ETCS Onboard System - Baseline 3 - National Onboard Subsystem Requirements Specification

Prepared By:

Mike Burbeck  
Senior Engineer [Systems]

Agreed By:

Chris Winter  
Senior Engineer (T&RS)

Reviewed by:

ERTMS Systems Body (ESB)

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Operational Strategy Group (OSG)

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Authorised By

Andrew Simmons  
Technical Development Director

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1 Introduction

1.1 Purpose of this document

This document provides a specification, intended to promote effective implementation of ETCS on rolling stock. It is applicable to both retro-fit and new build installations, and provides requirements that are optimised for operation on the GB rail network.

The document provides the requirements which have been developed as part of a suite of ETCS requirements, covering all elements required to optimise performance and operation of an ETCS railway. The document can be utilised as a standalone specification for the onboard aspect of the ETCS system; further details of the parent requirements that drive the development of this specification are included within the National Output and System Requirements Specifications [RD2] & [RD3].

This Specification for the ETCS Onboard has been written to complement the ERA specifications for Baseline 3 ETCS [RD1]. Every effort has been made to avoid conflict with the Baseline 3 specification but in case of conflict the Baseline 3 specification takes precedence.

The document is set out in the form of standard requirements with the National Onboard Sub System (NOSS) identifier, followed by guidance notes where appropriate.

1.2 Scope

This document consists of requirements which describe the functionality and application of the ETCS Onboard optimised for application on the GB rail network at all required levels of operation.

These requirements do not prevent the ETCS operating in conjunction with an Automatic Train Operation (ATO) system. Requirements will be added at a later date once the European specification for adding ATO to an ETCS system has been finalised, currently planned for completion by the end of 2014. Projects are encouraged to seek advice from the National ERTMS Programme if there is a wish to facilitate early introduction of ATO onto fleets.

These requirements do not prevent the ETCS operating in conjunction with a Traffic Management (TM) system. No specific TM requirements have been identified for inclusion to date.

Specific requirements and domain knowledge for a particular fleet of trains is not included within this document, and will need to be defined by the Contracting Entity or their appointed Agent.

Nothing in this document obviates any legal requirement to which any of the parties must comply. Furthermore, it does not preclude operation of a TSI compliant vehicle on the GB rail network, nor a vehicle compliant to this specification operating on TSI compliant infrastructure outside the GB rail network.

1.3 Context

This document is has been developed from a number of sources. The Trainborne Functional and Application Specification of Onboard ETCS Assembly [RD4] as used on Cambrian, and the Rail Industry Standard for ETCS [RD5], have been used as the base document, upon which this is founded. Subsequently to that, input from the national ERTMS programme, ETCS suppliers, and the wider rail industry has been used to further develop the requirements. A series of workshops and industry consultations have identified redundant information for removal and new requirements for addition, to take account of lessons learnt which, in some cases, has resulted from significant divergence from the original documents RD4 and RD5. Guidance has been added to justify such major changes.
Requirements deleted through the development process have been captured within reference document [RD9], along with justification for their removal.

1.4 Terms Abbreviations

Abbreviations are explained in full where used in Requirements. A fuller explanation of Terms and Abbreviations can be found in Appendix A and the ERTMS Glossary [RD6].

1.5 Requirements Formal, Applicability and Identification.

1.5.1 Basic Requirement Form

All requirements are in the following form:

<table>
<thead>
<tr>
<th>Requirement text.</th>
<th>Unique NOSS-Identifier</th>
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<tbody>
<tr>
<td>Status: Normative/Application-Specific/Preferred. (See Section 1.5.2 below)</td>
<td></td>
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<tr>
<td>Rationale: Shows applicability of the requirement.</td>
<td></td>
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<tr>
<td>Guidance: Supplementary information to support Requirement interpretation and satisfaction.</td>
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1.5.2 Normative / Application-Specific / Preferred status

Each requirement within this document is identified as one of: normative, preferred, or application-specific. These are defined as follows:

- **Normative**
  - Necessary to achieve compatibility or optimisation of the system in relation to the GB rail network, or
  - A system feature that is deemed to be cost effective and universally beneficial.

  Satisfaction of normative requirements in compliance with this document is expected to be a requirement of individual delivery contracts.

- **Application-Specific**
  - A requirement which may not be relevant or applicable to every application of ETCS onboard to a vehicle.

  Satisfaction of application-specific requirements in compliance with this document is expected to be a requirement of individual delivery contracts, as appropriate to the vehicles being considered.

- **Preferred**
  - A requirement of lower importance which, whilst not essential, the industry would prefer to be satisfied

  Satisfaction of preferred requirements in compliance with this document is not expected to be a requirement of individual delivery contracts.

1.6 Areas for development

Noting that this document represents the best understanding of the needs of UK rolling stock at the time of publishing, it is recognised that there are a number of areas where the document may be deficient. New deficiencies may be identified as understanding of ETCS develops, as
well as areas being closed out through further work being undertaken. A list of the current known areas of deficiency are listed in Appendix C
2 Responsibility

2.1 Fitness for Purpose

The onboard ETCS subsystem shall be compatible with the UK implementation of the trackside subsystem.

**Status:** Normative

**Guidance:** Network Rail is intending to specify the ETCS trackside subsystem against Baseline 3 Maintenance Release 2 of the ETCS specifications. It is understood that previous releases of the baseline 3 specifications are not guaranteed to be forward compatible with this version; therefore in this case the onboard component would be required to meet baseline 3 maintenance release 2 as a minimum.

It is noted that these specifications are still subject to change as maintenance releases are developed; the expectation would be for the latest set of specifications to be implemented for each project. Further guidance on this matter should be sought from the ERTMS system body.

The ETCS onboard system shall not adversely affect the Route Availability of the vehicle.

**Status:** Normative

**Guidance:** The desire is for ETCS to have no adverse impact on the vehicle performance, or the railway as an entire system, therefore the vehicle should be able to operate in on all routes / lines that it was able to prior to ETCS fitment. Satisfaction of this requirement is seen as an absolute necessity in reaching that goal.

Note, where vehicles operate abroad as well as the GB rail network then this must be considered in the design.

The ETCS onboard system shall not adversely affect the gauge clearance of the vehicle.

**Status:** Normative

**Guidance:** The desire is for ETCS to have no adverse impact on the vehicle performance, or the railway as an entire system. Satisfaction of this requirement is seen as an absolute necessity in reaching that goal.

Note, where vehicles operate abroad as well as the GB rail network then this must be considered in the design.

The ETCS onboard system shall not adversely affect the maximum design speed of the vehicle.

**Status:** Normative

**Guidance:** The desire is for ETCS to have no adverse impact on the vehicle performance, or the railway as an entire system. Therefore retaining the maximum speed of the vehicle (both in terms of the ETCS ceiling speed and the vehicle's...
design speed) is seen as a necessity in reaching that goal.

Note, where vehicles operate abroad as well as the GB rail network then this must be considered in the design.

The ETCS onboard system shall not adversely affect the braking capability of the vehicle.

Status: Normative

Guidance: The desire is for ETCS to have no adverse impact on the vehicle performance, or the railway as an entire system. Therefore retaining the vehicle’s existing braking performance (with regards it’s physical stopping capability) is seen as an absolute necessity in reaching that goal.

Note, where vehicles operate abroad as well as the GB rail network then this must be considered in the design.

The right for the vehicle to operate on specific routes under ‘Grandfather Rights’ shall not be revoked as a result of the installation of the ETCS onboard system

Status: Normative

Guidance: ‘Grandfather Rights’ is permission to operate rolling stock built before current regulations or standards were issued that do not comply with current regulations or standards, or for which specific derogations have been issued. It is important that the fitment of ETCS does not invalidate the rights of that stock. It is recommended that the supplier discusses this requirement with the DeBo before design takes place.

The ETCS onboard system shall, as a minimum, meet the onboard MTBSAF requirements specified in the Preliminary ERTMS Reliability Specification (NR/AM/SA/SPE/00147).

Status: Normative

Guidance: NR/AM/SA/SPE/00147 defines reliability and availability targets for the ETCS system, which are then apportioned to the respective elements of the onboard and trackside.

Operation in IS does not contribute to the MTBSAF requirements.

The onboard ETCS system shall take no more than 60s to go from No Power (NP) mode to being ready to accept data entry in Standby (SB) mode (Status S0).

Status: Normative

Guidance: This figure shall include all the time taken to undertake the system self test when operating in a nominal condition.

This figure is applicable to both start of mission when the vehicle is being energised, and after an ETCS reset where the onboard system has been de-powered and re-powered manually (as a result of system failure or otherwise).

State S0 is defined within Subset 026 chapter 5.
The onboard ETCS system shall take no more than 5s to enter Standby (SB) mode from any other available mode, upon cab closure, when all other necessary conditions for the transition are met.

**Status:** Normative

**Guidance:** Closing the cab when in an operational mode (FS, SR, OS, and so forth) will cause the ETCS onboard system to transition back to SB. Delays of more than 5s in returning to SB are unacceptable.

The onboard ETCS system shall be capable of operating in Level 3 without modification to the existing ETCS hardware.

**Status:** Application-Specific

**Guidance:** For Onboard ETCS systems, the migration to L3 includes using onboard train integrity proving rather than using trackside train detection to prove train integrity. Inclusion of this hardware shall be made within the ETCS fitment in order to enable a simple, cost-effective, safe and timely migration path to level 3 (L3) operations.

Whilst it is noted that developing a train integrity proving system for freight trains is likely to pose a number of difficulties (and may need national co-ordination, guidance on which can be sought from Shift2Rail); inclusion of such a system on fixed formation passenger stock with electrical interworking is likely to prove much simpler and will not require additional inter-vehicle connections be made. Therefore the expectation is that train integrity can credibly be included on passenger stock, without affecting its interworking capabilities. It is also expected that the train integrity proving system will need to be SIL 4 compliant.

### 2.2 Configuration Management

The part number, serial number and modification version of all line-replaceable components shall be labelled in a position that can be easily read with the unit installed in its normal working position.

**Status:** Normative

**Guidance:** The modification version of a component will relate to its software, firmware, hardware and parameter versions, as appropriate. Recording this modification version on line-replaceable components should assist in distinguishing between components during the replacement activity or during storage.

The part number, serial number and modification version of all software driven line-replaceable components shall be available to view electronically from the ETCS onboard system.

**Status:** Preferred.

**Guidance:** The ability for the ETCS onboard system to display (e.g. via the DMI or a connected maintenance tool) the configuration of the line replaceable units of the system allows for rapid verification of the modification state; particularly of use during a programme of modifications.
‘Software driven’ LRUs include DMI, EVC, BTM etc where the equipment can feasibly report its status to the DMI, but excludes ‘hardware only’ LRUs such as antennae and speed probes.

An authorised person shall be able to modify the configurable data that describes the performance and dimensions of the vehicle or train.

Status: Normative

Guidance: Trains are modified and their operations amended over the course of their life. For example, re-gearing of locomotives may amend their maximum speed; addition of extra equipment may affect their axle loadings. Also, certain operations may require temporary modification of parameters, such as adjusting the front end of the train to account for a snow plough or officer’s saloon being propelled. The maintainer (or other authorised person) must be able to amend such relevant parameters within the train data and presets.

It is not expected that the driver will be able to modify such parameters through train data entry.

It shall be possible to configure the range of values over which an authorised person may modify the train data.

Status: Normative

Guidance: Whilst flexibility to amend the train data is required, freedom to enter values which are outside of realistic or safe bounds should be restricted. This is to avoid problems caused by mis-entering data (extra digit, incorrect decimal point position, etc).

This requirement relates to the modification of data within the EVC (e.g. by a maintainer or other person), not to data amended by the driver on the DMI.
3 System Requirements

3.1 Braking

The ETCS onboard system shall be able to apply the service brake.

**Status:** Normative

**Rationale:** The conditions under which ETCS can command a service brake application can be configured through National Values. The GB implementation will be to inhibit service brake applications for target speed monitoring, but allow it for ceiling speed monitoring. In doing so, the FLOI in target speed monitoring will be enforced by the emergency brake and will occur later than if the service brake were enabled. This will mitigate the potential performance loss associated with the service brake intervention curve being more restrictive than the emergency brake.

Whilst the service brake will not be used for target speed monitoring, a brake application may still be invoked as part of trackside braking reactions (e.g. M_NVCONTACT). Non fitment of the service brake would result in an emergency application, which is likely to be an excessive reaction given that the driver is powerless to avoid it. Therefore the service brake shall be fitted to avoid such scenarios.

**Guidance:** The ETCS onboard system can be interfaced with the vehicle service brake, such that ETCS can command it to apply when required. This interface is optional within the SRS, however it is deemed to be beneficial therefore shall be implemented.

An ETCS service brake application shall be applied at a rate and with a response time equivalent to that which can be achieved by a driver initiated full service brake application.

**Status:** Normative

**Guidance:** The ETCS brake model and parameters are defined within the TSI requirements, however the method of interfacing the ETCS to the train is specific to the class. The method of providing the interface should be appropriately designed such that it does not compromise or unacceptably alter the ETCS brake application. Issues may include:

- Introduction of excessive delay between ETCS application and train brake reaction
- Excessively slow / fast brake application compared to a driver initiated application.

The rate chosen will take into account the effects of any enhanced service braking, where that system provides a guaranteed application under full service brake applications.

An ETCS emergency brake application shall be applied at a rate and with a response time equivalent to that which can be achieved by a driver initiated emergency brake application.

**Status:** Normative

**Guidance:** The ETCS brake model and parameters are defined within the TSI requirements, however the method of interfacing the ETCS to the train is specific to the class. The method of providing the interface should be appropriately designed such that it does not compromise or unacceptably alter the ETCS brake application. Issues may include:

- Introduction of excessive delay between ETCS application and train brake reaction
- Excessively slow / fast brake application compared to a driver initiated application.

The rate chosen will take into account the effects of any enhanced service braking, where that system provides a guaranteed application under full service brake applications.
requirements, however the method of interfacing the ETCS to the train is specific to the class. The design of the interface will have an impact on how quickly the brakes apply after ETCS commands an emergency brake application.

The method of providing the interface should be appropriately designed such that it does not compromise or unacceptably alter the ETCS brake application. Issues may include:

Introduction of excessive delay between ETCS application and train brake reaction

Excessively slow / fast brake application compared to a driver initiated application.

Deceleration rates less than that provided by a driver initiated application.

The rate chosen will take into account the effects of any enhanced emergency braking, where that system provides a guaranteed application under emergency braking circumstances.

### The performance and reliability of the brake shall not be compromised by the presence and operation of the ETCS onboard system.

**NOSS-18**

**Status:** Normative

**Guidance:** Performance of the brake relates to brake force, retardation rate, tolerance to rail conditions, etc). Reliability refers to the ability of the brake to apply when commanded.

