



Digital Railway – GB Generic Customer Requirements Specification for ETCS Trackside

Prepared By:
John Alexander
Lead Architect, ETCS Trackside

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Reviewed By:
David Nicholson
System Integration and Interface Manager

DJN-18032019-0078

Date: 18/03/2019

Approved By:
Rubina Greenwood
Head of System Requirements & Integration

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Document owner: Rubina Greenwood, Head of System Requirements and Integration

Version History

Issue	Date	Comments
0.1	14-02-18	First draft for internal review
0.2	28-02-18	Second draft for internal review
0.3	15-03-18	Updated to feedback from SoS team and external stakeholder review meeting
0.4	29-03-18	Updates to comments received from review (VK, PN, DM)
0.5	29-03-18	Updated to DOORS output
1.0	23/04/18	Updated to levelled requirements and submitted for signature
1.1	20/11/18	Updated to new CRS template (v0.7) and incorporated requirements agreed at the Change Review meeting on 12/11/2018
2.0	27/11/18	Second release version
2.1	28/02/19	Document updated to reflect comments received from DRIIAT, Ricardo and as part of the RICMWG review. The requirements (section 3) will be inserted from DOORS once the Change Requests have been agreed.
3.0	18/03/19	Third release version

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Exclusions

These are items currently missing from this version of the document that should be included in a later publication.

1. Best endeavours have been used during the development of this specification to align it to the relevant Concepts of Operations documents which have been updated in parallel. Final assurance of the complete alignment of this specification with the relevant industry-endorsed Concepts of Operations will be achieved in a later version.
2. This document has been submitted for Level 3 assurance in accordance with the System Management Plan [RD16]. A response has been received showing no Category 1 comments (i.e. there is no issue associated with a fundamental concern, error, omission or question that has a direct bearing on the acceptability of the document). Other comments will be addressed in a future revision of this document.
3. For a list of open points please refer to section 4.1

Assumptions

These are items upon which the validity of this document relies, and which will be delivered by others. Non-delivery of these items will necessitate a change to this document.

1. For a list of assumptions please refer to section 4.2

Dependencies

There are items upon which the validity of this document depends. Any changes to the referenced document may require further changes to this document.

1. For a list of dependencies please refer to section 4.3

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ABBREVIATIONS, ACRONYMS AND DEFINITIONS

Abbreviations are explained in full on first use within this document. A comprehensive list of abbreviations and definitions is contained in the Glossary [R11]

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REFERENCES

Dependent References

An update to one of these references requires a review to identify any potential need for an update to this document.

- RD1 Digital Railway – Integrated Concept of Operations, 000000-NWR-PLN-MPM-000005, version 1.0
- RD2 Digital Railway – GB Generic System of Systems Customer Requirements Specification, 153819-NWR-SPE-ESE-000003, Version 5.0
- RD3 Digital Railway – European Train Control System (ETCS) Trackside System Definition, 153821-NWR-REP-ESE-000006, version 3.0
- RD4 Digital Railway – GB Generic Interface Requirements Specification, 153821-NWR-SPE-ESE-000013, version 3.0
- RD5 Technical Standard for Interoperability (CCS), Commission Regulation (EU) 2016/919
- RD6 DRP Integration Fundamentals Handbook, 153819-NWR-GDN-MPM-000001, version 1.0
- RD7 DRP Customer Requirements Deployment Policy, 153819-NWR-SPE-ESE-000002, version 1.0
- RD8 DRP Customer Requirements Change Control Process, 153819-NWR-SPE-ESE-000004, version 1.0
- RD9 DRP Requirements Management Plan, 153819-NWR-PLN-ESE-000006, version 1.0
- RD10 System of Systems Data Specification, 153831-NWR-SPE-000001, Version 1.0
- RD11 Digital Railway – GB Generic Customer Requirements Specification for Traffic Management Systems (TMS), 153821-NWR-SPE-ESE-000011, Version 3.0
- RD12 Digital Railway – GB Generic Customer Requirements Specification for Connected Driver Advisory System (C-DAS), 153821-NWR-SPE-ESE-000010, Version 3.0
- RD13 Digital Railway – GB Generic Customer Requirements Specification for ETCS Onboard, 153821-NWR-SPE-ESE-000008, Version 3.0

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- RD14 Digital Railway – GB Generic Customer Requirements Specification for Operations & Maintenance, 153819-NWR-PLN-ESE-000014, Version 2.0
- RD15 Digital Railway Requirements – ETCS Trackside, 153821-NWR-SPE-ESE-000016, Version 1.0
- RD16 System Management Plan, 153819-NWR-PLN-MPM-000002, v8.0

Informative References

These references have no material bearing on the content of this document but are referenced within it. Unless otherwise specified, the latest version should be used.

- RI1 Digital Railway – Glossary of Terms & Abbreviations, 153819-NWR-SPE-ESE-000001
- RI2 Digital Railway – Introduction to the Requirements Structure, 153819-NWR-PLN-ESE-000012

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1 Introduction

1.1 Purpose

The purpose of this document is to set out the generic Customer Requirements that apply to the ETCS Trackside when it is deployed on the GB railway network. These generic Customer Requirements are intended as a baseline to ensure that the ETCS Trackside solutions adopted on any individual deployment project will integrate and be compatible across route boundaries and with the generic ETCS On-board, using ETCS trackside in the context of the System of Systems Generic Baseline Architecture shown within the Trackside System Definition [RD3].

All deployment projects involving the ETCS Trackside will use this document as a basis of their requirements suite for this system.

1.2 Scope

This document provides the generic Customer Requirements for the ETCS Trackside, including functional, non-functional and process requirements. The ETCS Trackside includes interlocking functions which monitor and control trackside equipment. It is aligned to the [RD1], which describes how the GB railway is intended to operate where this system is deployed. The scope is limited to ETCS Level 2 without lineside signals and the transitions to/from lineside signalling.

Acceptable solutions to the Customer Requirements in this document are constrained by the Digital Railway Requirements contained within the 'Digital Railway Requirements – ETCS Trackside' [RD15], and deployment projects must comply with both the Customer and Digital Railway Requirements. The relationship between the Customer Requirements and other elements of the overall Requirements Structure for Digital Railway is explained further within the Introduction to the Requirements Structure document [RI2].

The Customer Requirements sit within a legal framework of the European Interoperability Directive (translated into UK legislation via the Railway Interoperability Regulations) and the Technical Standards for Interoperability of which the Control, Command and Signalling TSI is relevant to this document [RD5]. The CCS TSI requires the European Union Agency for Rail (ERA) to publish error corrections on a periodic basis and it is assumed, for the purposes of this document, that the deployment of ETCS will be to set of specifications #3 (within [RD5]) and the latest Technical Opinion issued in accordance with Article 10 of the TSI.

This system will not exist in isolation on the railway and will need to interact with a variety of other systems, which may include both existing systems and Digital Railway systems. The relevant parts of the baseline System of Systems architecture are set out in the Figure 1. This document supports, and is reliant upon, the GB Generic System of Systems Customer Requirements Specification [RD2].

