

The technical principles and standards for the implementation of ERTMS on the GB mainline need to be specified according to the safety and performance requirements necessary for the predicted traffic type and usage.

The provision of continuous GSM-R data radio or fixed train detection coverage may not be cost-effective for low traffic-density rural lines, etc. Some locations may need to retain lineside signals to support the operation of unfitted trains. Consequently, a range of ERTMS configurations are required to cover the GB Mainline Railway.

The process used for early applications of ERTMS in GB needs to take account of subsequently extending the process for different types of routes.

**Bus: Facilitate Traffic Management**
The design of ERTMS applications shall include or make provision for traffic management systems.

**Rationale:** To meet the industry carbon and capacity target set by TSLG.

**Guidance**
This is related to providing the ability to maximise performance and therefore lead to an improvement in system availability and train punctuality.

**Bus: Facilitate Engineering Access**
The design of ERTMS applications shall not impose restrictions on the ability to provide engineering access.

**Rationale:** To enable economic maintenance of railway infrastructure.

**Guidance**
ERTMS may not facilitate this directly, this could be achieved by a traffic management system, and ERTMS would be required to support this. Engineering access applies to fixed infrastructure and rolling stock.
Bus: Facilitate Automatic Train Operation
The design of ERTMS applications shall include or make provision for automatic train operation systems.

**Rationale:** To meet the industry cost and capacity targets set by TSLG.

**Guidance:** This is related to providing the ability to maximise performance and therefore lead to an improvement in system availability and train punctuality.

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Bus: Maintain safe user workload and competence
The implementation of ERTMS on the GB mainline railway must not increase or decrease user workload and user competence beyond what is considered acceptable for the safe and efficient operation of the railway.

**Rationale:** Users, in particular drivers and signallers, must be provided with adequate information, controls and indications to enable relevant activities to be carried out in a manageable and efficient manner.

**Guidance:** The aim is that the introduction of ERTMS must not place unmanageable workload demands upon users (either too low or too high). This is particularly relevant to drivers and signallers, but could also impact on other staff, for example persons in charge of possessions (PICOP), Engineering Supervisors etc who interact with the railway.

If workload is too low, users may lose situational awareness and be less likely to respond appropriately to unanticipated events. If workload is too high, users may take incorrect decisions or miss important information.

The expected workload should be assessed when ERTMS is introduced and then managed. The information, controls and indications provided should support users in carrying out their work and not place unnecessary demands on users.

ERTMS is likely to cause changes to the competence requirements of users. Application of ERTMS may present opportunities for alternative control measures for risks mitigated by user competence, hence reducing the dependence on competence in these respects with inherent reduction in training/competency management requirements.

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Bus: Deliver maximum capacity of the railway
The implementation of ERTMS on the GB Mainline Railway shall be capable of delivering the maximum capacity of the railway where there is a business need.

**Rationale:** This is so that the implementation of ERTMS does not constrain capacity and supports the delivery of capacity targets set out in the Network Rail route utilisation strategies [RD4] and the UK strategic freight network [RD3]. Also, the TSLG strategy [RD1] requires a substantial increase in capacity.

**Guidance:** To achieve this there may be a case for the design and application to automatically provide the maximum foreseeable capacity needs or make passive provision for additional capacity where a case can be made.
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The requirement to operate the timetable (and reasonably foreseeable increases to the timetable) under normal and perturbed operation and maintenance is likely to be the greatest influence on the minimum required capacity.

Examples where improvement can be made include:

- Better utilisation of the infrastructure by trains, eg by releasing routes quicker, reducing overlap lengths and reducing flank protection.
- Removal of lineside signalling so that the signal layout constraints are removed which impact on capacity and line speed.
- Taking opportunity to provide maximum capacity with routes minimal trackside track detection.
- Providing cost effective bi-directional signalling with ERTMS to enable working around line blockages.

It is important that the design configures the correct ERTMS parameters, both trackside and onboard because this will lead to trains being supervised to optimum speed profiles.

The capacity requirements for a scheme will determine how ERTMS is applied and this may not require ERTMS to deliver an increase in capacity.

2.4 Safety

Bus: Review Safety Management Systems

The application of ERTMS shall contribute to the objectives of the Railway Safety Directive.

Rationale: To fulfil the requirements of the Railway Safety Directive [RD8], Health and Safety at Work Act [RD9] and the Railways and Other Guided Transport Systems (Safety) Regulations [RD10].

Guidance: The Railway Safety Directive requires that the level of safety is maintained and where reasonably practicable, improved, taking into account the competitiveness of the mode.

Dutyholders are required to maintain their safety management systems. The application of ERTMS may affect their safety management system even if the dutyholder is not directly involved in the application of ERTMS. For example, the fitment of ERTMS on trackside infrastructure where conventional signalling is also provided may impact previous assumptions made when determining whether the provision of onboard automatic train protection is reasonably practicable.
Appendix A  Definitions and Abbreviations

A.1 Definitions

Availability
The ability of a product (or system) to be in a state to perform a required function under given conditions at a given instant in time or over a given time interval assuming that the required external resources are provided.

European Rail Traffic Management System (ERTMS)
The European Rail Traffic Management System as defined in the commission decision 2001/260/EC on 21 March 2001. The EC definition comprises ETCS and GSM-R.

Mainline Railway
Mainline Railway has the meaning given to it in the Railways and Other Guided Transport Systems (Safety) Regulations 2006.

Reliability
The probability that an item can perform a required function under given conditions for a given time.

A.2 Abbreviations

ALARP     As Low As Reasonably Practicable
ERTMS     European Rail Traffic Management System
GSM-R     Global System for Mobile Communications - Railway
TSLG      Technical Strategy Leadership Group