This requirement applies to all the braking levels available to the vehicle (off through to full service and emergency).

### The ability of the driver or existing safety systems to apply the brakes, when unsuppressed, shall not be compromised by the presence and operation of the ETCS onboard system.

**NOSS-19**

**Status:** Normative

**Guidance:** Implementing The ETCS onboard system on board the vehicle must be done in such a way that existing brake controls and safety systems are able to demand a brake application as per their current operations.

#### 3.2 Traction Power Cut Off

The traction power cut off command and interface shall be implemented.

**NOSS-20**

**Status:** Normative

**Guidance:** [RD1] subset 026 section 3.13.2.2.8 states that the ETCS may or may not be interfaced with the traction system in order to cut power, and the ETCS configured accordingly. Not interfacing the traction may have a performance impact due to the extra delays in cutting off traction after an ETCS intervention, therefore it shall be implemented.

The traction power cut off command shall cut traction to all traction units operating in multiple within the train.

**NOSS-21**
Status: Normative

Guidance: In the same way as for a driver initiated removal of traction, the traction should be removed from all vehicles operating in multiple under the control of a single driver within the train. This is expected to be achieved through existing vehicle functionality.

The supervising ETCS onboard system shall cut off traction effort to the train at a rate equivalent to a driver initiated command.

NOSS-22

Status: Normative

Guidance: Cutting the traction quickly will assist train performance, however doing so abruptly when the vehicle passes the ETCS warning limit may result in passenger and staff injury, power unit over-speed trips, buffer locking, and damage to on-train equipment or freight payloads. Therefore the time taken for ETCS to reduce the traction from full effort to zero shall be aligned with that achievable by the driver for the traction type in question. Driver reaction delays are to be excluded.

It is expected that this requirement will be met through design of the ETCS interface to the vehicle braking systems, not via bespoke onboard commands.

### 3.3 Isolation

An ETCS isolation switch / switches shall be provided for the driver to place the ETCS system into IS.

NOSS-23

Status: Normative

Guidance: The isolation switch should meet the requirements set out in GM/RT2185 for visibility and operation – in particular that an indication should be provided in each cab. SUBSET-026 section 4.4.3 also sets out relevant requirements.

Some trains use a ‘Safety systems isolated’ indicator in the cab to comply with the requirements set out in GM/RT2185 for visibility of isolation status. The isolation of ETCS should be visible to the driver but not in such a way as to make the train unfit for service.

The ETCS isolation switch shall be placed in each driving cab.

NOSS-24

Status: Application-Specific

The ETCS isolation switch shall act upon only one onboard ETCS system.

NOSS-25

Status: Normative

Guidance: Where a vehicle is fitted with more than one EVC (e.g. long trains where the economics dictate that to be the most effective option) then operation of an isolation switch should act upon only one of the ETCS onboard units. This retains the ability for ETCS operation from the remaining non-isolated cab.
The ETCS isolation facility shall be located beyond the reach of the driver when in the normal driving position.

Status: Normative

NOSS-26

Putting the ETCS Isolation Switch to the ISOLATE position shall prevent the onboard ETCS system inhibiting traction power.

Status: Normative

NOSS-27

A controlled key shall be used to de-isolate ETCS onboard system.

Status: Normative

NOSS-28

Guidance: In this context a controlled key is one whose distribution can be controlled to only those that require it (e.g. maintainer, but not the driver). A standard T key or driver's key would not be acceptable.

De-isolation of the ETCS onboard system shall be no more complex to achieve than the de-isolation of the existing class B safety systems.

Status: Normative

NOSS-29

Guidance: A mechanical or electronic key or a reset code could be used. De-isolation procedures that require configuration or take time to perform, for example using a laptop computer, are undesirable.

Isolation or loss of power to the ETCS onboard system shall not affect the recording of onboard driving data from non-ETCS systems.

Status: Normative

NOSS-30

Guidance: If the JRU and OTMR are combined in one data recorder then it needs to remain powered at all times in order to record the full range of OTMR data requirements specified in GM/RT/2472 and Rolling Stock TSI.

It shall be technically possible to operate the train indefinitely in revenue-earning service with the ETCS onboard system in IS.

Status: Application-Specific

NOSS-31

Guidance: To facilitate or support continued service operation in IS, on infrastructure equipped with lineside signals and alternative train protection systems, Class B protection systems need to remain available when the ETCS is isolated. Consideration shall be given as to if or how this requirement could be met when the class B protection system is integrated into the DMI in some form.

The positioning and size of the speedometer will also need to be considered, such that it is appropriate for a driver to utilise for continuous operation.

The decision to invoke this requirement is dependent upon the fleet to which the equipment is fitted, and their operations.
This technical requirement does not infer that indefinite operation in IS mode is either commercially acceptable or the intended approach for operation on non-ETCS fitted infrastructure.

3.4 ETCS Reset

It shall be possible for the driver to temporarily remove and reinstate power to the ETCS system, in order to force the system to transition to NP and then SB (i.e. reset the ETCS).

NOSS-32

Status: Normative

Guidance: This function is intended to provide an efficient means of resetting the ETCS onboard system in the event of a failure, without the need to shut down and restart other systems on the traction unit.

No special tools or equipment shall be required to reset the ETCS system.

NOSS-33

Status: Normative

Resetting the ETCS system shall not necessitate operation of other vehicle systems.

NOSS-34

Status: Normative

The ETCS reset function shall be protected against accidental use.

NOSS-35

Status: Normative

The ETCS reset facility shall be placed in each driving cab.

NOSS-36

Status: Normative

The ETCS reset facility shall be located beyond the reach of the driver when in the normal driving position.

NOSS-37

Status: Normative

The ETCS reset facility shall act upon only one onboard ETCS system.

NOSS-37A

Status: Normative

Guidance: Where a vehicle is fitted with more than one EVC (e.g. long trains where the economics dictate that to be the most effective option) then operation of the ETCS reset facility should act upon only one of the ETCS onboard units.

Operation of the ETCS reset facility shall be recorded on the vehicle data recorder,

NOSS-38

Status: Normative

Guidance: In this context ‘data recorder’ may be the JRU, existing OTMR, or
combined JRU / OTMR equipment.

### 3.5 Tandem Working

The method of interfacing the ETCS onboard system to the train control systems shall not affect the existing capability of the vehicle to work in tandem.

**Status:** Normative

The ‘allow non-leading mode’ vehicle interface shall be implemented.

**Status:** Application-Specific

**Guidance:** The current intention is to use NL mode for tandem working and some banking or rescue operations; as such it is highly recommended to include this function on locomotives working in variable consist trains. There may also be merit in enabling this functionality on other types of rolling stock.

The ‘Passive Shunting Permitted’ interface shall be implemented.

**Status:** Application-Specific

**Guidance:** The current intention is to use PS mode for top and tail working where the trailing locomotive is unmanned yet left running; as such it is highly recommended to include this function on locomotives working in variable consist trains. There may also be merit in enabling this functionality on other types of rolling stock.

### 3.6 Dead Hauling

The method of interfacing the ETCS onboard system to the train brakes shall not affect the existing arrangements for dead hauling vehicles.

**Status:** Normative

**Guidance:** This requirement ensures that additional steps do not have to be taken to isolate systems when assisting an ETCS fitted vehicle or train. It should not be necessary to place dead (i.e. no electrical power to any part of the vehicle) ETCS fitted vehicles in IS in order to move them.

The application of this requirement to the vehicle will be specific to the rolling stock in question, and must take into account the existing operating practices of the railway undertaking.

### 3.7 Multiple Working

The method of interfacing the ETCS onboard system to the train control systems shall not affect the existing capability of the vehicle to work in multiple.

**Status:** Normative

**Guidance:** Vehicles which are capable of being operated in multiple will have existing interfaces between compatible vehicles. Using these interfaces for ETCS inputs (such as ‘sleep mode requested’) rather than adding further ones will retain
inter-vehicle compatibility.

Existing compatibility shall be maintained for multiple working between ETCS fitted or unfitted vehicles.

Status: Normative

Guidance: Multiple unit working between compatible classes and locomotive haulage of train sets should not be restricted by the presence of ETCS, regardless of the supplier of the ETCS onboard system on the respective vehicles. Similarly, a multiple unit fitted with ETCS can be worked coupled with unfitted compatible multiple units in fitted or unfitted areas.

An isolated or failed ETCS onboard system in a trailing coupled unit shall not prevent the train from being driven from the leading unit.

Status: Normative

Guidance: It is not permissible for an ETCS system in System Failure (SF) in a trailing coupled unit to impact the operation of the train, where the train is being supervised by the ETCS system in the leading vehicle. For example, it should be possible for a unit with failed ETCS to provide traction power to the train if demanded by the leading unit.

3.8 On Track Machine operation

It shall not be necessary to isolate the onboard ETCS system when the train is performing its intended track maintenance functions.

Status: Application-Specific

Guidance: Isolating the ETCS onboard system aboard track maintenance machines when working may result in delays to the machine being able to clear the line for traffic, therefore this requirement is highly recommended for implementation in such cases.

There is currently an expectation that track machines working in traffic will perform their maintenance work using SH mode. Further options exist (e.g. NL, PS) for vehicles which perform their track maintenance functions only when within a possession.

Consideration also needs to be given to the fact that track maintenance machines may undertake reverse movements and operate automatically in working mode.

3.9 Power Supply

The ETCS onboard system power supply arrangements shall be configured for high availability.

Status: Normative

Guidance: Existing train power systems may be inadequate for the ETCS onboard system power requirements. Consideration should be given to using such techniques as cross feeding of power supply from independent sources (e.g. from both cars of a 2 car multiple unit).
The ETCS onboard system shall be tolerant of being de-energised before it has fully initialised.

**NOSS-48**

**Status:** Normative

**Guidance:** The power supply which feeds the ETCS onboard system might be energised for short periods (owing to power supply fluctuations or operation of the ETCS reset facility), such that the ETCS is de-energised part way through its start-up routine. The ETCS onboard system should therefore be designed to be compatible with this and should not be damaged, malfunction or otherwise fail when the power supply is removed after short periods of energisation.

The power requirements of the ETCS onboard system shall not affect the functionality of the existing vehicle power supply system.

**NOSS-49**

**Status:** Normative

The power requirements of the ETCS onboard system shall not affect the reliability of the existing vehicle power supply system.

**NOSS-50**

**Status:** Normative

The Onboard ETCS system shall be able to operate over the full range of vehicle power supply voltages, surges and transients encountered on the vehicle.

**NOSS-51**

**Status:** Normative

**Guidance:** The ETCS onboard system shall be tolerant of anticipated onboard power supply fluctuations, including moments of significant demand, for example when starting diesel engines. Severe voltage reductions occur when starting engines in diesel locomotives and multiple units. This must be addressed during the installation design stage.

Legacy power supplies on older vehicles may contain power supply perturbations, spikes and ripples well in excess of current standards. The present requirement according to EN 50155:2007 is for a maximum of 15% ripple on the nominal D.C. voltage. The limit according to legacy standard RIA12 is 30%. These limits are likely to be exceeded on older vehicles; therefore an installation design that only meets these standards may still be unacceptable.

The ETCS onboard system shall energise automatically, only when the primary source of power is available.

**NOSS-52**

**Status:** Normative

**Guidance:** Starting the ETCS automatically removes the need for a separate 'ETCS start' button. The specific trigger for this automatic energisation will be class specific.

This automatic start shall occur when and only when primary power is available, such that the risk of the vehicle batteries being discharged by the ETCS is
minimised. It shall not start automatically if only vehicle battery power is available.

In the context of this requirement, the primary source of power is 25kV AC / 750v DC supply, or engines running.

> It shall be possible to manually energise the ETCS without the primary source of power being applied.

**NOSS-53**

**Status:** Normative

**Guidance:** In the context of this requirement, the primary source of power is 25kV AC / 750v DC supply, or engines running. The ability to manually energise ETCS facilitates some maintenance activities, as well as further scope for vehicle rescue in the event of engine / electric failure.

> In the event of a loss of primary power, the onboard ETCS installation shall be load shed after a class specific delay.

**NOSS-54**

**Status:** Normative

**Guidance:** In the context of this requirement, the primary source of power is 25kV AC / 750v DC supply, or engines running. Batteries are not considered as a source of primary power.

ETCS is not expected to de-power as soon as primary power is lost (e.g. during neutral sections, traction gaps, OLE trips, etc), however it would be undesirable for the ETCS to consume the remaining battery power in order to remain energised if primary power is lost for a significant period. In doing so, other systems may be de-powered and / or the batteries too discharged to restart the engine.

For electric traction, a class specific delay of 10 minutes or more is considered to be sufficient to mitigate the performance risk from of the majority of unplanned interruptions in 25kv / 750v DC supply.

### 3.10 Cab detection

**The ETCS ‘cab active’ signal shall be derived from existing vehicle controls...**

**NOSS-55**

**Status:** Normative

**Guidance:** The ETCS shall not require specific actions from the driver in order to provide the ‘cab active’ signal to the ETCS. The ETCS shall be use appropriate existing controls (cab open switch, direction controller, etc) such that the correct train orientation is determined.

**The ETCS ‘sleeping requested’ signal shall be derived from existing vehicle controls.**

**NOSS-56**

**Status:** Normative

**Guidance:** The ETCS shall not require additional controls or wiring to be added to facilitate the communication of the sleeping requested signal to other EVCs within the same train. To do so may introduce difficulties for inter-working with other types of stock, or unfitted vehicles of the same type. Where such scenarios
3.11 Self Test

The Onboard ETCS system shall automatically inform the driver upon start-up if the ETCS is unfit for service.

Status: Normative

NOSS-57

The Onboard ETCS system shall be capable of performing any power up initialisation or self-test without the presence of specific ETCS trackside infrastructure.

Status: Normative

NOSS-58

The Onboard ETCS system shall be capable of performing any power up initialisation or self-test without the presence of an operator during the course of the test.

Status: Normative

NOSS-59

The results of any power up initialisation or self-test shall be displayed in a succinct and intuitive form.

Status: Normative

Guidance: Providing the driver with information on faults or failures on the train upon which they cannot act provides no benefit, and may overload the driver with unnecessary information.

It is expected that information would be provided in plain English at all times; use of foreign languages which the driver must interpret would not be deemed to meet the requirement.

Provision of data as a series of fault codes which must be interpreted by the user would also be deemed unsatisfactory.

3.12 Driver Machine Interface

The default speed display on the ETCS DMI shall be in mph when in Level NTC (AWS / TPWS), and kph in all other levels.

Status: Normative

NOSS-61

Guidance: The GB rail network has a special case to allow the display of dynamic train speed in mph on the DMI. This does not extend to static information (labels, etc) or distances (which will remain in metres).