This Customer Requirements Specification forms part of a suite of requirements specifications and therefore for a complete understanding of Digital Railway operation, should be read in conjunction with the CRSs/IRS for:

- System of Systems [RD2]
- Traffic Management System [RD11]
- ETCS Onboard [RD13]
- Operations and Maintenance Readiness [RD14]
- Interface Requirements Specification [RD4]

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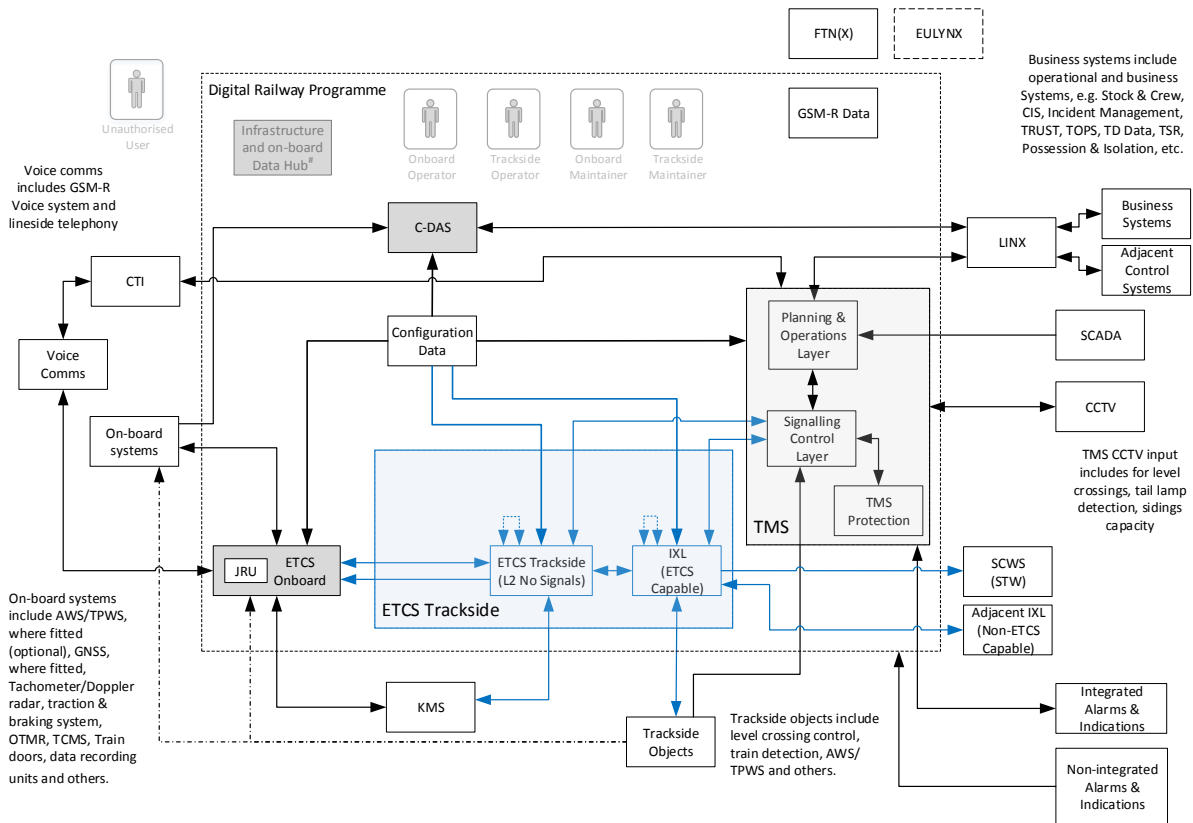


Figure 1 – The SOS Architecture

The system boundary for the ETCS Trackside is set out in the European Train Control System (ETCS) Trackside System Definition, [RD3], which also describes the generic environmental context in which the system is expected to exist.

This document does not set out interface requirements between the ETCS Trackside and other systems as these are separately documented in the Interface Requirements Specification [RD4]. The successful implementation of the ETCS Trackside is reliant upon compliance with the relevant interface requirements in [RD4].

This document does not contain details of any deployment project-specific requirements. These may be found in deployment project-specific documentation, which is subordinate to this document.

Section 2.2 of this document sets out how a deployment project will identify which of the requirements in this document are relevant to its needs.

The acceptance criteria applicable to the Customer Requirements within this document will be documented separately in a Verification and Validation Matrix.

1.3 Business Need for this Specification

There are many potential solutions for implementing the Digital Railway Strategy and realising the visions set out in the Concepts of Operations [RD1] (note, the DR SoS Concept of Operations publication will require a review of this document). However, if left totally unconstrained, there is a risk that different deployment projects could independently generate solutions that were sufficiently different as to create technical or operational compatibility issues

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at the railway system boundaries. Compatibility issues of this nature would inhibit the GB railway's ability to meet the objectives set out above and must, therefore, be avoided. Examples of compatibility issues could include:

- One project's Traffic Management System solution being unable to provide a second project's Traffic Management System solution with all the information needed for effective management of train services crossing the boundary between them; or,
- a train driver having to learn and apply different sets of operational procedures relating to the same underlying system across different geographical areas.

The generic Customer Requirements are intended to promote the development of technically, operationally and environmentally compatible solutions, which are safe and secure, and which could be deployed across the GB rail network in order to maximise the benefits which the industry can reap from the adoption of digital technologies.

This document is one of a suite of generic Customer Requirements Specifications for the core CCS systems and is sub ordinate to the generic System of Systems Customer Requirements Specification [RD2].

The generic Customer Requirements for the ETCS Trackside are intended to be complementary to the Command, Control and Signalling Technical Specification for Interoperability (CCS TSI) [RD5] and associated Baseline 3 ETCS specifications detailed in Table A2.3 issued by the European Union Agency for Railways. Every effort has been made to avoid conflict with the CCS TSI and Baseline 3 specifications but, in case of conflict, the CCS TSI (including the UK specific cases) and Baseline 3 specifications take precedence.

1.4 Document Maintenance

This document is owned by the DR Programme's Head of System Requirements and Integration (SR&I).

Updates may be instigated, as necessary, as indicated below:

- To incorporate any changes arising from industry consultation
- To incorporate any lessons learnt
- In response to formal change proposals
- In response to changing constraints in applicable legislation, standards or associated Digital Railway Requirements
- In response to changes in objectives set out in the Business Requirements or Concept of Operations
- At the direction of the Head of SR&I as the document owner
- When the disbanding of the SR&I team is planned, in order to transfer ownership of the document, if it is still necessary, to an alternative organisation

Potential proposers of change include, but are not limited to, duty holders, deployment project teams, suppliers and asset owners.

Proposed changes to the requirements within this document will be managed in accordance with the Requirements Change Control Process [RD8].

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2. Application of this Specification

2.1 Requirements Presentation

All requirements are in the following form:

<p><i>Safety</i> Requirement text.</p> <p style="text-align: right;">Unique-Identifier</p>

Source: Identifies where the requirement originated.

Status: Normative or Application-Specific. (See Section 2.2).

Rationale: Shows applicability of the requirement, including why the requirement exists, who it is for, what industry benefit could be achieved, what the constraints are, and any other essential detail. Note: Cross-referencing should be used to avoid over-lengthy rationales.

Guidance: Supplementary information to support Requirement interpretation and satisfaction.

2.1.1. Safety Requirement

Where a requirement has been associated with a Safety Measure, this is identified and referenced to the hazard record number. (Note, the requirements marked as *Safety* in this document arise from the work on the Reference Design, hazard identification for the SoS is outstanding. For this reason, hazard identities are not included in this version).

2.1.2. Unique Requirement Identifier

Each requirement has been identified uniquely. The requirement numbers have been generated within the DOORS database, which means that the requirement numbering may be neither sequential nor gap-free.

2.1.3. Requirement Status

Each requirement within this document is identified as either 'Normative' or 'Application-Specific'.

Normative requirements are mandatory for all deployment projects.