The current requirement within GE/RT/8402 is to use NID_C to determine the units of speed display; however analysis has shown that this method is far from ideal. It is therefore proposed to use level as the default method of determining the speed display, with packet 44 information to be used to modify the display if required.
It shall be possible, using packet 44 information, to change the units of speed display from the default.

Status: Normative

Guidance: The current requirement within GE/RT/8402 is to use NID_C to determine the units of speed display; however analysis has shown that this method is far from ideal. It is therefore proposed to use level as the default method of determining the speed display, with packet 44 information to be used to modify the display if required. This will apply to all levels. The specific format of the packet 44 information will be defined by the infrastructure manager, as per the requirements of GE/RT/8064, and specified within reference document RD11.

Level NTC (AWS / TPWS) shall be displayed as ‘??????’ on the ETCS DMI

Status: Normative

Guidance: Level NTC (AWS/TPWS) is described in section 4.2. The exact naming on the DMI has been raised within the European Rail Agency, in an attempt to standardise naming conventions across member states, therefore this requirement exists as a placeholder.

Level NTC (TVM 430) shall be displayed as ‘??????’ on the ETCS DMI

Status: Normative

Guidance: Level NTC (TVM 430) is described in section 4.5. The exact naming on the DMI is yet to be specified, however it has been raised within the European Rail Agency in an attempt to standardise naming conventions across member states, therefore this requirement exists as a placeholder.

Level NTC (CBTC) shall be displayed as ‘??????’ on the ETCS DMI

Status: Normative

Guidance: Level NTC (CBTC) is described in section 4.6. The exact naming on the DMI is yet to be specified, however it has been raised within the European Rail Agency in an attempt to standardise naming conventions across member states, therefore this requirement exists as a placeholder.

Level NTC (AWS / TPWS) Fixed shall be displayed as ‘??????’ on the ETCS DMI

Status: Normative

Guidance: Level NTC (AWS/TPWS) Fixed is described in section 3.23. The exact naming on the DMI is yet to be specified, however it has been raised within the European Rail Agency in an attempt to standardise naming conventions across member states, therefore this requirement exists as a placeholder.

Applies only when Level NTC (AWS/TPWS) Fixed is implemented
The ETCS DMI shall comply with the principles of EN 894-1:1997 Chapter 4.

Status: Preferred

Guidance: EN 894-1:1997 sets out good practice principles for effective human-machine interaction, and should be considered as complementary to ERA_ERTMS_015560. Where conflict exists, the ERA specifications must take precedence.

The DMI should be considered as the primary driver control and speedometer as set out in GM/RT2161.

End user consultation is seen as being a critical part of achieving acceptance of the system, therefore it is highly recommended that this forms part of the project development alongside the implementation of standards and good practice guidance.

The DMI shall comply with section 4.2 of EN 9241-400:2007.

Status: Preferred

Guidance: Section 4.2 refers to design requirements for physical input devices, and should be considered as complementary to ERA_ERTMS_015560. Where conflict exists, the ERA specifications must take precedence.

NOSS-63

NOSS-64

NOSS-65

NOSS-66

NOSS-67
The ETCS DMI shall respond to driver inputs within 100ms.

Graphical objects on the DMI shall be fully rendered and displayed within 20ms of the DMI display being commanded to present them.

The driver shall be able to interact with the DMI display area without impediment by other cab equipment, controls or structure.

DMI luminance shall adjust automatically to changing cab lighting levels

Manual DMI luminance adjustment and loudspeaker volume control shall be simple to achieve whilst the vehicle is in motion.
distraction to the driver. Simple external controls (set out as options in ERA_ERTMS_015560) or minimal menu navigation mitigate the risk of distraction.

It shall not be possible to reduce the luminance of the DMI to the point where the visual information cannot be reliably passed to the driver.

**Status:** Normative

**NOSS-73**

Manual DMI loudspeaker volume adjustment shall be simple to achieve whilst the vehicle is in motion.

**Status:** Normative

**NOSS-74**

**Guidance:** Adjusting the volume in service by navigating multiple DMI menus is a distraction to the driver. Simple external controls (set out as options in ERA_ERTMS_015560) or minimal menu navigation mitigate the risk of distraction.

It shall not be possible to reduce the volume of the DMI to the point where the information cannot be reliably passed to the driver.

**Status:** Normative

**NOSS-75**

The brightness of the DMI and cab indications shall be sufficiently adjustable to be comfortably viewed over the full range of ambient cab lighting levels.

**Status:** Normative

**NOSS-76**

**Guidance:** Previous experience of ETCS fitment has shown that the brightness of the cab indications and DMI needs to be sufficiently variable to accommodate a wide range of ambient lighting levels, as well as driver preference. This is especially important for dark conditions where excessive brightness can destroy driver’s night vision.

An analysis of suitable display screens should be undertaken before a type is selected because technology is frequently improving. With present technology, it is expected that a display using LED backlit technology will provide an optimum solution for low maintenance cost, low heat emission and a suitable range of luminance.

The DMI alarms shall be audible above background noise at all speeds and in all operating conditions.

**Status:** Normative

**NOSS-77**

**Guidance:** Noises from the wheel / rail interface, wind noise and other sources such as rain, tunnels etc should be considered. Consideration should also be given to providing alarms that automatically adjust to the background noise level detected in the cab. RSSB Research Project T326 alarms and alerts guidance and evaluation tool, recommends that components of the alert should be at least 12dB(A), but not more than 24dB(A), above ambient noise levels.

To avoid the alarm being inaudible, consideration should be given to restricting the minimum sound level setting so that alarms are audible above the background noise level in the cab in all operating conditions.
Where existing non-ETCS cab alarms impair the driver’s recognition of standard DMI alarms, the existing non-ETCS alarm shall be changed.

Status: Normative

Guidance: Section 14 of ERA_ERTMS_015560 sets out the audible information requirements for the ETCS DMI.

Failure of the driver to recognise ETCS alarms may be due to conflict with the non-ETCS system. Conflict may arise through similar tones and frequencies being used on the non-ETCS system, or where there is a potential for non-ETCS alarms to mask ETCS warnings if they were to sound together.

The DMI shall not freeze or otherwise fail without the driver being made aware.

Status: Preferred

Guidance: Should the DMI freeze during operation or start-up it may not be immediately noticeable to the driver. Delays in the driver recognising this failure may affect operations.

This requirement may be met through eradicating failure modes that result in a DMI freeze or hidden failure, or by providing a positive indication of the DMI function at all times (heartbeat, rotating icons, etc).

The facility to show planning area information shall be provided.

Status: Normative

Guidance: Section 8.3 of ERA_ERTMS_015560 sets out the planning information requirements for the ETCS DMI. It is an option to enable or disable it within the onboard, however its use forms part of the ETCS operational concept.

### 3.13 Data Entry and Interaction

The DMI data entry process shall be designed to minimise the likelihood of driver error when selecting the train type or parameters.

Status: Normative

Guidance: Clear and intuitive labelling of train types and range-checking of flexible data entry parameters can contribute to meeting this requirement.

Section 10.3.4 of European Rail Agency (ERA) specification ERA_ERTMS_015560 sets out requirements for data checks to verify correct entry of data.

The DMI data entry process shall be configured to enable data entry to be completed within 60s of the ETCS onboard system being ready to accept data entry in standby (SB) mode (Status S0).

Status: preferred
Guidance: European Rail Agency (ERA) specification ERA_ERTMS_015560 clearly specifies the DMI data entry process, however there are certain elements which can be configured to minimise driver workload, including:

- Rationalisation of DMI presets to an easily interpreted set.
- Auto population of some aspects of train data where it is fixed or known from other systems.
- Non-display of data options that are not appropriate to that installation of the ETCS onboard system.

An authorised person shall be able to configure the DMI for fixed, variable or switchable data entry.

**NOSS-82**

Status: **Normative**

Guidance: ERA_ERTMS_015560 permits fixed, flexible and switchable train data entry. It is prudent to allow the train maintainer (or authorised person) to change the type of train data entry available to the driver in the event of vehicle operations changing.

Many modern passenger train sets and multiple units have a train data bus compliant with EN 61375-1:2012, which could provide an indication of train length.

ERA_ERTMS_015560 only specifies data entry in metric units. This includes data relating to speed and distance.

The DMI shall only display symbols that are relevant to the traction type.

**NOSS-83**

Status: **Normative**

Guidance: ERA_ERTMS_015560 contains a number of symbols which are displayed to the driver when track conditions change. Such symbols may include lowering of pantograph, change of traction system, inhibition of regenerative brake, etc. These shall only be displayed if they are relevant to the train in question.

The ETCS shall have the functionality to automatically export train running number and driver ID to the GSM-R voice radio.

**NOSS-84**

Status: **Normative**

Guidance: The ETCS specifications permit the population of the GSM-R train running number and driver identification number from the ETCS data entry process. This shall be implemented. Furthermore, it would be operationally beneficial for the link to be bi-directional to allow all data and any subsequent failure messages to be displayed in the same location.

Reference document [RD8] may be used as a reference to guide the design of the interface; however the exact specification must be confirmed with the cab radio supplier and the national ERTMS programme (which is undertaking further development of this specification) before implementing a solution.
The ETCS DMI shall support Alphanumeric entry of the train running number.

**NOSS-84A**

**Status:** Normative

**Guidance:** The UK uses Alphanumeric train running numbers to describe the train, unlike the standard numeric method employed within ETCS. In order to retain operational consistency between ETCS and non ETCS fitted trains, the ETCS should be able to accept alphanumeric train running numbers (which are convertible to numeric train running numbers via defined algorithms) in addition to numeric train running numbers.

GE/RT/8402 provides further details of the specific case which allows this functionality.

The need for multiple entry of any particular item of data shall be avoided through the linkage of cab systems by appropriate interfaces.

**NOSS-85**

**Status:** Application-Specific

**Guidance:** The start of mission time may be extended by entering the same data manually into multiple systems. This reduces route capacity and driving efficiency and may result in errors. It should be noted that where data is provided to ETCS from external systems it should be of a high enough integrity to meet the ETCS data requirements.

Such cab systems may include onboard driving data recording systems or public address systems.

The labels of the train type data sets shall be a configurable part of the data set.

**NOSS-86**

**Status:** Normative

**Guidance:** This should ideally be an action that an authorised person within the owner / operator / maintainer organisation can undertake, without resorting to the supplier.

The train type data entry process shall use no more than five menu levels.

**NOSS-87**

**Status:** Preferred

**Guidance:** If the train types menus is presented as a series of nested lists (i.e. where selection of one train type on the first list presents a second list of subtypes etc), then human factors research suggests that the driver would not be able to manage the data entry process if more than 5 layers of nested lists were present.

A menu shall not be shown where there are one or zero data sets on that menu level.

**NOSS-88**

**Status:** Preferred

**Guidance:** This requirement applies to train data sets; it is not applicable to menu levels intended only to ever have one option for confirmation e.g. override window.
The vigilance timer in the cab shall be reset whenever the driver presses any valid button on the DMI associated with a genuine DMI interaction.

**NOSS-89**

**Status:** Preferred

It shall be possible for an authorised person to pre-configure the ETCS system to place limits on the data ranges available for DMI input fields.

**NOSS-90**

**Status:** Normative

**Guidance:** Where the driver is expected to enter data rather than select from a preset (e.g. flexible data entry), the range of values that the driver may select should be able to be restricted to realistic values only. For example, upper and lower limits may be specified for train length or lambda value.

The onboard ETCS system shall not impose a timeout limit on the data entry task.

**NOSS-91**

**Status:** Normative

The DMI interface shall support the future provision of a remote train data entry system

**NOSS-92**

**Status:** Application-Specific

**Rationale:** Manual entry of train data (particularly lambda data entry) introduces the risk of incorrect braking data being used to populate the ETCS, thereby rendering the ETCS braking curves unsafe. Automatic data entry is believed to reduce some of the risk of error.

**Guidance:** NOSS 157 requires provision for a data bus to support remote population of train data. The DMI design needs to have corresponding functionality to make use of this.

The term 'remote', in this context, means a data source external to the DMI or EVC. This may be from other train systems or from a source external to the train.

### 3.14 Set Speed Function

When a ‘Set Speed’ automatic speed control function is active, the speed set point shall be displayed on the DMI speed dial.

**NOSS-93**

**Status:** Application-Specific

**Guidance:** This requirement is only applicable to vehicles fitted with a ‘Set Speed’ system; for vehicles where such a system exists this functionality is deemed to be most appropriate.
The speed set point shall be displayed by symbol ST07 in area B of the DMI in the form shown in Figure 1 below (identified by red arrow).

**Figure 1: Set speed indicator**

Guidance: Set speed automates train acceleration and dynamic braking to a precise set point chosen by the driver, as well as regulating the speed at that level.

Area B0 is defined within ERA_ERTMS_015560.

The design of the set speed indicator ST07 above is consistent with set speed proposal EEIG398, which has been agreed (although at time of issuing this document has yet to be formalised).

This requirement is only applicable to vehicles fitted with a ‘Set Speed’ system; for vehicles where such a system exists this functionality is deemed to be most appropriate.

Any automatic set speed control shall be disengaged immediately when the ETCS commands a brake intervention.

**Status:** Application-Specific

Guidance: It is possible that, on entering target speed monitoring, a set speed control could cause an intervention. This requirement is designed to eliminate the possibility that when ETCS stops the intervention (because the train speed is below the permitted speed) the set speed control does not try and increase speed.
to the previous level.

This requirement is only applicable to vehicles fitted with a ‘Set Speed’ system; for vehicles where such a system exists this functionality is deemed to be most appropriate.

There shall be no potential for confusion between the units of set speed on the DMI and those on the external set speed system.

NOSS-96

Status: Application-Specific

Guidance: This requirement is designed to mitigate the risk of an incorrect speed being selected, caused by confusion between different units of speed measurement on the set speed device and the speedometer. This may be addressed through obscuring the set speed system display, or use of unitless values.

If the set speed control is configured in discrete steps, consideration should be given to the appropriateness of the step interval for the units of measurement in use. For example, a set speed control configured only in 5 mph steps will not generally align to commonly used speed limit values on lines operated in km/h.

This requirement is only applicable to vehicles fitted with a ‘Set Speed’ system; for vehicles where such a system exists this functionality is deemed to be most appropriate.

3.15 Speed Display

Where multiple speedometers may simultaneously be active within a cab, the speed displayed shall be consistent on all displays visible to the driver in the normal driving position.

NOSS-97

Status: Normative

Guidance: Conflicting speed displays (either in terms of the absolute speed value or the units of measure) are not permitted, as this can cause driver confusion.

Obscuring or deactivating all but the primary speed display in normal operation may be an acceptable method of achieving this requirement.

The driver shall be presented with vehicle speed information whilst the ETCS onboard system is isolated.

NOSS-98

Status: Application-Specific

Guidance: A speed display being available to the driver when the ETCS is isolated mitigates risks associated with having no ETCS speedometer due to ETCS failure, as well as assisting the driver training programme in being able to run trains irrespective of driver ETCS training on unfitted lines.

The speed display may be presented as an Additional Speed Display (ASD), totally independent of the ETCS onboard system, though this option is less favoured. A preferable and possibly more practical method (due to space / packaging constraints) would be to utilise the DMI to provide speed information if a speed source can be provided despite the EVC operating in a degraded mode.
Requirements governing the accuracy of speed indicating systems are set out in GM/RT2004.

The ETCS DMI speed display in IS mode, where provided, shall be capable of displaying speed in the correct units for the location of operation.

Status: Normative

Guidance: Where the speed display in IS is provided via the DMI, it needs to be capable of showing the correct units for the location in which the vehicle is operating. NOSS 61 and 62 give further details of which units are required.

This could be achieved through dual marking of the DMI in IS, driver selection of the correct units (by a DMI option within IS or an external switch), or by other means.

The Additional Speed Display, where provided, shall display speed in kph and mph with kph the dominant scale.

Status: Normative

Guidance: Where the Additional Speed Display (ASD), where provided, shall be illuminated in IS only, to a colour and luminance matching existing cab instrumentation.

Status: Normative

3.16 Odometry and Tachometry System

Calibration of the odometry system shall not require additional or more complex measurement of the wheels beyond that already performed on the vehicle for conventional purposes.

Status: Normative

Guidance: Wheel sizes / tyre thicknesses are routinely measured at periodic intervals for wheel management purposes, and are accurately known at tyre turning events. The fitment of ETCS should not increase the frequency at which these measurements are taken. Furthermore, the skill level and complexity of the wheel measurement process shall not be greater than existing requirements. The required accuracy shall be no more difficult to achieve than it is for the current wheel measurement accuracy and method.

Automatic Odometry Calibration, needing no maintainer intervention at all for in routine odometry calibration, is a highly preferred method of meeting this requirement. Please see NOSS 104 for further requirements on such systems.

The odometry system shall not require additional wheel turning or renewal to maintain accuracy further to that necessary for the physical wheel / rail interface.

Status: Normative

Guidance: Variations in distance measurement will occur as track and wheel profiles change with wear; such variations should be accommodated by the odometry system. Specifying tighter tolerances for wheel profiles than would otherwise be maintained is not acceptable.
Wheel diameter calibration shall not require specific additions or changes to the GB rail network  

Status: Normative  

Guidance: NR is not intending, currently, to modify its GB rail network infrastructure to support any automatic odometry system introduced. Balises will not be located to any higher accuracy than that stated against Q_NVLOCACC or Q_LOCACC; however the value for Q_LOCACC is expected to be more accurate in ATO areas.

Infrastructure contained wholly within the confines of a train maintenance facility is excluded from this requirement.

3.17 Eurobalise Reader

The Eurobalise reader system shall not require adjustment during maintenance in order to operate on the train to which it is fitted.

Status: Normative

Guidance: Manual re-calibration or re-positioning of the Eurobalise reader system or other intrusive maintenance should not be necessary during the life of the equipment on any given vehicle. This includes adjustment to accommodate wheel turning, wheelset change, ride height change, etc.

The onboard ETCS system shall be tolerant of the Eurobalise reader being positioned directly over a balise during its start-up self test.

Status: Preferred

Guidance: Vehicles may stop in locations where one or both Eurobalise readers are located directly over a balise. If the Eurobalise reader is subsequently de-powered, there should be no impact on the ETCS when it is subsequently re-powered over a balise.

3.18 Cold Movement Detection (CMD)

The Onboard ETCS system shall include a cold movement detection system.

Status: Normative

Guidance: Cold movement detection serves to re-validate the train position upon leaving NP, subject to the train not moving. Maintenance of a valid position helps to reduce the dependency on operational procedures that result from degraded operation when starting with an invalid position. Risks associated with operational procedures are likely to increase if multiple trains are affected, for example when resuming service after a major infrastructure failure.

72 hours operation is the minimum duration set out in SUBSET-026, however it is anticipated that locomotives may well be in NP for longer periods, which the system shall accommodate.

The period for which external vehicle power may be lost will be dependent upon
the power supply system to the train and the anticipated duty cycle. It is customary in diesel powered vehicles to shut down engines at terminating stations, during turnarounds and layovers. Unplanned shutdowns may also occur. Electric traction may be subject to loss of electrification power.

**Cold movement detection shall only be used to validate stored information if the information was known to be correct upon entry to NP mode.**

**Status:** Normative

**Guidance:** This requirement addresses the fact that cold movement is, by definition, only active when in NP. Changes to the vehicle position when in IS may not be correctly recorded by ETCS; if the system then transitioned from IS to NP and then back to SB then this potentially incorrect position data should not be revalidated by cold movement detection.

**Movement in excess of 5m shall invalidate the vehicle position report held in the EVC.**

**Status:** Normative

**Guidance:** This requirement specifies the sensitivity of the cold movement detection system; the system should be sufficiently sensitive to movement to guarantee that the position report will be invalidated when the train moves by 5m or more.

**Movement of less than 1m shall not invalidate the vehicle position report held in the EVC.**

**Status:** Normative

**Guidance:** This requirement specifies the maximum sensitivity of the cold movement detection system. Coupling / buffering of vehicles may move the train by up to 1m; this should not invalidate the position report.

Note: The response of the cold movement detection system to movement of between 1m (NOSS-110) and 5m (NOSS-109) is not specified; the system response is supplier specific.

**The Cold Movement Detection system shall monitor absolute movement of the vehicle.**

**Status:** Normative

**Guidance:** It is feasible that vehicles may be shunted onto adjacent tracks, or be returned to the same position but facing the opposite direction. Such scenarios must be recognised by the CMD system as movement.

### 3.19 Data Radio

**The data radio antenna installation shall not compromise the performance of other communication and data systems.**

**Status:** Normative
Guidance: Other communication and data systems include, but are not limited to, Wi-Fi, global navigation satellite systems (GNSS), Global System for Mobile Communications (Railway) (GSM-R), cab secure radio (CSR) and National Radio Network (NRN)) antenna installations.

.GK/GN0602 sets out guidance on Train Rooftop Antenna Positioning.

The maximum radio signal losses between the train antenna and antenna socket of EDOR (ERTMS Data Only Radio) will be 3dB, and typically 1dB.

The onboard system shall be fitted with two ERTMS Data Only Radios (EDORs)

Status: Normative

Guidance: 2 off EDORs will facilitate a seamless handover when transitioning between circuit-switched and packet-switched GSM-R bearer services, especially when coinciding with RBC handovers.

The ERTMS Data Only Radios (EDORs) shall be EDGE GPRS Class B capable.

Status: Normative

Guidance: GPRS has been identified as offering significant increases in radio capacity. As such the EDOR shall be capable of operating in circuit switched and packet switched modes, depending upon the trackside infrastructure and ETCS functionality.

The ERTMS Data Only Radios (EDORs) shall be designed to be resilient to interference from 3rd party mobile networks.

Status: Normative

Guidance: A number of change requests are currently being progressed by ERA, intended to safeguard against any possible interference from mobile network operators’ systems. One such change request is a revision to the performance specifications for the EDOR, as documented in reference [RD10]. It is expected that EDORs procured for UK rolling stock will incorporate this specification. This will allow them to operate correctly when exposed to 3rd party interference, without the need for further signal filters.

In the event of failure or degradation of one of the radio mobiles, shall use the remaining available radio in a way to minimise service disruption.

Status: Preferred

Guidance: In the event of a failure of a radio when in service, it is preferable that the system optimises operation based on remaining radio capability.

The ETCS application may make use of the two radio mobiles within the ETCS data radio for optimum performance during cell handover or RBC transition.

The ETCS onboard system shall be designed to avoid peaks in the use of GSM-R capacity.

Status: Preferred
Guidance: Limitations on GSM-R capacity, particularly at busy termini and with several multiple units running together in a rake, have led to this requirement. Issues may arise in trains with multiple EVCs, which will simultaneously report a mode change between SB and SL when a cab is opened. This ‘spike’ in ETCS data calls may lead to lower priority voice radio calls being disconnected.

Provision shall be made for GSM-R radio filters on the RF antenna connections to the train GSM-R voice and ETCS data radios to be fitted at a later date.

Status: Application-Specific

Guidance: A number of change requests are currently being progressed by ERA, intended to safeguard against any possible interference from mobile network operators’ systems. One such change request is the potential to add GSM-R filters. Although the solution required for UK rolling stock is to implement radios that are resistant to 3rd party interference, in line with reference document [RD10], it is still thought prudent in some cases to allow for the retrofitment of filters at a later date.

Approximate specifications for the filters are as follows:

i. Dimensions: 240 x 420 x 190mm plus connections
ii. Weight: 10kg
iii. Power: 110VDC 30W.
iv. RF Connectors: N Type – female on filter

GSM-R radio filters on the RF antenna connections to the train GSM-R voice and (ETCS) data radios are to the following specification:

**Downlink**

<table>
<thead>
<tr>
<th>Operation</th>
<th>Isolation</th>
<th>Frequency</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation</td>
<td>Isolation</td>
<td>800MHz to 900MHz</td>
<td>&gt; 12dB</td>
</tr>
<tr>
<td>Operation</td>
<td>Insertion loss</td>
<td>918MHz to 918.2MHz</td>
<td>&lt; 1.5dB</td>
</tr>
<tr>
<td>Operation</td>
<td>Insertion loss</td>
<td>918.2MHz to 924.8MHz</td>
<td>&lt; 0.5dB</td>
</tr>
<tr>
<td>Operation</td>
<td>Insertion loss</td>
<td>924.8MHz to 925MHz</td>
<td>&lt; 1.5dB</td>
</tr>
<tr>
<td>Operation</td>
<td>Isolation</td>
<td>925.6MHz to 925.8MHz</td>
<td>&gt; 37dB</td>
</tr>
<tr>
<td>Operation</td>
<td>Isolation</td>
<td>925.8MHz to 1000MHz</td>
<td>&gt; 70dB</td>
</tr>
<tr>
<td>Operation</td>
<td>Isolation</td>
<td>1000MHz to 3000MHz</td>
<td>&gt; 65dB</td>
</tr>
<tr>
<td>Operation</td>
<td>Return Loss</td>
<td>918MHz to 925MHz</td>
<td>&gt; 16dB</td>
</tr>
<tr>
<td>Bypass</td>
<td>Return Loss</td>
<td>800MHz to 960MHz</td>
<td>&gt; 16dB</td>
</tr>
<tr>
<td>Bypass</td>
<td>Insertion Loss</td>
<td>800MHz to 960MHz</td>
<td>&lt; 1dB</td>
</tr>
</tbody>
</table>
Uplink

<table>
<thead>
<tr>
<th>Operation</th>
<th>Isolation</th>
<th>Frequency Range</th>
<th>Isolation Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation</td>
<td>Isolation</td>
<td>DC to 750MHz</td>
<td>&gt;70dB</td>
</tr>
<tr>
<td>Operation</td>
<td>Isolation</td>
<td>750MHz to 800MHz</td>
<td>&gt;60dB</td>
</tr>
<tr>
<td>Operation</td>
<td>Insertion loss</td>
<td>873MHz to 880MHz</td>
<td>&lt;1.8dB</td>
</tr>
<tr>
<td>Operation</td>
<td>Isolation</td>
<td>900MHz to 915MHz</td>
<td>&gt;40dB</td>
</tr>
<tr>
<td>Operation</td>
<td>Isolation</td>
<td>915MHz to 1000MHz</td>
<td>&gt;70dB</td>
</tr>
<tr>
<td>Operation</td>
<td>Isolation</td>
<td>1000MHz to 3000MHz</td>
<td>&gt;65dB</td>
</tr>
<tr>
<td>Operation</td>
<td>Return Loss</td>
<td>873MHz to 880MHz</td>
<td>&gt;16dB</td>
</tr>
<tr>
<td>Bypass</td>
<td>Return Loss</td>
<td>800MHz to 960MHz</td>
<td>&gt;16dB</td>
</tr>
<tr>
<td>Bypass</td>
<td>Insertion Loss</td>
<td>800MHz to 960MHz</td>
<td>&lt;1dB</td>
</tr>
</tbody>
</table>

Linearity

<table>
<thead>
<tr>
<th>DL Inband</th>
<th>IM3 (2 x 0dBm)</th>
<th>Isolation Level</th>
</tr>
</thead>
</table>

Provision of GSM-R filters on the RF antenna shall include a by-pass mode to be selected by a manual switch that is accessible by maintenance personnel.

NOSS-117

Status: Application-Specific

Guidance: GSM-R filters, if fitted, will further restrict the bandwidth of the received transmission to minimise the likelihood of interference. In some scenarios it may be required to allow the EDOR to receive such frequencies.

Provision shall be made to cater for future migration of EDOR functionality into Communication Gateways where Communication Gateways already exist on trains, or where they are planned.

NOSS-118

Status: Application-Specific

3.20 Cab security

It shall be possible to secure the train from unauthorised operation without losing the mission data.

NOSS-119

Status: Preferred

Guidance: The driver is, on occasions, required to leave the cab to perform other duties (reset a passenger alarm, or operate safety systems). Such activities often require the driver’s key to perform; it is also standard practice to remove they key from the cab desk in order to prevent unauthorised operation when the driver is not present.

Such tasks could necessitate the closure of the desk, and therefore loss of the train data / MA. This would lead to unnecessary delays through the subsequent start of mission process, and so shall not occur.

Such ‘cab security’ functionality could be provided externally to the ETCS onboard system by applying brakes and inhibiting the driver controls if the cab is left unoccupied, or through application of standstill supervision via a driver enabled setting.
The operation of the ‘cab security’ function shall be recorded on the onboard driving data recording system.

Status: Normative

Guidance: Only applicable where a cab security function is implemented.

### 3.21 Key Management

Note 1: It is recognised that, at the time of publishing, the specifications for online key management are not fully formed and so compliance may prove challenging in the near term. However, the long term aspiration is for this function to be included on all vehicles so best endeavours shall be made to comply.

The Onboard Subsystem shall be capable of accepting both on-line and off-line key management updates.

Status: Normative (See Note 1 above)

Guidance: Online key management will be achieved through a packet-based solution (e.g. using GPRS).

Offline key management is achieved through a file-based solution (e.g. using encrypted memory sticks).

The National Key Management System will be based on an on-line solution backed by an off-line solution, compatible with SS 038v300 and SS 114v1.0.0, for which work is now underway. Online key management will be included in Baseline 3 Maintenance release 2, which is the anticipated minimum specification for the trackside implementation.

On-line key management solution shall require no maintenance staff intervention.