Application-specific requirements are mandatory for all deployment projects on which the issue or subject addressed by the requirement occurs.

2.2 Identification of Applicable Requirements

The generic Customer Requirements in this document are intended to cover the vast majority of circumstances that will be encountered on the GB rail network. However, not all circumstances will be encountered by every deployment project and some deployment projects may encounter local issues that are not covered by the generic Customer Requirements Specification.

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Consequently, each deployment project must ensure that it establishes and documents the appropriate set of Customer Requirements for its circumstances. The process for doing so is outlined in the DRP Integration Fundamentals Handbook [RD6] and in detail for deployment projects within the DRP Customer Requirements Deployment Policy [RD7] and may be summarised as follows:

1. The starting point is the generic Customer Requirements Specification (i.e. this document for the ETCS Trackside).
2. All normative requirements within the generic Customer Requirements Specification are applicable to every deployment project.
3. Any application-specific requirements which relate to circumstances that do not apply to the deployment project in question may be deleted and marked as 'not required' along with the rationale for their non-inclusion.
4. New Customer Requirements may be generated to address local issues which only apply to a specific deployment project but are not covered in the generic Customer Requirements Specification, provided that they do not compromise the achievement of cross-boundary compatible solutions. The rationale for the locally-developed requirement will be captured along with the requirement, including any reasons for not following a particular path.

Appendix A contains a template which deployment projects can populate to indicate which of the application-specific requirements are applicable to their particular circumstances (step 3 above).

Appendix B contains a template which deployment projects can use to record any new customer requirements they generate for their particular circumstances (step 4 above).

Note that a deployment project is not permitted to:

1. amend the wording of an existing generic Customer Requirement; or,
2. replace an existing generic Customer Requirement with a differently worded requirement relating to the same issue.

These restrictions are necessary to prevent the risk of generating a project-specific set of Customer Requirements that may not achieve a cross-boundary compatible solution.

If a deployment project considers that the wording or status of an existing Customer Requirement is incorrect, or wishes to add a new requirement to cover any local issues which apply to the deployment project but are not covered in the generic Customer Requirements Specification, then this should be raised with the System Authority via the change request process for consideration at a national level, as described in section 1.4 and in detail in the DRP Customer Requirements Change Control Process [RD8].

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3 Customer Requirements

3.1 Functional Requirements

This section sets out functional requirements that define, where applicable, what the system needs to accomplish.

3.1.1 Principles

Safety

The ETCS Trackside shall be designed so that rail vehicles operate with the highest available form of supervision.

CRS-ETCS(T)-1

Source: ETCS Reference Design process

Status: Normative

Rationale: The safe operation of rail vehicles is a prime objective of the industry. Legislation requires passenger rail vehicles to be operated with an active train protection system.

Guidance: ETCS Levels 1 to 3 provide Automatic Train Protection (ATP) functionality and are therefore preferable to Level NTC (Train Protection Warning System (TPWS)). Within ETCS levels, the modes provide different amounts of supervision of the rail vehicle and support to the driver. The need for the driver to manage the train utilising operational rules and verbal instructions should be minimised. The minimum level of ETCS operation is Level 2. The ETCS Trackside should not preclude a future change to Level 3 with partial or no rail vehicle detection. Full Supervision (FS) mode assures the driver that the line is clear and provides speed and distance to go supervision - this is the preferred mode. On Sight (OS) mode requires the driver to confirm that there are no obstructions; however, it supervises speed and distance to go. On Sight (OS) should be available at all locations where trains will be operating under ETCS supervision. Shunting (SH) mode may be necessary to meet operational needs but it has limited supervision and needs additional trackside and operational controls – many shunting activities can be undertaken using FS or OS. Staff Responsible (SR) is the last resort for when a Movement Authority (MA) cannot be issued, but the Trackside should offer trains an MA as soon as the reasons for SR have been resolved.

Safety

The ETCS Trackside shall provide the ETCS Onboard with information for the safe management of the rail vehicle by the driver.

CRS-ETCS(T)-2

Source: ETCS Reference Design process

Status: Normative

Rationale: When operating with cab signalling, all the information required by the driver should be provided on the cab display.

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Guidance: The requirement for route knowledge or reference to a route book should be minimised.

The need for the driver to identify and interpret lineside signage should be limited to those occasions when the information cannot be provided in the cab. For operational reasons, the driver should not be encouraged to react by reducing speed purely because information (e.g. extent of Movement Authority (MA)) is not available on the cab display.

The driver needs information on the permissible speed of the train, the distance to travel, the route the rail vehicle will follow (where critical), and any track-related actions (e.g. neutral sections).

There are scenarios in which a message may be displayed at the entry to On Sight (OS) or Full Supervision (FS) requiring the driver to manage the speed of the rear of the train - these should be minimised. The location of announcements to, and acknowledgements by the driver will be determined for each site.

The extent of an MA sent to the ETCS Onboard needs to be of sufficient length (subject to availability) to allow the driver to continue to manage the rail vehicle at the permissible speed or at the advisory speed from the Connected Driver Advisory System (C-DAS). The update of the MA needs to avoid the driver misinterpreting how far the rail vehicle may travel.

There may be occasions where the in-cab display needs to be supplemented by lineside signs, e.g. to mark the end of a movement in Staff Responsible (SR) (Stop Marker) or the stopping location when a release speed is applied (Location Marker).

The meaning of an MA to a driver needs to be agreed with a consistent set of underlying rules for the issue of the MA (interlocking principles).

Speed profiles sent to the train will enable the ETCS Onboard to select a safe speed profile based on the available train data.

The ETCS Trackside should provide facilities to mitigate misrouting. The provision of supplementary information to the driver via the ETCS will assist them in identifying possible routing errors. It will offer the opportunity to stop the train before an undesirable situation occurs as trains are sometimes routed in error onto lines with which they are not compatible. With the ETCS, some existing methods of mitigating these errors will be lost. Where site-specific conditions dictate, then the facilities will be identified and implemented.

Safety

The ETCS Trackside shall monitor and maintain a record of the location of all rail vehicles.

CRS-ETCS(T)-3

Source: ETCS Reference Design process

Status: Normative

Rationale: To enable the Trackside to confirm that the line is clear.

Guidance: The issue of an FS Movement Authority is on the basis that the line is known to be clear for the rail vehicle. This requires the Trackside to know whether the route is obstructed.

Rail vehicles which are not communicating also need to be monitored. Detecting that the line is clear can be accomplished through the use of trackside rail vehicle detection or by recording the location of all vehicles to determine that the route is clear.

The Trackside should maintain a record of the last reported location of all communicating trains and trains which undertake End of Mission (EoM). The solution should not preclude the replacement of trackside rail vehicle

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detection with rail vehicle based location systems.
The recording of data for evidential purposes is a separate issue (CRS-ETCS(T)-29).

Safety

The ETCS Trackside shall record when sections of the line have been reserved and are not available for unrestricted rail vehicle movements.

CRS-ETCS(T)-59

Source: ETCS Reference Design process

Status: Normative

Rationale: To prevent unrestricted rail movements when sections of line have been reserved for specific reasons/purposes.

Guidance: Sections of line may be reserved for a number of reasons, preventing Movement Authorities being issued into or through those sections. Reasons include: line blockages for staff safety, active shunting areas, staff protection systems, transfer of control to ground frames, reminders to enable cautioning, etc.
The Trackside should allow the signaller to mark sections of the line as reserved/unavailable for the passage of rail vehicles.

Safety

The arrangements for work-site management shall be consistent between those used for lineside signalling and those used with ETCS Level 2 Trackside without signals.