Status: Normative (See Note 1 above)

Guidance: Maintenance staff intervention includes distribution, deletion or updating of any key entry.

The Onboard Subsystem shall be capable of requesting an on-line update for the onboard keys at any time, except when a conflict with other ETCS functions occurs.

Status: Normative (See Note 1 above)

The Onboard Subsystem shall be capable of requesting an on-line update for the onboard keys at any location on the GB rail network.

Status: Normative (See Note 1 above)

The onboard subsystem shall be capable of requesting keys using the ERA subset for on-line key management.

Status: Normative (See Note 1 above)
Guidance: The ERA subset is not yet drafted, though is intended to be published as part of Maintenance release 2. In principle, it is expected that the onboard will request keys when:

a) The onboard cannot establish a session due to missing key or invalid key;

b) If an update has not occurred within a given period (onboard setting)

c) During Start of Mission if that is the first connection after the period in b) has expired

It is also envisaged that the key update must take place before the OBU contacts the RBC.

The Onboard Subsystem shall store and action downloaded key data in accordance with its validity period.

Status: Normative (See Note 1 above)

3.22 Ancillary Systems

The ETCS onboard system shall support lowering and raising of pantographs.

Status: Application-Specific

Guidance: Application of this requirement is predicated upon the unmodified vehicle being able to support the functionality.

Subset 119 is intended to define how such functionality would be managed via a parallel or serial interface. It will be available in the application guide as part of Baseline 3 Maintenance release 1.

The ETCS onboard system shall support lowering and raising of DC shoegear.

Status: Application-Specific

Guidance: Application of this requirement is predicated upon the unmodified vehicle being able to support the functionality.

The ETCS onboard system shall support changing of traction power supply sources

Status: Application-Specific

Guidance: Application of this requirement is predicated upon the unmodified vehicle being able to support the functionality.

It is expected that this functionality will be achieved through use of M_Voltage and NID_CTRACTION. Subset 119 is intended to define how such functionality would be managed via a parallel or serial interface. It will be available in the application guide as part of Baseline 3 Maintenance release 1.

The ETCS onboard system shall support the change of allowed traction current consumption.

NOSS-126

NOSS-127

NOSS-128

NOSS-129

NOSS-129A
Status: Application-Specific

Guidance: Application of this requirement is predicated upon the unmodified vehicle being able to support the functionality.

Subset 119 is intended to define how such functionality would be managed via a parallel or serial interface. It will be available in the application guide as part of Baseline 3 Maintenance release 1.

The ETCS onboard system shall support opening / closure of 25kV traction power circuit breakers when crossing neutral sections.

NOSS-130

Status: Application-Specific

Guidance: The intention is for the GB rail network to announce neutral sections using ETCS alongside existing APC magnets for the foreseeable future. The option to implement ETCS operation of 25kv traction power circuit breakers should be assessed based upon the business benefits of moving from APC to ETCS control over the life of the vehicle.

Application of this requirement is predicated upon the unmodified vehicle being able to support the functionality.

Where the ETCS onboard function is implemented and APC retained (for use on non-ETCS lines), it is expected that the two systems should work in parallel.

The ETCS onboard system shall not extend the time during which traction power is lost when crossing neutral sections, beyond that already experienced through operation of the existing vehicle systems.

NOSS-131

Status: Application-Specific

Guidance: Neutral sections are currently indicated to the traction system by trackside APC magnets placed a defined distance either side of the location. Corresponding receivers are fitted to the train such that the 'power off' time is kept to the minimum required to traverse the section safely.

Were ETCS to define the 'power off' section as being the whole length of the train, this may result in the power being lost for an unacceptable length of time. For example, a long freight train hauled by a single electric locomotive need only have the power removed for the length of the leading locomotive.

Extended response times caused by the trackside design are excluded from this requirement.

3.23 Driver training

The ETCS onboard system shall be configured to include Level NTC (AWS/TPWS) Fixed.

NOSS-131A

Status: Application-Specific
Guidance: Level NTC (AWS/TPWS) Fixed is intended to be used in overlay areas during the driver training process. Where a driver is not trained in the use of ETCS beyond Level NTC, the intention is for the driver to select this level at start of mission.

Conditional transition order balises will be used at the border between AWS/TPWS areas and Level 2 ETCS (overlay) areas. The balises will be programmed such that only vehicles in Level NTC (AWS/TPWS) transition to level 2; vehicles in Level NTC (AWS/TPWS) Fixed will remain in that level through the transition.

NID_NTC has yet to be assigned to this system.

Level NTC (AWS/TPWS) Fixed shall be functionally identical to Level NTC (AWS/TPWS)

Status: Normative

Guidance Applies only where Level NTC (AWS/TPWS) is implemented.
4 National Systems

4.1 General

The onboard ETCS system shall interact with all existing onboard train protection systems in a manner that does not cause unnecessary distraction to the driver.

NOSS-132

Status: Normative

Guidance: Class B protection systems include: AWS, TPWS, RETB and ATP

4.2 AWS/TPWS

Guidance: AWS/TPWS is considered to be operating as a standalone system (with rudimentary interfaces to the ETCS for suppression), partially or fully integrated into the ETCS DMI, or as a fully compliant specific transmission module (STM). Operationally, all of these configurations are Level NTC (AWS / TPWS) and are permissible within the scope of this document.

For new build vehicles the option to integrate the driver interface with the DMI may be favourable, in order to optimise the cab layout. However it should also be noted that AWS / TPWS is a class B system that will ultimately be withdrawn, so the economics of implementing on the DMI should be considered. Furthermore, the DMI may be considered to be a SIL0 component of the ETCS subsystem in some architectures, so its applicability for use within other class B systems needs to be considered.

In the following paragraphs, the requirements only apply to AWS/TPWS implemented separately to ETCS, unless specifically stated otherwise. Subset 035 specifies much of the functionality required when a class B system is interfaced as an STM.

It is noted that compliance with the requirements of this document is likely to require an upgrade to the AWS / TPWS system aboard the vehicle, in order to provide the functionality specified. The requirements assume compliance with the content of GE/RT8075.

Section 4.3 provides requirements for cases where AWS/TPWS is integrated into the DMI.

The ETCS onboard system shall not prevent any continuous AWS / TPWS in-service monitoring from being undertaken.

NOSS-135

Status: Normative

Guidance: AWS / TPWS self tests and monitoring shall occur irrespective of the use of ETCS. Consideration should be given to how this is achieved when AWS / TPWS is suppressed for operation outside Level NTC (AWS / TPWS) areas.
This requirement should also apply when AWS/TPWS is integrated into the DMI, or when interfaced through an STM,

GE/RT8075 sets out the requirements for onboard AWS and TPWS self-testing.

AWS/TPWS shall be suppressed when the ETCS onboard system is operating in all levels other than Level NTC (AWS / TPWS).

NOSS-136

Status: Normative

Guidance: In accordance with the strict definition of levels, only Level NTC (AWS / TPWS) requires that AWS / TPWS be energised. Whilst it could be energised in L0, suppression of the system aligns more correctly with the intent of the standard.

AWS/TPWS shall be unsuppressed when the ETCS onboard system is operating in Level NTC (AWS/TPWS).

NOSS-137

Status: Normative

AWS/TPWS shall be suppressed when the ETCS onboard system is operating in Non Leading (NL) mode.

NOSS-138

Status: Normative

Guidance: This is an exception to NOSS 137; when tandem working it is necessary to isolate AWS / TPWS on conventional lines therefore it would be beneficial for ETCS to suppress it automatically for such operations (including in Level NTC AWS / TPWS).

AWS/TPWS shall be unsuppressed when the ETCS onboard system is operating in IS.

NOSS-139

Status: Normative

Guidance: This is an exception to NOSS 136, to account for failure situations.

The AWS / TPWS system shall be suppressed no later than 5s after the point of level transition from Level NTC (AWS / TPWS).

NOSS-140

Status: Normative

Guidance: AWS / TPWS is expected to be suppressed at the transition border from Level NTC (AWS/TPWS). No AWS / TPWS trackside equipment will be placed within 5s (at line speed) of the border in overlay areas, to ensure that the train is not inadvertently tripped.

The AWS / TPWS system shall be in the Operational Ready state no later than 5s after the point of level transition to Level NTC (AWS / TPWS).

NOSS-141

Status: Normative

Guidance: AWS / TPWS is expected to be unsuppressed at the transition border to Level NTC (AWS/TPWS). No AWS / TPWS trackside equipment will be placed
within 5s (at line speed) of the border, to ensure that the system is able to detect the first signal after leaving ETCS control.

The Operational Ready state is defined within GE/RT8075, and is equivalent to the ‘Data Available’ state in Subset 035.

AWS/TPWS outputs to onboard driving data recording systems and to the ETCS onboard system shall be suppressed only during isolation of AWS/TPWS.

Status: Normative

The suppression by ETCS of the AWS/TPWS shall be recorded

Status: Normative

The driver shall always be made aware of a failed or malfunctioning AWS / TPWS system before or upon the train transitioning from any level to Level NTC (AWS/TPWS).

Status: Normative

Guidance: This requirement ensures that AWS/TPWS is available for areas where ETCS is unavailable and that ETCS is operating for fitted areas, and that the driver cannot pass a transition believing incorrectly that protection is being provided.

A means of achieving this may be for the ETCS to provide visual / audible warning to the driver of the failure state, the AWS / TPWS system to provide the indication, or an independent indication of the system state.

Temporary isolation of AWS / TPWS shall not prevent the selection or use of an ETCS level where AWS / TPWS is required to be active.

Status: Normative

Guidance: Temporary isolation of AWS / TPWS is sometimes required, in order to pass a failed signal or operate in a possession. The use of Level NTC (AWS / TPWS) is being considered for movements in a possession, therefore should be available irrespective of any temporary isolation of the class B system.

During operation in Levels other than Level NTC (AWS / TPWS) the ETCS onboard system shall cause any external AWS visual indicator to display ‘all black’.

Status: Normative

The AWS shall display a black and yellow visual indicator upon transitioning from Levels 0, 1, 2 or 3 to Level NTC (AWS/TPWS).

Status: Normative
4.3 AWS / TPWS – DMI Integration

Guidance: It is not required to integrate AWS / TPWS indications or controls within the DMI. However, where this is undertaken the following requirements shall apply. GE/RT8075 provides further reference and mandatory requirements for AWS / TPWS interfaces.

There shall be no further requirement for driver interaction with AWS / TPWS systems by virtue of placing any AWS / TPWS indications or controls on the DMI.

Status: Normative

4.4 BR – ATP

Guidance: It is not expected that suppliers will integrate BR-ATP with the ETCS onboard system; as such the current trackside design proposal does not include the facility for running transitions.

Should a project wish to integrate the systems then this position shall be reviewed with the National ERTMS programme, such that the onboard requirements and trackside proposals can be revised.

4.5 TVM / KVB / BRS

Guidance: The integration requirements for TVM/KVB/BRS systems are yet to be formalised. Should a project wish integrate these systems with ETCS then this shall be reviewed with the National ERTMS programme who will assist in development of requirements.

4.6 CBTC

Guidance: The integration requirements for CBTC systems are yet to be formalised. Should a project wish integrate these systems with ETCS then this shall be reviewed with the National ERTMS programme who will assist in development of requirements.

4.7 TASS

Guidance: The integration requirements for TASS systems are yet to be formalised, though will be included in future iterations of this document.
5 Vehicle Interface

5.1 Safety Integrity

The interface of the ETCS onboard system with the train shall not compromise the safety integrity of the existing train systems.

Status: Normative

5.2 Circuit Protection

The ETCS onboard system shall be protected from fault currents caused by short-circuits in the interfacing train wiring.

Status: Normative

Guidance: If a short circuit occurs which causes a high current to flow and operate a circuit breaker or fuse, then the ETCS onboard system should not be damaged before the circuit breaker or fuse operates.

The ETCS onboard system shall be protected by correctly-rated protective devices.

Status: Normative

Guidance: The positioning of protective devices should be co-ordinated within the train layout to group protection devices and minimise the number of different locations of protective devices. The design and combination of circuits on protection devices should take into account the impact on vehicle reliability.

Resettable protective devices are preferred, if they are able to provide the level of protection required.

Installation of the ETCS onboard system shall not compromise the hierarchy of protection of the vehicle’s circuits.

Status: Normative

Where more than one switch or contact is fitted serially in a circuit, it shall be possible to test each switched output independently.

Status: Normative

Guidance: It is common practice to use serial switches and contacts in safety braking circuits to reduce the chance of a single switch failure causing a hazard to the train. The ability to test each switched output independently reduces the likelihood that hidden failures are undetected when supported by maintenance activity at suitable periodicity. This functionality may be built into the train interface design.
5.3 Fault tolerance

The ETCS onboard shall not enter SF or NP as a result of erroneous ETCS inputs which might reasonably occur on the vehicle.

Status: Normative

Guidance: Such scenarios include: two cabs being open at once during coupling/uncoupling, closure of a cab desk running self-test, rapid opening/closing of cabs.

Faults caused solely by a temporary mismatch in the readiness or status of individual ETCS-related devices during train power up or power down sequence shall not occur.

Status: Normative

5.4 Future Provisions

Five spare digital inputs and outputs shall be provided by the ETCS onboard, to accommodate anticipated future functionality.

Status: Application Specific

Provision shall be made for an external data connection for interfacing with future train systems.

Status: Preferred

Guidance: As it is unclear what interface will be required for future systems (e.g. door control, pantograph control, train management, etc), a spare slot which can accommodate a variety of interface cards or an existing interface based on a railway-compatible data standard should be provided. This may be used to export Packet 44 data and / or train data from ETCS to the attached system.

Provision shall be made for an external data connection to be used for the remote population of train data.

Status: Application-Specific

Guidance: Research is being undertaken into the risks and practicality of DMI entry for train data. Current logic is that the driver data entry process is unlikely to be robust enough, so it is expected that there will be a need to be able to upload the train data that would normally be entered upon the DMI to be entered via other means (for example OTA, swipe card, etc).

The term ‘remote’, in this context, means a data source external to the DMI or EVC. This may be from other train systems or from a source external to the train.

Subset 119 provides details of how such an external data interface may be specified. Although not formally issued the principles within it provide a solid foundation.
Where inter-vehicle jumpers are added as part of the ETCS onboard design, they shall be provided with 20% spare capacity for connecting future inter-vehicle wiring.

**NOSS-158**

**Status:** Application Specific

**Guidance:** Inter vehicle jumpers are likely to be required on multiple unit vehicles. Given the expectation that future modifications will require wiring through the train, the jumpers should be specified so as to reduce the likelihood of needing to replace the jumpers with higher capacity ones in the future.

It should also be noted that spare wiring capacity may also be beneficial to facilitate future functionality expansion; therefore consideration should be given to providing additional capacity to appropriate looms as part of the installation design.