CRS-ETCS(T)-4

Source: ETCS Reference Design process

Status: Normative

Rationale: Drivers, possession staff, signallers, and workers should have a single, consistent set of rules to follow for ETCS, lineside, and overlay signalling arrangements.
The system should not cause ETCS Onboard reactions whilst the Trackside is being amended or is not present as they could cause injuries to staff on rail vehicles.

Guidance: Rail vehicles operating in possessions with lineside signalling currently isolate their train protection systems (Automatic Warning System (AWS)/Train Protection & Warning System (TPWS)).
The ETCS Level needs to avoid any potential system reactions to Trackside input and to allow trains to move forwards and backwards. Level 0, SH meets this requirement.
Possession and other staff work in areas of ETCS, overlay and lineside signalling, and also the operating rules, should remain consistent as new processes or technology are/is introduced.

The ETCS Trackside shall minimise the requirements for lineside equipment and signage.

CRS-ETCS(T)-5

Source: ETCS Reference Design process

Status: Normative

Rationale: Lineside equipment requires maintenance, which exposes track staff to risk.

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Guidance: Lineside signage should only be provided if there is a demonstrable need and the sign is usable in all circumstances.
 Stop and Location markers should only be provided when they are needed operationally (including in degraded scenarios) - most Ends of Authority (EOAs) can be unmarked.
 Speed signage is not required for normal ETCS operation and its provision for degraded operation should be minimised.
 If signs are required operationally, then they should be designed and placed so that they can be used by staff in all normal conditions (including at night time).

Safety
 The ETCS system in operation on the GB network shall use metric units throughout.
CRS-ETCS(T)-6

Source: ETCS Reference Design process

Status: Normative

Rationale: The system is designed to use metric units for speed and distance. Staff joining the industry are likely to have limited knowledge of imperial units for measurements.
 Conservative rounding issues between systems (always rounding down from mph to a multiple of 5 km/h) reduces the functionality and usability of the system by reducing speeds.
 In areas of transition and overlay, the use of metric units provides clarity for the driver and other staff. It also avoids inconsistency between lineside information and cab information.

Guidance: It is assumed that lineside signalling will retain imperial speeds and signage. It is assumed that the ETCS system in operation will use metric speeds and that drivers will ignore all lineside speed signage except that in specific locations where the signs will be distinctive.
 The ETCS Trackside assumes that the principles in GERT8402, Issue 2 are applied with regards to the display on the ETCS Driver Machine Interface. The ETCS Trackside will instruct trains operating in ETCS Levels 1-3 to use the default units of km/h.
 The adoption of metric speed and distance units on an ETCS Level 2-only railway is not regarded as a risk (following RSSB research), however transitions between units and areas where both units may apply (e.g. overlay) need careful management, training and risk assessment.
 ETCS is a metric system operating in speed units which are multiples of 5km/h. Converting existing published speeds in mph to km/h by rounding down to a multiple of 5km/h will have a small detrimental effect on performance and capacity. In most cases the track and structures will be unaffected by a small increase of speed and hence rounding to the nearest multiple of 5km/h should be considered.

Safety
 The ETCS Trackside shall manage the safe operation of rail vehicles when in Shunting (SH) mode.
CRS-ETCS(T)-7

Source: ETCS Reference Design process

Status: Normative

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Rationale: The use of SH may be required in areas where it is always available (typically, off the running lines), in areas where it is authorised on a regular basis (and interlocking controls can be applied), or anywhere on the network. In SH the Trackside has limited ability to control the extent of the movement (i.e. it is restricted to balise messages) and other controls may be required for the safety of Shunting and other movements.

Guidance: Rail vehicles operating in SH are disconnected from the system and cannot receive emergency stop messages or updated balise lists. Risks considered include a shunting activity exceeding its authority and entering an open running line (trapping protection may be needed), and movements entering a Shunting area endangering site personnel. SH allows rail vehicles to move forwards and backwards; consequently, the ETCS traction unit may not be at the front of a movement, thereby limiting the effectiveness of interventions. The driver and other site staff should be able to establish the state of the infrastructure prior to undertaking moves - this may require extra facilities such as lineside signals or indicators. Further information is available as Guideline 75 (Management of Shunting Activities utilising SH) from the ERTMS User Group website at www.ertms.be.

Safety

The issue of a Movement Authority (MA) to a rail vehicle shall reserve a section of line exclusively for that train until the MA is no longer available on board.

CRS-ETCS(T)-9

Source: ETCS Reference Design process

Status: Normative

Rationale: It is a fundamental principle that only one train has authority to move into a section of line (which may be occupied by another rail vehicle at certain locations). When a Movement Authority is held on board, the driver can expect it to be available; the Trackside needs to maintain the route locking until the MA has been used or returned by the Onboard.

Guidance: Where there is a need for a rail vehicle to enter a section of line occupied by another train, e.g. for joining, then the train to be joined should not have an MA allowing it to move and On Sight (OS) should be used. There may be circumstances where it is not possible to receive confirmation from the ETCS Onboard that an MA has been used or released. In these cases, the use of timers or operational controls needs to be considered and justified by safety rationale.

The underpinning architecture of the ETCS trackside shall not limit the facilities available to the signaller and driver at any location.

CRS-ETCS(T)-10

Source: ETCS Reference Design process

Status: Normative

Rationale: The boundaries between interlockings; Radio Block Centres (RBCs); and suppliers' equipment should be transparent to the users of the system.

Guidance: The boundaries need to support the seamless emergency stopping of rail vehicles and recovery after an emergency stop.

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Speed restrictions (including temporary restrictions) need to be managed. The extent of the Movement Authority issued to the rail vehicle needs to be consistent with the driveability requirements. The handover between RBCs needs to occur consistently when only one operational mobile terminal is available on the train. Other facilities may need to be addressed depending on the application and architecture.

The ETCS Trackside shall verify that requests from the Traffic Management System (TMS) to operate controls are valid before they are actioned. CRS-ETCS(T)-11

Source: NR/L2/SIG/30009/GKRT0060

Status: Normative

Rationale: To determine that requests from the TMS are safe before being actioned.

Guidance: Checks will normally include ensuring that the asset is not locked by a route or other control, that routes do not conflict, that a Movement Authority has not already been issued, that a reminder or staff protection control is not active, etc.
Requests need to be actioned as soon as possible after they are received (allowing for processing of previous requests) and in the event of failure/rejection of the request they must not be repeated/re-applied.

The ETCS Trackside shall transmit route-specific track conditions to the ETCS Onboard with Movement Authorities. CRS-ETCS(T)-41

Source: ConOps-SOS-014, SOS-062, ETCS-02130 & ETCS-02140

Status: Normative

Rationale: To enable track conditions to be displayed to the driver, where relevant, and, where the Onboard is configured to allow it, to enable the management of train features such as power control.

Guidance: Track conditions such as powerless sections, areas where the pantograph is to be lowered, and restrictions on current consumption can be configured on the train to dictate its behaviour.
Whilst the intention is to retain systems such as Automatic Power Control (APC) magnets and Packet 44 Automatic Power Changeover (APCO) control whilst trains operate on both ETCS and non-ETCS lines, the sending of track conditions will allow the eventual elimination of these systems.
The track conditions have limited functionality and for some applications they will not fulfil GB needs.
Each Deployment Project Team needs to establish the route-specific track conditions needed to be sent in an MA.