### 5.5 Additional (Driver Training) Display

**Provision shall be made for an additional display to be temporarily fitted and viewed from a non-driving seat in the cab.**

**NOSS-159**

**Status:** Application-Specific

**Guidance:** Driver instructors might have to monitor driving performance during training and service conditions. This requires observation of movement authorities and other DMI data.

On some vehicles this might require additional or portable DMI equipment (repeater DMI, providing indications only) to be provided if the DMI is not readily visible. As such, appropriate power and signal connections as well as a mounting bracket would be required.

**The additional display shall have no ETCS functionality.**

**NOSS-160**

**Status:** Normative

**Guidance:** This requirement shall only apply where an additional display is provided.

It shall be possible to record the images provided from the DMI to the additional display (where provided) in order to facilitate post journey analysis.

**NOSS-161**

**Status:** Normative
6 Installation Design

6.1 General

The ETCS onboard system shall incorporate modularity and the facility to upgrade or replace parts of the system separately.

Status: Preferred

NOSS-162

The ETCS onboard system shall minimise the requirements for space on the vehicle.

Status: Normative

NOSS-163

The ETCS onboard system shall incorporate, to the extent permitted by the requirements of this specification, proven available components and software.

Status: Preferred

NOSS-164

Introduction of ETCS shall not compromise existing provision of redundancy within other systems.

Status: Normative

NOSS-165

Guidance: Trains may have redundant systems that provide tolerance to failures, for example operation on a single engine or a defective battery charger. The application of ETCS should not have an adverse effect on these existing arrangements.

6.2 Environmental

The ETCS onboard system shall meet its reliability requirement in the environmental conditions in which it will operate.

Status: Normative

NOSS-166

Guidance: The environment includes internal and external temperature, radiation and humidity

The operating environment will include heat given off by the ETCS onboard system, as well as ambient conditions (which will include heat given off by other equipment).

The values set out for EN 50125-1:1999 Class T1 is appropriate for GB.

The ETCS onboard system shall meet its predicted service life in the environmental conditions in which it will operate.

Status: Normative

NOSS-167

Guidance: The environment includes internal and external temperature, radiation and humidity
The operating environment will include heat given off by the ETCS onboard system, as well as ambient conditions (which will include heat given off by other equipment).

The values set out for EN 50125-1:1999 Class T1 is appropriate for GB.

The ETCS onboard system shall not reduce the reliability or performance of other systems on the train.

Status: Normative

The ETCS onboard system shall not cause discomfort to passengers or train crew.

Status: Normative

Guidance: The environment includes conducted, convected or radiated heat or draughts from ETCS onboard components.

Equipment shall not be damaged or degraded in appearance by ultraviolet and infrared radiation experienced by the equipment during its lifetime.

Status: Normative

Guidance: Sources of ultraviolet and infrared radiation include sunlight and depot roof radiant heaters.

Modifications to the cab layout shall ensure that the driver controls and indications are clearly legible from the driver's operating position over the full range of ambient lighting levels and incidence angles.

Status: Normative

Guidance: Previous experience of ETCS fitment has shown that ‘washout’ of the DMI and cab indications is a problem that needs to be addressed, particularly on retrofitment where the cab layout is not optimised for in cab signalling.

The DMI installation should be arranged to provide clarity of the display when taking into account the cab environment, including screen position, sources of sunlight, the position of the driver (including viewing angles), cab lighting levels, maximum night-time cab illumination levels, reflections etc.

Cambrian experience also shows that reflected glare from driver clothing (white shirts, high visibility vests etc) can affect DMI visibility. The effects of this and it potential mitigations (DMI viewing angles, diffuse coating on screen) should be considered.

6.3 Shock, Vibration & Noise

The ETCS onboard system shall meet the reliability requirements and predicted service life in the shock and vibration environment encountered on the vehicle to which it is fitted.

Status: Normative

Guidance: Specific research is available from RSSB on this subject (research
report T088), which compares actual fatigue and shock levels measured on the vehicle with EN 61373:1999 and GM/TT0088 requirements. This includes short periods of running with faulty equipment (out of round wheels, faulty damping) and jointed track. EN 61373:1999 has subsequently been superseded by EN 61373:2010 and it is recommended that this later version is used.

Vehicle bodies are prone to twisting during low frequency vibration; equipment mounting should prevent transmission to sensitive printed circuit board and backplane connections, and possible resonance of equipment.

The ETCS onboard system shall not induce other equipment to vibrate or introduce noise, which may cause discomfort or distraction to train crew or passengers.

Status: Normative

Guidance: Guidance and requirements for the measurement of noise and vibration are set out in EN 15892:2011 and GM/GN2460. Acceptable limits for passengers are not prescribed but should be derived on the basis of avoiding any appreciable increase in noise (sound power level) or vibration beyond the level experienced while the ETCS onboard system is neither fitted or operating. Acceptable limits for train crew should be derived on a similar basis, while acknowledging that limiting criteria will be governed by The Control of Vibration at Work Regulations 2005 and The Control of Noise at Work Regulations 2005. The Rolling Stock (Noise) TSI also sets out noise limits and measurement criteria for drivers' cabs.

Vibration experienced by the vehicle in operation shall not render the DMI or cab indications illegible at any time.

Status: Normative

Guidance: On track machines are particularly susceptible to vibration during operation. It is not desirable for the DMI to become obscured due to harmonics induced in the vehicle structure.

6.4 Electromagnetic Compatibility

The ETCS onboard system shall not induce other equipment to vibrate or introduce noise, which may cause discomfort or distraction to train crew or passengers.

Status: Normative

Guidance: Guidance and requirements for the measurement of noise and vibration are set out in EN 15892:2011 and GM/GN2460. Acceptable limits for passengers are not prescribed but should be derived on the basis of avoiding any appreciable increase in noise (sound power level) or vibration beyond the level experienced while the ETCS onboard system is neither fitted or operating. Acceptable limits for train crew should be derived on a similar basis, while acknowledging that limiting criteria will be governed by The Control of Vibration at Work Regulations 2005 and The Control of Noise at Work Regulations 2005. The Rolling Stock (Noise) TSI also sets out noise limits and measurement criteria for drivers' cabs.

Vibration experienced by the vehicle in operation shall not render the DMI or cab indications illegible at any time.

Status: Normative

Guidance: On track machines are particularly susceptible to vibration during operation. It is not desirable for the DMI to become obscured due to harmonics induced in the vehicle structure.

6.4 Electromagnetic Compatibility

The ETCS onboard system shall not degrade any other system or component on the vehicle by introducing electromagnetic or electrostatic interference.

Status: Normative

Guidance: When an ETCS onboard system is fitted to vehicles that have electronic systems without proven immunity, tests should be carried out to ensure compatibility with other onboard systems. The design should consider the proximity of radiating equipment and cables.

The ETCS onboard system should behave in a controlled and predictable manner when subjected to electromagnetic interference and input and power supply perturbations outside its design capability.

The ETCS onboard system shall not be adversely affected by electromagnetic or electrostatic interference from other vehicle systems.
6.5 Contamination

Underframe and roof-mounted equipment shall be appropriately sealed against moisture ingress.

NOSS-177

Splash-proof drains shall be provided on underframe boxes and conduits where water is likely to accumulate.

NOSS-178

Interior mounted equipment shall be sealed to an appropriate level to protect against fluid spillage, contamination, or debris.

NOSS-179

All equipment shall be tolerant of cleaning using the typical range of cleaning materials and processes used in the railway environment.

NOSS-180
Exterior equipment is subject to acid and / or alkaline cleaning chemicals applied at pressure or forcibly through brushing action. High pressure hot water with or without detergent, or steam might also be applied.

6.6 Crashworthiness

Any modifications undertaken to the driving desk, cab or any other part of the vehicle shall not degrade the existing vehicle crashworthiness provision.

Status: Normative

Guidance: In low speed collisions the driver’s desk often provides a significant proportion of the front end stiffness. The recommendations of the Uff / Cullen report should be considered.

Status: Normative

6.7 Vandalism and Accidental Damage

The ETCS onboard system shall be designed to afford protection from vandalism and accidental damage by drivers, train crew, other staff and members of the public.

Status: Normative

Externally mounted equipment shall be designed continue to function when subjected to the conditions and impacts reasonably expected in normal service operation.

Status: Normative

Guidance: It is reasonable to expect that external equipment would be subject to impact by flying ballast, snow and ice build-up, and minor flood waters, during normal operation. Additionally, on track plant equipment may be exposed to more harsh environments – ballast dust, grinding cinders, etc. This list is not exhaustive.

The DMI surface shall be robust and scratch resistant, and support simple routine cleaning without scratching.

Status: Normative

6.8 Health and Safety

No part of the ETCS onboard system shall, while safety guards provided are in place, be capable of exposing any person to harm.

Status: Normative

Guidance: Harm could be caused through exposure to extreme temperatures (be it through radiation, conduction or convection), electro-magnetic radiation, electrostatic hazards or trapping hazards.

The ETCS onboard system shall not include uncovered hazardous live terminals in areas that have to be accessed for routine maintenance of live equipment.
The ETCS onboard system shall be located such that risk of slips, trips, falls, cuts and other injuries to both staff and public is not increased.

Guidance: This includes the location access for maintenance staff to effect fitment or repairs.
7 Maintenance

7.1 General

The ETCS onboard system shall, as a minimum, meet the onboard MART requirements for underbody mounted equipment specified in the Preliminary ERTMS Reliability Specification (NR/AM/SA/SPE/00147)

Status: Normative

Guidance: NR/AM/SA/SPE/00147 defines reliability and availability targets for the ETCS system, which are then apportioned to the respective elements of the onboard and trackside.

The ETCS onboard system shall, as a minimum, meet the onboard MART requirements for interior mounted equipment specified in the Preliminary ERTMS Reliability Specification (NR/AM/SA/SPE/00147)

Status: Normative

Guidance: NR/AM/SA/SPE/00147 defines reliability and availability targets for the ETCS system, which are then apportioned to the respective elements of the onboard and trackside.

Maintenance tasks shall be designed to be achieved by maintainers with skills equivalent to existing maintenance staff.

Status: Normative

Guidance: The design of the ETCS onboard system should consider minimising the likelihood of incorrect maintenance or component fitment.

Incorrect maintenance or component fitment may be mitigated, for example, by coded plugs and sockets or diagnostics.

The design and location of the ETCS onboard system shall not affect adversely the cleaning and maintenance of the vehicle interiors and exteriors.

Status: Preferred

Guidance: Where equipment is exposed within the vehicle interior, flush surfaces without dirt traps facilitate effective cleaning without the use of excessive quantities or concentrations of cleaning fluids or excessive force.

Floor-mounted equipment should not have grilles or louvers that allow ingress to the equipment enclosure during service or cleaning. The cleaning of floors using mops and / or vacuum cleaners, as appropriate, should not be impeded by floor-mounted equipment. Access for maintenance should be taken into consideration especially for floor-mounted equipment.

Exterior-mounted equipment should not impede effective exterior machine washing or create dirt traps which lead to dirt streaks on roofs or bodysides as the wash and rinse chemicals drain off.
At least 90% of predicted equipment failures shall be rectified by replacement of the applicable Line Replaceable Unit (LRU).

Status: Normative

Guidance: As a target, 99% of predicted equipment failures should be rectified by replacement of the applicable LRU.

Line Replaceable Units (LRU) shall be clearly delimited and marked to prevent subdivision, loss of configuration, or traceability.

Status: Normative

Guidance: This is important for equipment where staff may swap components during fault finding, resulting in loss of configuration and traceability.

All ancillary electrical equipment within the ETCS onboard system, such as terminals, MCBs, fuses, relays, contactors etc shall be easily accessible for testing or replacement.

Status: Normative

A DMI shall take no more than fifteen minutes to be replaced, configured and tested by a single trained person.

Status: Application-Specific

Rationale: Whilst most components will be changed at maintenance depots, it is feasible that DMIs will be swapped out by station based maintenance staff while the train is in service. As such, the requirements for changing a DMI are much more stringent than for other components.

The design shall reflect good ergonomic practice in mounting components and accessing fasteners and connectors.

Status: Normative

Guidance: Ergonomic maintenance practice avoids problems such as: trapping, scraping or straining hands; difficulty aligning mounting holes; placement of screws with tips of fingers; trapping loose cables behind components; hardware, connections or cable looms obstructing access to fasteners; accidental dropping of fasteners or tools into inaccessible or hazardous locations, etc.

Onboard ETCS preventative maintenance tasks shall fit within the existing vehicle maintenance schedules.

Status: Normative

Guidance: Vehicle exam schedules are well defined for existing rolling stock. Changing the periodicity at which vehicles are stopped for maintenance is not acceptable; therefore the new maintenance tasks must be specified to fit within the existing stoppage pattern.
The scheduled vehicle downtime required as a result of ETCS preventative maintenance or upgrade shall be minimised.

NOSS-199

Status: Normative

Guidance: The ‘scheduled vehicle downtime’ is the time required out of service for scheduled maintenance activity. It is not expected that significant maintenance of the ETCS onboard system will be required, as the system should self-diagnose and contain few moving parts.

The need to reduce or eliminate maintenance of the system should be considered at each stage of the installation design. The target time for carrying out any maintenance examination should not be longer than two hours; the target time to perform software upgrades should not be longer than four hours.

The use of components that require replacement after a fixed time interval without assessment of condition should be avoided.

Calibration of odometry systems shall be made as simple as possible, or eradicated entirely through the use of automatic calibration systems.

The ETCS onboard system shall not adversely affect the maintenance of existing equipment.

NOSS-200

Status: Normative

Guidance: Examples include: blocking access to existing equipment and fasteners; awkward new inter-vehicle or body-bogie connectors; impeding or interrupting test cycles; requiring additional limitations (for example, engines running, underframe clear, radio reception required) during routine maintenance; and impeding wheel re-profiling equipment.

Specialist anti-static, bench test or clean room precautions shall not be required to maintain the ETCS onboard system.

NOSS-201

Status: Normative

Guidance: The low projected failure rate of the ETCS onboard system does not indicate a need for specialist equipment or technicians in depots.

A separate clean and dry store for electronic equipment is permissible.

7.2 Diagnostic tools

Guidance: Diagnostic tools include maintenance, download, fault finding, interrogation and analysis tools.

Diagnostic tools shall be capable of operation and interpretation by the staff normally employed by the Train Operator.

NOSS-202

Status: Normative

Software based diagnostic tools shall be designed for use on standard, modern operating systems.

NOSS-203
### Status: Preferred

**Guidance:** The software should not rely on legacy operating systems for its operation; it should function correctly within modern, commercially available operating systems. This may include, but is not limited to, Windows, iOS, Linux and Android systems.