The entry to ETCS Trackside areas shall be configured such that both ETCS and non-ETCS trains are fully supervised. CRS-ETCS(T)-47

Source: ConOps-SOS-123, SOS-124, ETCS-03670, ETCS-03760, ETCS-03770 & ETCS-03810

Status: Normative

Reference	153821-NWR-SPE-ESE-000007
Issue/Ver:	3.0
Date:	18/03/2019

Rationale: Not all trains may be equipped with ETCS or have the capability to operate in specific ETCS levels. At the entry to ETCS areas the authority from the final lineside signal should be conditional on the train being able to operate in a compatible level.

Guidance: ETCS Level 2 /3 requires operational data communications and a session to be established prior to the issue of a Movement Authority and clearance of the last signal.
Trains reporting Level NTC (NID_NTC=21) will not be allowed to enter an ETCS area since the driver has selected that they are not authorised to operate with the train in ETCS Levels 1-3.
Degraded situations, such as the entry into the ETCS area in Staff Responsible (SR), need to be accommodated.

The ETCS Trackside shall action a valid request to set a route.

CRS-ETCS(T)-49

Source: SoS CRS Review

Status: Normative

Rationale: Following acceptance of a valid request, moveable infrastructure (primarily points and level crossings) needs to be instructed to move to the correct position and the route needs to be locked/reserved to prevent conflicting moves.

Guidance: Points/moveable infrastructure include/s those/that within the route itself (i.,e. that the train will pass over) and outside the route, but which are/is necessary to provide protection of the movement (e.g. flank protection, trapping protection and overlaps).
In deciding the extent of infrastructure outside the route to be requested (and whether it has to respond), the provision of an effective automatic train protection system should be considered to mitigate the potential impact of infrastructure failures not in the route.
Where level crossings are required to be proven, it may be advantageous not to request the level crossing until a short period before a train requires a Movement Authority to be issued to minimise road closure times. For some types of crossing there may be no request sent from the Trackside in response to setting a route.

The ETCS Trackside shall support the re-routing or change in priority of train movements.

CRS-ETCS(T)-50

Source: SoS CRS Review

Status: Normative

Rationale: To accommodate changes to the Current Plan.

Guidance: Normally routes will be set for train movements in accordance with the Current Plan and then used by trains. In some cases, it may be necessary to change the plan and cancel routes to allow different routes to be set.
The Trackside should support these changes, safely managing the impact on trains originally planned to use the cancelled routes.
Information on whether a Movement Authority (MA) has been issued for a route will enable the signaller to decide whether to allow a train to run or whether the route can be cancelled without the risk of leading to a brake intervention.
The Trackside should not normally issue MAs to a train until the train is

Reference	153821-NWR-SPE-ESE-000007
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approaching a location where the driver is likely to start reducing speed – this minimises the instances where a driver would see an MA being shortened. The Trackside should have the ability to reject a ‘conditional’ cancellation request for a route where it can detect that this would lead to a potential brake intervention.

The ETCS Trackside shall apply site-specific rules prior to the issue of a Movement Authority (MA). CRS-ETCS(T)-52

Source: SoS CRS Review

Status: Normative

Rationale: Application of site-specific rules to the issue of an MA provides more flexibility for route cancellation or changing, whilst enabling the MA to be provided in sufficient time to avoid the driver starting to reduce power prior to applying the brake unnecessarily.

Guidance: 'An MA will only be issued when the required checks have been completed and the train needs the authority to avoid the driver starting to brake unnecessarily. Not issuing the MA as soon as the route is set and proved allows routes to be cancelled/changed without generating adverse indications to the driver. Where an MA will lock points or level crossings, then it is desirable not to issue the MA until the train reaches the location where the driver is likely to react to information displayed on the ETCS Driver Machine Interface (DMI). The identification that the MA needs to be updated may also be used to trigger a request for level crossings to be operated subject to the MA not being issued until the level crossing is closed. In areas without moveable infrastructure or interlocked level crossings, MAs may be issued as soon as the route is set, provided this will not create the potential for driver error. This is the equivalent of Control Tables for conventional signalling.

The ETCS Trackside shall send reporting parameters to the ETCS Onboard. CRS-ETCS(T)-53

Source: SoS CRS Review

Status: Normative

Rationale: The Onboard will report train position and the need for Movement Authority updates in accordance with parameters sent by the Trackside.

Guidance: Train position reports can be requested to allow correlation of train reports and train detection occupation, e.g. to enable step up to Full Supervision (FS) as part of Start of Mission, or for routine monitoring of the train's location. Reports should not be requested so frequently that they are likely to cause queues or delays within the communications bearer. The parameter for requesting a Movement Authority update can be varied to allow reaction time for the system on receiving an update request, e.g. operation of a level crossing.

The ETCS Trackside shall send National Values to the ETCS Onboard. CRS-ETCS(T)-63

Source: SoS CRS Review

Reference	153821-NWR-SPE-ESE-000007
Issue/Ver:	3.0
Date:	18/03/2019

Status: Normative

Rationale: National Values configure the operation of the Onboard to be compatible with the Trackside.

Guidance: National Values have been established for the GB operation and should be sent to the Onboard at Start of Mission, transitions, RBC handovers, and at other times where, for safety or compatibility, the Trackside needs to be sure the Onboard has the right values. For some projects, or in specific circumstances, it may be appropriate to apply different National Values, e.g. to enable a train to pass through an area of GSM-R failure without a reaction.

The ETCS Trackside shall send the Train Running Number (TRN) received from the Traffic Management System (TMS) to the ETCS Onboard.

CRS-ETCS(T)-64

Source: SoS CRS Review

Status: Normative

Rationale: To enable the Onboard to change the TRN in accordance with the Current Plan.

Guidance: When the TMS initiates a change to the TRN, the ETCS Trackside needs to send the information to the ETCS Onboard.

3.1.2 Driveability

Updates from the ETCS Trackside shall not be sent to the Onboard if they are likely to cause an intervention, unless there is an immediate safety need.

CRS-ETCS(T)-12

Source: ETCS Reference Design process

Status: Normative

Rationale: Updates of Movement Authority, speed profiles, gradients, Temporary Speed Restriction (TSR) data, mode profiles, etc. cause the ETCS Onboard to recalculate the supervision curves.

Guidance: Unless there is a safety need (e.g. issue of an emergency stop, or withdrawal of an MA), then the supervision curves should not become more restrictive, leading to an immediate or imminent intervention. Infrastructure failures should only lead to an update of the Movement Authority if the safety of the movement is impacted. When a TSR is imposed, it should only be sent to a rail vehicle at a time when it will not cause an intervention; normally, this can be achieved by only sending it at the time that an MA is first sent for a section of line. The intermittent loss of proving of trackside assets can cause the Trackside to issue a more restrictive MA - the majority of proving should occur only at the time of issue of the MA and only of critical items resulting in a reaction.

Safety

The ETCS Trackside shall be designed to provide the ETCS Onboard with sufficient information for the rail vehicle's safe operational approach to a stopping location.

CRS-ETCS(T)-13

Source: ETCS Reference Design process

Reference	153821-NWR-SPE-ESE-000007
Issue/Ver:	3.0
Date:	18/03/2019

Status: Normative

Rationale: The system should allow rail vehicles to be driven safely to the required stopping location.

Guidance: The Onboard supervision includes a number of allowances which may supervise the train to stop a considerable distance from the EOA unless other measures are applied.
 Rail vehicle systems include a degree of delay/hysteresis, which means that driving at low speed can be difficult for drivers, depending on the rail vehicle type.
 Measures to allow the rail vehicle to be driven close to the EOA, need to balance driveability and safety, should the driver make an error.
 Release speeds can be used to allow the driver to control the last part of the movement. They should be set so as not to mislead the driver and should be consistent with management of the risk of the driver exceeding the EOA. For instance, a buffer stop collision would have immediate consequences. It will be possible for trains to approach within 2m of a buffer stop.
 Where there is an overrun distance beyond the EOA to the first potential hazard, then the system should be able to detect that the rail vehicle has passed the EOA and stop it before the hazard.
 Passenger rail vehicles typically have a brake reaction time (apply and release) of a few seconds, whilst for freight rail vehicles this can be in the order of 20 seconds.

Safety

The ETCS Trackside shall support the safe and operationally efficient Start of Mission (SoM) in ETCS in all conditions.

CRS-ETCS(T)-14

Source: ETCS Reference Design process

Status: Normative

Rationale: To reduce the use of Staff Responsible (SR) at SoM and achieve the transition to the highest level of supervision as soon as reasonably practicable.

Guidance: There are a wide range of scenarios which can occur during SoM and the information available to the driver and signaller is limited.
 The use of SR is to be avoided unless the driver and signaller have been advised of the reasons/need. Normally, the signaller should be required to authorise the Trackside offering SR to the Onboard.
 There is a need to start trains in ETCS, provide the driver with the correct information, and enable the safe departure of the rail vehicle.
 Once the rail vehicle has set off, it should reach the highest level of supervision as soon as possible.
 Scenarios to consider include when the train's position is not known by the Onboard or uniquely recognised by the Trackside (when the driver needs to be advised of the need to contact the signaller for authority or to connect to the correct Trackside).
 The ETCS Trackside should allow the simultaneous departure of two trains from the same location in opposite directions and be able to manage multiple trains reporting in the same section of line.
 The Traffic Management System will need to be able to present relevant information to the signaller to support them in their task.
 The need to confirm that the line ahead of the rail vehicle is clear must be

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considered where this cannot be determined by the Trackside. Movements within an occupied section need to be supported. The Track Ahead Free (TAF) facility should be incorporated within the ETCS Trackside design where operationally required. TAF enables the driver to confirm to the Radio Block Centre (RBC) that the line ahead is free (as far as a marked location), enabling the train to be granted a Full Supervision (FS) Movement Authority.

Safety

Transitions between cab and lineside signalling shall be driveable and not impact safety, capacity or performance.

CRS-ETCS(T)-60

Source: ETCS Reference Design process

Status: Normative

Rationale: To maintain the operational capacity of the route as a whole.

Guidance: Transitions need to support the driver through the change in sources of information. To achieve driveability, information from lineside and cab systems must be consistent during the transition and not require the driver to take urgent action. Only communicating rail vehicles must be signalled into an ETCS-only area. The risk of the driver losing in-cab information must be considered. 'Driveable' means that the driver is able to assimilate all the information (both that provided by the system and that from other sources), interpret it, and identify the appropriate activities to achieve safe operation of the rail vehicle, thereby meeting operational performance targets. Ergonomic assessments should consider the frequency and volume of information being provided, its completeness, and its clarity.

3.1.3 Degraded Operations

Safety

The ETCS Trackside shall, when authorising Staff Responsible (SR) mode, manage the risks so far as is reasonably practicable.

CRS-ETCS(T)-15

Source: ETCS Reference Design process

Status: Normative

Rationale: SR allows the driver to proceed with minimal supervision from the system and is therefore undesirable.

Guidance: Authorisation of SR by the Trackside should only occur when the driver is aware of the circumstances and limits of the movement. Its authorisation must be supported by the appropriate operational rules and processes. The ETCS Trackside must not offer SR in the absence of an MA unless the signaller authorises the issue of SR. The ETCS Trackside should address the issues of ETCS Onboards with unknown or ambiguous position reports. The use of override and acceptance of offers of SR by the driver need to be managed through operational rules, including the Operation and Traffic Management Technical Specification for Interoperability (OPE TSI).

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Safety

The ETCS Trackside shall include measures to manage the risks arising from movements in Staff Responsible (SR) mode.

CRS-ETCS(T)-61

Source: ETCS Reference Design process

Status: Normative

Rationale: SR allows the driver to proceed with minimal supervision from the system and the limits of the authorised movement could be exceeded.

Guidance: The ETCS Trackside must manage the risk of a driver exceeding the limit of an SR movement, for instance, by the provision of Stop Markers and 'Stop if in SR' (SiiSR) balise messages.
The extent of any potential overrun at a Stop Marker should be considered; where this may reach a hazard, other measures may be required, such as reducing the speed of trains in SR or application of operational rules.

Safety

The ETCS Trackside shall provide for the short-term restriction of rail vehicle speeds.

CRS-ETCS(T)-16

Source: ETCS Reference Design process

Status: Normative

Rationale: There will be situations when the speed of a type/ some types of rail vehicle, or all rail vehicles needs to be restricted.

Guidance: The need for Restrictions can arise, for example, due to infrastructure defects or climatic conditions, or for staff safety.
To avoid rail vehicles which do not need to be restricted (e.g. diesel rail vehicles in high winds) being affected, the system needs to be flexible in selectively applying speeds.
Speed restrictions need to take account of the characteristics in the ETCS speed profiles and be available to the Trackside through validated train data.
Speed restrictions can be selected to apply to the whole length of the rail vehicle or just the front of it (e.g. at a level crossing).
Speed restrictions can apply in either direction or both directions.
The current rules only allow a simple differential Temporary Speed Restriction (TSR); the system needs to remove this constraint since it is operationally restrictive.

Safety

The ETCS Trackside shall enable rail vehicle movements in degraded and emergency scenarios to be managed safely.

CRS-ETCS(T)-17

Source: ETCS Reference Design process

Status: Normative

Rationale: Staff Responsible (SR) is regarded as a last resort; the signaller should be able to set degraded routes and issue corresponding Movement Authorities (MAs) with On Sight (OS) mode profiles.

Reference	153821-NWR-SPE-ESE-000007
Issue/Ver:	3.0
Date:	18/03/2019

Guidance: The ETCS must support the safe movement of trains in degraded and emergency operations. Where a failure prevents a degraded route being set, then tools and processes should be in place to release locking (e.g. override the memory of an MA issued, release route locking due to train detection failure, release points due to train detection failure).
The system should provide the signaller with the best available information from multiple sources.
This requirement will be met by a combination of technical solutions within the ETCS Trackside and the Traffic Management System, and through operational rules and training.
The risk of human error in degraded and emergency conditions must be reduced by the ETCS. Human involvement in safety operation systems increases risk, which the ETCS should be used to mitigate so far as is reasonably practicable. Examples of mitigation methods are implementing speed supervision if this is still functional or demanding brake intervention where MAs are exceeded.

Safety
The ETCS Trackside shall respond to an emergency stop request from the Traffic Management System by sending stop instructions to all trains in, or approaching, a pre-defined area.
CRS-ETCS(T)-51

Source: SoS CRS Review

Status: Normative

Rationale: To protect the area by stopping, or attempting to stop, all trains at risk when the signaller becomes aware of a safety incident or the system has detected an unsafe event.

Guidance: If the signaller becomes aware of a safety incident they must be able to protect the area by stopping, or attempting to stop, all trains at risk.
If systems detect an authorised train movement or a safety hazard, then the Trackside should respond to a request to stop train movements in the affected area.
The request may be initiated by the signaller, a Traffic Management system, a Signal Passed at Danger (SPAD) detection system or other hazard detection system, such as a rock fall trip wire.
The pre-defined areas should be developed in the same way as for lineside signals, following the principles in NR/L2/SIG/30009/E421.
The method of sending the stop instruction to the train should take account of the recovery of the train service and Movement Authorities when the issue has been resolved.
In areas of dual signalling (ETCS and lineside signals) the area over which the control applies should be the same.