<table>
<thead>
<tr>
<th>Software based diagnostic tools shall not require complex procedures for manual input and recording of outputs.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NOSS-204</strong></td>
</tr>
</tbody>
</table>

### Status: Normative

**Guidance:** Ethernet, USB and other common electronic interfaces shall be utilised to avoid potential obsolescence issues with the device hardware. RS232, RS485 and other legacy interfaces should be avoided.

<table>
<thead>
<tr>
<th>Software based diagnostic tools shall use modern, universally available interfaces for communicating with the onboard ETCS system.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NOSS-206</strong></td>
</tr>
</tbody>
</table>

### Status: Application-Specific

**Guidance:** The ability to identify ETCS faults with the ETCS onboard system from locations remote to the vehicle is deemed to be beneficial. This may be facilitated through exporting system fault logs at defined intervals or upon demand, via a remote communication medium.

<table>
<thead>
<tr>
<th>Functionality shall be provided to remotely download ETCS diagnostic information stored onboard while the train is in service.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NOSS-207</strong></td>
</tr>
</tbody>
</table>

### 7.3 Failure Reporting and Data Recording

**Guidance:** Interfacing a train system / device with the ETCS onboard system should not compromise the ability for faults or status reports to be conveyed to authorised persons at any time. This may be achieved by retaining existing fault reporting functionality, or integrating the fault reporting into ETCS processes.

<table>
<thead>
<tr>
<th>Where more than one device is used for data recording, a robust means of correlating the data across the devices shall be provided.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NOSS-209</strong></td>
</tr>
</tbody>
</table>

**Guidance:** Data recording requirements for ETCS are set out in SUBSET-027.
Data recording requirements for trains in general are set out in GM/RT2472. Failure / incident investigation is likely to require data from both conventional and ETCS systems in order to fully explain the events that occurred.

Any new data recorder fitted shall be provided with at least 20% spare channels, above that needed to comply with the requirements of GM/RT2472 and the ETCS JRU.

Status: Normative

Guidance: GM/RT2472 specifies the minimum requirements for on train monitoring and recording. The revised standard (issue 2) is soon to be available for consultation from RSSB, and is expected to place further monitoring requirements upon rail vehicles. This is likely to be in force before ETCS fitment is completed, so provision shall be made to support it.

In this context ‘data recorder’ may be either an independent JRU, or a combined OTMR / JRU unit. This requirement is not applicable to existing data recorders that are retained on the vehicle.

Functionality shall be provided to remotely download JRU data from the onboard while the train is in service.

Status: Application-Specific

Guidance: The ability to download JRU data from the ETCS onboard system from locations remote to the vehicle is deemed to be beneficial. This may be facilitated through exporting JRU logs at defined intervals or upon demand, via a remote communication medium.

7.4 Diagnostic Information

The ETCS onboard system shall provide authorised persons with diagnostic information sufficient to confirm the complete ETCS onboard system is operational and functioning correctly.

Status: Normative

The ETCS onboard system shall provide authorised persons with diagnostic information sufficient to allow the diagnosis of faults to a single line replaceable unit (LRU).

Status: Normative

ETCS onboard diagnostic information shall be displayed to authorised persons without the need for equipment other than access keys.

Status: Preferred

Guidance: A maintainer shall be able to interrogate the ETCS diagnostic information from displays / interfaces integrated within the ETCS onboard system. There should be no need to use maintenance tools or laptop based interrogation software, other than access keys if located in a secure area.
Diagnostic information shall be recorded with a time stamp with sufficient resolution to identify all events accurately.

Status: Normative

The details and nature of safety-critical faults within the ETCS onboard system shall be recorded onboard the vehicle.

Status: Normative

The ETCS onboard system shall be able to identify malfunctioning Line Replaceable Units to an authorised person before they cause a service failure.

Status: Preferred

Guidance: Partial failure of redundant systems or tolerable but unusual activity (e.g. abnormal data errors, dropped connections, inconsistent ETCS inputs and software watchdog resets) are examples of faults which a system may reasonably identify before it results in a failure.

Failures in unmonitored hardware (wiring degradation, sticking relays, etc) cannot reasonably be expected to be identified before failure.

Faults reported by the ETCS onboard system that relate to trackside equipment shall be supported with information on the location and nature of the failure.

Status: Normative

Guidance: Location information may be derived from the Last Relevant Balise Group and distance, or other relevant co-ordinates if supported.

Section 15 of ERA specification ERA_ERTMS_015560 sets out requirements for system status messages.

Information for faults that require immediate driver attention shall be presented in an unambiguous, operationally meaningful manner

Status: Normative

Guidance: The indication is to be provided in a manner that minimises inappropriate driver distraction.

Information for faults that require immediate driver attention shall require acknowledgement.

Status: Normative

Guidance: The requirements for display and acknowledgement of text messages related to the SRS defined system status is set out in ERA_ERTMS_015560. The acknowledgement of supplier specific text messages, informing of faults within the ETCS onboard system, is not specified. The requirement is for these text
messages to need acknowledgement by the driver.

| Information for faults that require immediate driver attention shall persist after acknowledgement. |
| NOSS-221A |

### Status: Normative

**Guidance:** ‘End of display’ determines whether the message is deleted after acknowledgement or is retained in a list that can be scrolled. It is proposed that, owing to the message requiring immediate attention by the driver, it is appropriate for them to persist in the scrolling list of text messages.

### Detailed maintenance information about the cause of faults and appropriate action shall be provided via the DMI or exported to train control systems.

| NOSS-224 |

### Status: Preferred

**Guidance:** When the vehicle is fitted with train control systems which report faults directly to drivers, and/or to maintainers remotely, the ETCS fault logging system should be integrated with the vehicle system if it is economical to do so. The failure of one system in an integrated solution should not affect the fault logging of other systems.

#### 7.5 System Security

### An access control system for configuration settings and data shall be provided.

| NOSS-225 |

### Status: Normative

**Guidance:** Access control will incorporate user identifications and appropriate access levels.

‘System Security’ refers to security against unauthorised access to the ETCS onboard system settings, configuration data, cryptographic keys and software.

Rigorous mechanisms and procedures should be adopted to avoid ETCS being compromised by malware. These should extend to the whole system, including maintenance and diagnostic equipment and all removable media.

The ETCS onboard system should have ETCS cryptographic keys installed that are compatible with any ETCS Level 2 or Level 3 infrastructure on which it is required to operate, before entering service. GE/RT8403 sets out requirements for the management of ETCS cryptographic keys.

SUBSET-037 sets out how the keys are used.

### The onboard ETCS system shall be designed to reduce the risk from cyber attack to an acceptable level.

| NOSS-226 |

### Status: Normative

**Guidance:** Risks to consider may include the possibility of malicious remote operation of the EVC, remote editing of data within the EVC, remotely disabling the ETCS system, or unauthorised use of access keys to ETCS equipment.
The level of risk from a cyber attack will be agreed with the Centre for the Protection of National Infrastructure.

Any equipment not contained within a secure enclosure shall be failsafe in the event of tampering.

Status: Normative

Exclusive access to the ETCS onboard system equipment enclosure shall be provided for the staff using the relevant tool.

Status: Normative

Guidance: The “relevant tool” will vary depending upon the fleet being fitted, but should be selected to align with the existing access arrangements for the particular fleet. For example, one may use items from the ‘Southco’ product line or equivalent compatible products which include:

Maintainers (access to equipment cabinets) – gated 8mm hex recess.

Drivers (access to circuit breakers) – gated 8mm square driver.

Driver manager (access to JRU and repeater DMI) – gated 7mm triangle.

Where both maintainers and drivers / train preparers require access to equipment, two separate locked areas can be provided to allow access only to the appropriate parts of the system. Each such area can be accessed by a separate key which is common for maintainers or for drivers / train preparers, as appropriate.

Status / fault indicators and download ports necessary for maintenance and fault-finding shall be accessible with access keys only.

Status: Normative

Status or fault indicators necessary for operations shall be visible without the need for access keys.

Status: Normative

Guidance: Drivers or other operational staff may need to view fault indicators in service (e.g. basic fault diagnosis in the event of failure). Such indicators need to be easily accessible to the driver.

If staff needs to observe an indicator in an unauthorised area, a window should be used that allows visibility from an authorised area.
8  Process / Procedure

8.1  System Support

The onboard ETCS system shall be supported by a lifecycle management plan which is in place on first authorisation of an installation.

Status: Normative

Guidance: The onboard lifecycle management plan will need links into a lifecycle management strategy for ETCS as a system on the rail network to enable effective management of configuration and reliability management through industry DRACAS processes. The National ERTMS Programme is able to provide further guidance on this area. Standard lifecycle support arrangements are also expected to be included and may include but not be limited to:

- Arrangements for update of equipment including for obsolescence
- Spares provided
- Test equipment
- Endemic and epidemic faults
- Warranty support
- Ongoing training
- Repair process
- Documentation updates
- Decommissioning and disposal
- Support to DRACAS processes
- Configuration management (including use of existing train operator systems, e.g. component tracker)
- Reliability
- Monitoring and trend analysis for all relevant applications of the Contractor’s ETCS systems and interoperable constituents.
- Safety monitoring and reporting for all safety related incidents for all relevant applications of the Contractor’s ETCS systems and interoperable constituents anywhere in Europe or the rest of the world.

The onboard ETCS system shall have its Baseline 3 software updated with Baseline 3 maintenance releases in a reasonable timescale following the instruction for their implementation.

Status: Normative

Guidance: ETCS is a software based system defined by a core European specification and the GB Programme is deploying the baseline of this specification known as Baseline 3. During the life of the system, system updates or maintenance releases will be required to fix errors, implement compatible functionality, and act upon feedback from that and other projects. This means that the system version deployed on an installation will need to change during the lifetime of the system to allow incorporation of the updates, and should be formalised contractually between owner / operator and supplier.

A “reasonable timescale” shall be agreed between operator and supplier, after assessment of the content of the release and consideration of its impact on individual fleet operation. Compliance to this requirement would be judged on looking at when first authorisation took place, when maintenance releases were issued, whether they had been deployed and if not checking that plans were in place to deploy supported by the appropriate contracts and processes.
8.2 Human Factors

Guidance: The scope of HF studies will be limited to application principles and national elements only. It is not necessary to carry out a systematic validation of mandatory TSI requirements. Any necessary changes to TSI requirements shall be managed through the established Change Control Management Process.

The design of the Onboard ETCS system and its application onto the vehicle shall incorporate user-centred design activities to ensure effective human factors and ergonomics design techniques are applied in all aspects of system development and operation & maintenance in line with UK operational practice.

Status: Normative

Guidance: ISO 9241-210:2010 provides guidance on using user-centred design techniques to achieve quality in use throughout the life cycle of interactive computer-based systems. It describes user-centred design as a multi-disciplinary activity, which incorporates ergonomics knowledge and techniques with the objective of enhancing effectiveness and productivity, improving human working conditions, and counteracting the possible adverse effects of use on human health, safety and performance. This includes everyone who comes into contact with any part of the Onboard ETCS system.

It is expected that substantial consultation with the end user of the respective system elements will be required in order to arrive at the optimum solution.
APPENDIX A DEFINITIONS AND ABBREVIATIONS

The following definitions are supplementary to those set out in the ETCS Glossary [RD6].

ALARP  As Low As Reasonably Practicable

APC  Automatic Power Control. A train system for performing onboard functions corresponding to features in the traction power supply system such as the operation of circuit breakers at neutral sections.

Application Engineer  Engineer authorised on behalf of the railway undertaking and infrastructure manager to make alterations to the settings and data within the ETCS onboard system beyond those that may be configured by the driver, train preparer or maintainer.

ASD  Additional Speed Display: a secondary speed display that operates totally independently from the ETCS onboard system and is separate to the ETCS DMI.

ATO  Automatic Train Operation.

AWS  Automatic Warning System.

CCS  Control-Command and Signalling.

CCS TSI  Technical Specification for Interoperability relating to Control-Command and Signalling.

Cold Movement Detector  A device outside the ETCS system that informs the ETCS onboard system whether or not the train has been moved. When the ETCS onboard system has been powered down, it cannot tell if any movement has taken place. If the cold movement detector confirms that no movement has taken place, the ETCS onboard system can use the last known location with certainty.

Contracting Entity  Any person who, in relation to a structural subsystem used in or intended for use in the construction, upgrading or operation of the rail network schemes, either:

Any person who, in relation to a structural subsystem used in or intended for use in the construction, upgrading or operation of the rail network schemes, either:

   a) Has contracted with another person for the manufacture or construction by that other person of that structural subsystem.

   or

   b) Manufactures or constructs that structural subsystem for his / her own use, or for sale to, or use by, another person but not where he / she is contracted to do so by a person falling under paragraph (a), and includes an authorised representative established in the community of such a person.

Contractor  The organisation or individual contracted to supply ETCS onboard system or undertake its application design, installation, test or commissioning.

Cryptographic Key  A predefined component necessary to be able to interpret encrypted data.

Design Authority  Body recognised and authorised as recording and controlling the specification pertaining to a component, product or system through the possession and application of appropriate knowledge, technical competence and data.
DMI Driver machine interface.
EC European Commission.
EDOR ETCS Data Only Radio
EMC Electromagnetic Compatibility.
Entry Transition Operational change from existing signalling to ETCS.
ERA European Railway Agency.
ERTMS European Rail Traffic Management System.
ETCS European Train Control System.
Eurobalise Reader The part of the ETCS onboard system that reads the information held in the Eurobalise.
Euroradio The radio network functions and message protocols that provide an acceptably safe communications channel between trackside and ETCS onboard system.
EVC European Vital Computer.
Exit transition Operational change from ETCS to existing signalling.
Firmware Software embedded within hardware components.
FIS Functional Interface Specification.
FFFIS Form-Fit Functional Interface Specification.
FLOI First Line of Intervention
FS Full supervision mode, as defined in SUBSET-026.
GB Great Britain.
GNSS Global navigation satellite system: generic term for systems such as GPS.
GPRS General packet radio service.
GPS Global Positioning System.
GSM-R Global System for Mobile Communications (Railway).
IS Isolation mode, as defined in SUBSET-026.
JRU Juridical Recording Unit.
Level 0 (or L0) A level of ETCS defined to cover instances when the ETCS onboard system is operating in an area where the trackside is not fitted with operational ETCS or alternative train protection equipment, as defined in SUBSET-026. See also Level NTC.
Level 1 (or L1) A level of ETCS overlaid onto conventional lineside signalling or ETCS Application Level 1 with or without infill transmission (train equipped with ETCS operating on a line equipped with Eurobalises and optionally Euroloop or Radio infill), as defined in SUBSET-026.
Level 2 (or L2) A level of ETCS that uses radio to pass movement authorities to the train while relying on conventional means to determine train location or ETCS Application Level 2 (train equipped with ETCS operating on a line controlled by a Radio Block Centre and equipped with Eurobalises and Euroradio) with train location and train integrity proving performed by the trackside, as defined in SUBSET-026.
Level 3 (or L3) A level of ETCS similar to Level 2 operation using train location and train integrity information supplied to the signalling system by the onboard
system, as defined in SUBSET-026.