When a Global System for Mobile Communications – Railway (GSM-R) cell is unavailable, the ETCS Trackside shall enable the continued operation of ETCS trains.
CRS-ETCS(T)-48

Source: ConOps-ETCS-03470, ETCS-03480, ETCS-03490, ETCS-03530, ETCS-03540

Status: Normative

Reference	153821-NWR-SPE-ESE-000007
Issue/Ver:	3.0
Date:	18/03/2019

Rationale: To meet the operational requirement for trains to be managed through areas of GSM-R failure, possibly at a reduced capacity.

Guidance: In the event of a cell failure, the train will not be able to communicate with the Trackside to receive updated Movement Authorities and is likely to come to a stand in an area of no radio coverage (data or voice).
 In the event of a cell failure, Movement Authorities (MAs) need to be issued which extend the whole way through the cell rather than just the minimum distance across which they are normally sent.
 The train needs to be instructed not to react to the loss of communications either by provision of a temporary set of National Values or declaration of a radio hole.
 The Traffic Management System should be able to set 'long routes' through the area of communications failure which cause the ETCS Trackside to generate appropriate MAs, and speed and gradient profiles.

3.1.4 Other

The ETCS Trackside shall share infrastructure and train status information with the Traffic Management System (TMS). CRS-ETCS(T)-18

Source: ETCS Reference Design process

Status: Normative

Rationale: To allow the signaller and the TMS to make operational decisions based upon current information.

Guidance: The signaller's display system, as part of the TMS, receives information from the interlocking function to enable the signaller to perform their tasks, including the status of the moveable infrastructure, routes set and signal aspects. The signaller requires extra information to manage trains operating in ETCS in both normal and degraded scenarios. Traffic Management Systems (including the automated setting of routes) will also require information. Information required includes: MA, rail vehicle data, rail vehicle position, Train Running Number, validated ETCS train data, etc. The information needs to meet the needs of the signaller in performing their tasks.

The ETCS Trackside shall store required safety-critical dynamic information in non-volatile memory. CRS-ETCS(T)-20

Source: ETCS Reference Design process

Status: Normative

Rationale: The signaller or other systems may apply safety-critical controls restricting the movement of infrastructure or issue of Movement Authorities; these need to be preserved in the event of a system failure or restart.

Guidance: Dynamic information changes with time; the following data should be stored:
 - Possession and staff protection;
 - Inhibitions of automated control by external systems;
 - Train data for all communicating trains and for those having undertaken End of Mission (EoM);

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- Last position reports from communicating trains;
- Extent of Movement Authorities issued to trains; and
- The status of Shunting Areas.

The data should be preserved for a minimum of 24 hours, but the system should allow a 'restart with restore' or a 'clean restart'.

Safety

Upon initialisation or restart, the ETCS Trackside shall obtain dynamic safety-critical information before authorising rail vehicle movement.

CRS-ETCS(T)-21

Source: ETCS Reference Design process

Status: Normative

Rationale: To prevent Movement Authorities (MAs) being issued before all safety-critical information has been restored.

Guidance: MAs require dynamic safety-critical information, such as speed profiles and temporary restrictions. These need to be obtained from configuration data and the Traffic Management System.
Staff and possession protection needs to be preserved.
The status of shunting areas needs to be preserved.
The status of moveable infrastructure and occupancy of the track needs to be established.
Some information may be stored in non-volatile memory. Upon restoration, the system needs to evaluate which information is still valid and apply relevant controls.
Upon initialisation or restart, the system needs to collect information on speed restrictions and other information from other systems.
The system needs to obtain information from trackside objects and other systems to establish the state of the infrastructure.

Safety

The ETCS Trackside shall support the Signal Controlled Warning System by the provision of information.

CRS-ETCS(T)-62

Source: SoS Architecture

Status: Normative

Rationale: Improving track worker safety requires new systems which can reliably inform workers of when it is safe to be on the track and give appropriate warnings of approaching rail vehicles.
These systems require information from the ETCS Trackside.

Guidance: The information will probably include the status of the infrastructure and the location of trains.
The interface is expected to be based on the EULYNX format.

Safety

The ETCS Trackside shall support train operation into, out of and within depots attached to an ETCS-only railway.

CRS-ETCS(T)-42

Source: ConOps-SOS-034, ETCS-01520 & ETCS-1550

Reference	153821-NWR-SPE-ESE-000007
Issue/Ver:	3.0
Date:	18/03/2019

Status: Normative

Rationale: Train movements in depots attached to the ETCS railway should be controlled in an appropriate manner and the risks of errant movements occurring on the running line should be controlled.

Guidance: For depots and sidings used principally for the stabling of passenger multiple units or fixed formation trains, Level 2 or Hybrid Level 3 would be appropriate. For locations where the infrastructure is controlled locally, or which extend from the running line (e.g. privately-operated freight branches), Level 0 or NTC would be appropriate.
At the boundary between the depot and running line, the system should manage the transitions and prevent trains not in the appropriate Level/mode entering the running line.
Each Deployment Project Team needs to establish the trackside support needs in each depot on their route.

Safety
The ETCS Trackside shall support risk reduction at level crossings. CRS-ETCS(T)-44

Source: ConOps-SOS-123, SOS-124, ETCS-03670, ETCS-03760, ETCS-03770 & ETCS-03810

Status: Normative

Rationale: The interface with road users and pedestrians is an area of high risk. Whilst the ETCS cannot control the behaviour of level crossing users, it can contribute to risk reduction through more consistent arrival times and better information to the signaller.

Guidance: Train position reports may be used to “suppress” a level crossing strike-in based on the reported position and speed of the train whilst those reports are being received. This would lead to more consistent arrival times and reduce crossing closed time.
Train position reports may be used to advise the signaller of the likely arrival time of trains at a level crossing, particularly user-worked crossings, and whether the train has passed the crossing, enabling better information to be provided to level crossing users.
The use of train position reports for these purposes is outside the ETCS Trackside scope.

Safety
The ETCS Trackside shall support the safe dispatch of passenger trains from platforms. CRS-ETCS(T)-45

Source: ConOps-ETCS-00290, ETCS-00330 & ETCS-01070

Status: Normative

Rationale: Train dispatch is a risk to the industry, especially if there is a breakdown in communication between train crew and station staff. The train departure corridor needs to be confirmed clear before the train departs; this may be achieved by station staff.

Guidance: Depending on the dispatch arrangements, which may involve station staff and/or train crew in addition to the driver, it may be necessary to provide

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trackside facilities.

Train Ready to Start (TRTS) equipment may be provided to enable station staff or train crew to advise that the train is ready for the route to be set. The ETCS Trackside would normally pass this request to the Traffic Management System. Indicators may be required to advise the station staff or train crew that the route has been set and a Movement Authority (MA) is available. Note that, similar to lineside signalling, the driver may not have completed train setup and the MA may not have been transmitted to the train.

Controls and indicators may be required to enable the station staff to communicate to the driver that the doors can be closed and, separately, that the departure corridor has been checked and the train can depart.

RIS-3703-TOM provides additional guidance.