<table>
<thead>
<tr>
<th><strong>Level NTC</strong></th>
<th>A level of ETCS where protection of the train is undertaken by a national system.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LRU</strong></td>
<td>Line replaceable unit: a self-contained module designed to be replaced quickly when faulty instead of being repaired on site.</td>
</tr>
<tr>
<td><strong>LRBG</strong></td>
<td>Last Relevant Balise Group</td>
</tr>
<tr>
<td><strong>MA</strong></td>
<td>Movement Authority.</td>
</tr>
<tr>
<td><strong>MART</strong></td>
<td>Mean Active Repair Time.</td>
</tr>
<tr>
<td><strong>MTBSAF</strong></td>
<td>Mean Time Between Service Affecting Failures</td>
</tr>
<tr>
<td><strong>Multiple unit</strong></td>
<td>A group of one or more rail vehicles semi-permanently coupled together with integrated driving cabs and propulsion distributed along the vehicles.</td>
</tr>
<tr>
<td><strong>NL</strong></td>
<td>Non-leading mode, as defined in SUBSET-026</td>
</tr>
<tr>
<td><strong>NP</strong></td>
<td>No power mode, as defined in SUBSET-026.</td>
</tr>
<tr>
<td><strong>NRN</strong></td>
<td>National Radio Network: existing GB national Band 3 VHF radio network being superseded by GSM-R.</td>
</tr>
<tr>
<td><strong>Onboard driving data recording system</strong></td>
<td>Data recording equipment, including on train data recorder, ETCS juridical recording units etc.</td>
</tr>
<tr>
<td><strong>Operator</strong></td>
<td>Any person that operates the system on a day-to-day basis (for example, driver, signaller, guard, and shunter) or ensures that the systems are in an operational state (for example, train preparer, maintainer, and trackside worker).</td>
</tr>
<tr>
<td><strong>OS</strong></td>
<td>On-sight mode, as defined in SUBSET-026.</td>
</tr>
<tr>
<td><strong>OTA</strong></td>
<td>Over the Air</td>
</tr>
<tr>
<td><strong>Over-speed</strong></td>
<td>Exceeding the current maximum permitted speed (this being the lower of the trackside and onboard limits, taking due account of temporary and emergency speed restrictions).</td>
</tr>
<tr>
<td><strong>PT</strong></td>
<td>Post-trip mode, as defined in SUBSET-026.</td>
</tr>
<tr>
<td><strong>Public address</strong></td>
<td>Onboard system for providing journey and station information to passengers. This may also be referred to as passenger information system (PIS).</td>
</tr>
<tr>
<td><strong>Railway Undertaking</strong></td>
<td>An organisation providing railway passenger or freight services, as defined in Directive 2001/12/EC.</td>
</tr>
<tr>
<td><strong>RBC</strong></td>
<td>Radio Block Centre.</td>
</tr>
<tr>
<td><strong>Repeater DMI</strong></td>
<td>Passive DMI display for relaying DMI indications received by the driver to an instructor driver for training and assessment purposes.</td>
</tr>
<tr>
<td><strong>RGS</strong></td>
<td>Railway Group Standards</td>
</tr>
<tr>
<td><strong>ROSCO</strong></td>
<td>Rolling Stock Leasing Company</td>
</tr>
<tr>
<td><strong>RV</strong></td>
<td>Reversing mode, as defined in SUBSET-026.</td>
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<tr>
<td><strong>SB</strong></td>
<td>Standby mode, as defined in SUBSET-026</td>
</tr>
<tr>
<td><strong>SF</strong></td>
<td>System Failure mode, as defined in SUBSET-026.</td>
</tr>
<tr>
<td><strong>SH</strong></td>
<td>Shunting mode, as defined in SUBSET-026.</td>
</tr>
<tr>
<td><strong>SIL</strong></td>
<td>Safety Integrity Level, as used in EN50128.</td>
</tr>
</tbody>
</table>
SL  Sleeping mode, as defined in SUBSET-026.
SN  STM National Mode, as defined in SUBSET-026.
SoM Start of Mission: the procedure initiated by the driver; data is entered for the ETCS onboard system to leave SB and perform supervision activities.
SRS System Requirements Specification.
STM Specific Transmission Module.
Supervised location The farthest point along the track at which the train should stop when the ETCS onboard system intervenes with an emergency brake demand.
Suppressed In the context of a Class B system, the system does not respond to trackside equipment insofar as it does not provide indications to the driver other than healthy / fault indications that do not require a response during suppression or cause a brake intervention.
Tachometry The function of measuring and recording / reporting axle speed(s) – as a specific element of odometry. Also the equipment and algorithms used to measure axle speed(s).
TIU Train Interface Unit, as defined in SUBSET-034.
TPWS Train Protection and Warning System.
Train parameters Defined characteristics of a particular vehicle or train that are used by the ETCS onboard system and which may be variable – that is to say, they can be altered by the driver (for example, train length) – or fixed (for example, the braking characteristics).
Train preparer Person performing routine train activities prior to service; this includes powering up and performing basic checks of suitability for service. This function may be carried out by the driver or depot technical staff.
Train type A train configuration used as part of train data entry on the ETCS DMI, as defined in ERA_ERTMS_015560.
TR Trip mode, as defined in SUBSET-026.
TSI Technical Specification for Interoperability.
UNISIG An association of signalling manufacturers.
UN Unfitted mode, as defined in SUBSET-026.
User identification The identification reference of the user which could be a driver, train preparer, application engineer or maintainer.
APPENDIX B  LIST OF REFERENCED STANDARDS

NOSS References


[RD2] National ERTMS Output Requirements, CCMS: 11246027

[RD3] National ERTMS System Requirements, CCMS: 11246028


[RD6] ERTMS Programme Glossary of Terms, ERTMS/PGM/D0115

[RD7] Thameslink Programme TIIS, N000-01000-NRT-SPEC—EG-000002

[RD8] ETCS / Cab Radio –Siemens Interface Specification for GSM-R Cab radio project, 666/UJ/86157/000 issue 2

[RD9] RIS and NEPT requirements not included in the NOSS, CCMS: 64317054

[RD10] ETSI TS 102 933-1 - Railway Telecommunications (RT); GSM-R improved receiver parameters.

[RD11] Specification for packet 44 override of default speed display units (draft title, to be finalised)

The TSI and Class 1 Specifications are obtainable from the European Railway Agency.

In all cases where no date or issue number is stated the latest issue of the document should be used.

RGS References

The Catalogue of Railway Group Standards gives the current issue number and status of documents published by RSSB. This information is also available from:

www.rgsonline.co.uk.

RGSC 01  Railway Group Standards Code
RGSC 02  Standards Manual

Documents referenced in the text

Railway Group Standards

GE/RT8075  AWS and TPWS Interface Requirements
GE/RT8402  ERTMS/ETCS DMI National Requirements
GE/RT8403  ERTMS Key Management
GM/RT2004  Rail Vehicle Maintenance
GM/RT2161  Requirements for Driving Cabs of Rail Vehicles
GM/RT2185  Train safety systems
GM/RT2472  Data Recorders on Trains – Design Requirements
GM/TT0088  Permissible Track Forces for Railway Vehicles
RSSB documents

GK/GN0602  Guidance on Train Rooftop Antenna Positioning
GM/GN2460  Guidance on Compliance with Noise and Vibration Legislation in the Railway Environment
T088      Vibration environment for rail vehicle mounted equipment
T326      Human factors good practice guide to managing alarms and alerts

Other References


CCS TSI Control Command and Signalling TSI, Decision 2012/88/EU (OJ L51, 23.2.2012, p.1)


EN 50126-1:1999 Railway Applications, The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS)

EN 50155:2007 Railway Applications, Electronic Equipment Used on Rolling Stock

EN 60529:1991 Degrees of protection provided by enclosures (IP code)

EN 61373:1999 Railway applications: Rolling stock Equipment; Shock and Vibration tests

EN 61373:2010 Railway applications: Rolling stock Equipment; Shock and Vibration tests

EN 61375-1:2012 Electronic railway equipment. Train communication network (TCN) General architecture


EN 894-2:1997 Ergonomics requirements for design of displays and control actuators – Part 2: Displays

EN 9241-400:2007 Ergonomics of human-system interaction — Part 400: Principles and requirements for physical input devices

EN 9241-420:2011 Ergonomics of human-system interaction — Part 420: Selection of physical input devices

EN 9241-11:1998 Ergonomic requirements for office work with visual display terminals (VDT’s) – Part 11: Guidance on Usability

ERA_ERTMS_015560 ERA DMI specification version 3.3.0 March 2012 (ETCS Baseline 3)

ETCS Baseline 3  

ISO 9241-210:2010  
Ergonomics of human-system interaction -- Part 210: Human-centred design for interactive systems

NR/AM/SA/SPE/00147  
National ERTMS programme: Preliminary ERTMS Reliability Specification

RIA12  
General specification for protection of traction and rolling stock electronic equipment from transients and surges in d.c. control systems

Rolling Stock (Noise) TSI  

Specifications of DMI Ergonomics  
Specifications of DMI Ergonomics, Version 1.8, SBB, 17 October 2006

SUBSET-026  
ERTMS/ETCS Class 1 System Requirements Specification, version 3.3.0

SUBSET-027  
FIS Juridical Recording, version 3.0.0

SUBSET-034  
ERTMS/ETCS Class 1 FIS for the Train Interface, version 3.0.0

SUBSET-037  
ERTMS/ETCS EuroRadio FIS, version 3.0.0

SUBSET-040  
ERTMS/ETCS Dimensioning and Engineering Rules, version 3.2.0

SUBSET-041  
Performance Requirements for Interoperability, version 3.1.0
## APPENDIX C  AREAS FOR DEVELOPMENT

<table>
<thead>
<tr>
<th>No.</th>
<th>Issue</th>
<th>Description</th>
<th>Identified in version</th>
<th>Closed in version</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Integration with TASS</td>
<td>TASS, as used on C390 and C221 stock, will have some further specific requirements for ETCS integration. These must be considered before these fleets are fitted with ETCS.</td>
<td>2.0</td>
<td>Still open</td>
</tr>
<tr>
<td>2</td>
<td>Packet 44 for mph / kph</td>
<td>Whilst the use of packet 44 to amend the default speed display is proposed, the exact format of the packet has yet to be formalised.</td>
<td>2.0</td>
<td>Still open</td>
</tr>
<tr>
<td>3</td>
<td>OTM operation</td>
<td>Whilst no specific requirements are thought to be missing, the integration of ETCS onto OTMs poses specific challenges. It is likely that further work in this area will identify further ETCS requirements.</td>
<td>2.0</td>
<td>Still open</td>
</tr>
<tr>
<td>4</td>
<td>Data entry</td>
<td>The current industry position is that the standard ETCS data entry process on the DMI poses a severe risk of incorrect data being entered, resulting in potential Wrongside Failures. As such there is work ongoing to identify alternative, high integrity methods of data entry using either the DMI or external systems.</td>
<td>2.0</td>
<td>Still open</td>
</tr>
<tr>
<td>5</td>
<td>Cyber Security</td>
<td>The current NOSS document makes reference to the need for cyber security, however the detailed requirements concerning how to achieve this overall aim are currently in development.</td>
<td>2.0</td>
<td>Still open</td>
</tr>
<tr>
<td>6</td>
<td>Online Key Management</td>
<td>Online key management has been identified as a requirement for UK rolling stock, owing to the difficulties that would appear for key updates using a purely offline solution. Some requirements have been identified; however work is still ongoing within the ERTMS team and ERA which will ultimately lead to a revision of this section.</td>
<td>2.0</td>
<td>Still open</td>
</tr>
<tr>
<td>7</td>
<td>DMI labelling for Level NTC</td>
<td>Each level NTC is identified separately on the DMI with its own unique label. The labels for each Level NTC that are anticipated to be used in the UK need to be defined. However, alignment of these labels within European members is currently being pursued.</td>
<td>2.0</td>
<td>Still open</td>
</tr>
<tr>
<td>8</td>
<td>Integration with Class B systems other than AWS / TPWS</td>
<td>The requirements for interfacing with AWS / TPWS are defined within the document; however integration with other Class systems has not been fully addressed at this stage.</td>
<td>2.0</td>
<td>Still open</td>
</tr>
<tr>
<td>9</td>
<td>AWS brake application</td>
<td>The SRS requirements for the lambda braking model suggest that an ETCS brake application, affected by the AWS system, may not be acceptable. Work is being undertaken within ERTMS programme to verify this. If it is shown that AWS will work, the requirements for the brake interface system will be amended to allow it.</td>
<td>2.0</td>
<td>Still open</td>
</tr>
<tr>
<td>No.</td>
<td>Issue Description</td>
<td>Identified in version</td>
<td>Closed in version</td>
<td></td>
</tr>
<tr>
<td>-----</td>
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<td></td>
</tr>
<tr>
<td>10</td>
<td>ERA categorisation of requirements Work is being undertaken between the ERTMS programme and ERA to re-categorise the NOSS requirements in terms of their purpose rather than their necessity. This categorisation will not affect the document other than providing further information as to why a requirement has been generated.</td>
<td>2.0</td>
<td>Still open</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>JRU recording capacity A minimum recording capacity (expressed in time) has been identified as a worthwhile requirement for standardisation across fleets.</td>
<td>2.0</td>
<td>Still open</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Review of reference design packages The reference design process has developed a number of reference facilities, which have been subject to a preliminary NOSS impact assessment. A second more thorough impact assessment of these facilities, and those facilities yet to be defined, will be required.</td>
<td>2.0</td>
<td>Still open</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Removal of 'National' from document title Discussions with the European Rail Agency have led to their suggestion that the document is renamed to remove reference to it being national in focus, given that the content of the document would be of relevance to other member states.</td>
<td>2.0</td>
<td>Still open</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Impact of ATO It is possible that ATO will be a function added to ETCS equipped rolling stock, at a later date. The potential impact of this is yet to be considered</td>
<td>2.0</td>
<td>Still open</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Remote JRU / fault log download Whilst it is acknowledged that the ability to remotely download the JRU, fault logs or system status, it is not fully specified what remote means. Continuous remote monitoring in service will need a different solution to discrete remote download at defined locations.</td>
<td>2.0</td>
<td>Still open</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Standardisation of DMI fault codes Standardised fault codes and messages would enable a common set of operational procedures to be developed that cover the way onboard faults are dealt with, across fleets of different types. Further work in this area is ongoing</td>
<td>2.0</td>
<td>Still open</td>
<td></td>
</tr>
</tbody>
</table>