3.2 Non-functional Requirements

This section sets out non-functional requirements, such as those relating to performance, reliability, security, competence and training which, where applicable, place constraints on the design or implementation of the ETCS Trackside. Non-functional requirements which apply generically across all systems within the System of Systems are recorded in the GB Generic System of Systems Customer Requirements Specification [RD2] and are not duplicated here.

3.2.1 System Performance

The introduction of the ETCS Trackside shall not detrimentally affect the technical values used in timetable planning.

CRS-ETCS(T)-22

Status: Application-Specific

Rationale: To be acceptable to the industry and the public, journeys must not take longer than at present, which means that the overall balance of running times, re-occupation times and headways needs to enable the timetable to be planned and achieved.

Guidance: There is a potential that the conservatism of the brake model may result in longer journeys, particularly where there are speed reductions. The elimination of speed restrictions for purely signalling reasons should enable faster journeys. Freight rail vehicles are particularly affected by speed reductions. There may be an opportunity to reduce any negative impact by a pragmatic conversion from imperial to metric speed units: rounding up as well as down where safety can be shown not to be affected.

The ETCS Trackside shall be designed to meet the operational and capacity requirements of the section of route.

CRS-ETCS(T)-43

Source: ConOps-SOS-66

Status: Normative

Rationale: The system needs to be able to support the timetabled services and required journey times including recovery from degraded and failure situations.

Guidance: The layout of block sections should achieve the required headway and allow for recovery of the train service without adding excessive complexity. The option of limited capacity bi-directional operation should be considered as

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standard. As a minimum, a bi-directional route should exist between locations where trains could enter / leave the normally uni-directional line. Where a business case exists, then extra sections/capacity could be introduced.

The system should manage infrastructure failures and minimise the need for the use of Staff Responsible mode.

The design should allow for permissive moves where operationally needed.

The ETCS will permit vehicle movements into occupied sections. This allows for recovery of trains, movements into platforms to join trains as required by the timetable and moves into stabling sections that can berth multiple vehicles. In principle, moves into occupied sections should be in On Sight (OS) as the highest level of supervision available and should be possible anywhere on the railway (as a train could fail anywhere).

The ETCS will facilitate attaching and detaching as required for operational purposes. These moves will be undertaken in the highest level of supervision available, where possible. Coupling movements in Standby (SB) negate the need for complete data entry.

3.2.2 Reliability, Availability, Maintainability (RAM)

The ETCS Trackside Mean Time Between Service Affecting Failures (MTBSAF) shall not be lower than that for the current signalling system.

CRS-ETCS(T)-24

Status: Normative

Rationale: The reliability of the infrastructure is key to successful running of the business. Service affecting failures are those which affect the Public Performance Measure (PPM) of the service and it is on that that the industry is assessed by public and politicians.

Guidance: Some failures will be eliminated, such as signals, but others will become possible and the system will need to manage these. Each ETCS Trackside deployment will need to establish the current performance of the infrastructure in terms of service affecting failures and may set targets for improved performance. The design of the system can minimise the impact of failures such that they do not affect the ability to run a compliant train service.

The availability of the ETCS Trackside shall not be less than that of the current signalling systems.

CRS-ETCS(T)-25

Status: Normative

Rationale: Availability of the signalling system (comprising of ETCS Trackside, ETCS Onboard, and lineside signalling assets) is a key part of running a reliable train service and meeting all the industry business targets.

Guidance: Extra equipment runs the risk of increasing failures; the design of the Trackside needs to maximise the availability of the whole system. The change to Digital Railway systems where parts of the system are trackside and parts on board requires different processes and approaches to solving system issues. Provision of degraded facilities can improve overall availability. Each deployment project will need to establish the availability of the current signalling system and may set targets for higher availability. The document ERTMS Reliability Specification NR/AM/SA/SPE/00147 defines the Reliability, Availability and Maintainability (RAM) requirements for the

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constituents making up the ETCS (trainborne, lineside and centralised equipment), Telecommunication system and other interfacing systems/sub-systems.

3.2.3 Safety

None.

3.2.4 Security

Safety
The ETCS Trackside shall be protected against unauthorised access and modification.
CRS-ETCS(T)-26

Status: Normative

Rationale: To prevent unauthorised amendments to the safety software or configuration data that may lead to an unsafe situation.

Guidance: The protection needs to include both physical restrictions on access, resistance to electromagnetic attack (including denial of service), and unauthorised access to computer-based systems.
The data bearers between ETCS Tracksides and ETCS Onboards, and between adjacent ETCS Tracksides, should be protected.
Access to the system via communication ports should be restricted and protected by passwords, encryption or other suitable methods.
Staff should have restricted access and be trained in updates to the system.
Authorised amendments to data and configurations will follow robust processes reflecting that the system is safety-critical.
Security Assurance Document – 147833-NWR-REP-MPM-000001, based on IEC 62443, should be followed. Each Deployment Project should determine the appropriate security level and review its security requirements based on the principles contained within the Security Assurance Document taking into account its own particular deployment configuration.

Safety
All communications between elements of the ETCS Trackside shall be secured.
CRS-ETCS(T)-27

Status: Normative

Rationale: To prevent interruptions to communication/corruption of data that may lead to safety related incidents.

Guidance: The ETCS trackside typically consists of computer-based equipment fulfilling a safety-critical function. Information is exchanged between parts of the system and adjacent systems using data communications.
Interruptions to the communication or corruption of the data may lead to safety related incidents.
Data links could be secured through physical separation from other communications or through the use of addressing and encryption.

Reference	153821-NWR-SPE-ESE-000007
Issue/Ver:	3.0
Date:	18/03/2019

3.2.5 Information Management

The ETCS Trackside shall implement data transfer and storage in accordance with the DR System of Systems (SoS) Data Specification.

CRS-ETCS(T)-40

Source: CRS SoS and DR SoS Data Specification [RD10]

Status: Normative

Rationale: The DR SoS Data Specification [RD10] contains the data required and generated by the ETCS Trackside System to function correctly as part of the Digital Railway System of Systems.

3.2.6 Ergonomics and Human Factors

The implementation of the ETCS Trackside shall be assessed for driveability.

CRS-ETCS(T)-56

Source: ETCS System Requirement Review

Status: Normative

Rationale: To confirm that the driving task does not overload the driver and that the risk of a safety-critical/related error by the driver is reduced as far as is reasonably practicable.

Guidance: Each deployment project should assess the driveability of the proposed design to identify potential distractions, conflicts of information, multiple concurrent tasks, etc., including consideration of:

- Transitions to and from ETCS;
- Mode changes;
- Neutral section management;
- Station stops;
- Speed profiles; and
- Route information text messages.

The principles contained in RIS-0713-CCS may be applicable.

3.2.7 Electromagnetic Compatibility and Environment

The ETCS Trackside shall be environmentally and electrically compatible with the railway system in which it will operate.

CRS-ETCS(T)-58

Source: SoS CRS Review

Status: Normative

Rationale: The railway environment exposes equipment to a range of environmental conditions including heat, cold and moisture. The system needs to be protected against/tolerant of the electromagnetic interference experienced in a railway environment, taking account of all parts of the railway system. The electrical supply may vary in voltage/frequency outside the limits generally accepted for the domestic supply industry.

Guidance: The system should be demonstrated to meet all relevant standards, including Euronorms, British Standards and Network Rail Company Standards.

Reference	153821-NWR-SPE-ESE-000007
Issue/Ver:	3.0
Date:	18/03/2019

Each application should identify the relevant standards (including versions). The Deployment Project Team should assess the actual environment in which the ETCS Trackside will need to operate as it may not accord with the environment assumed in the standards.

3.2.8 Health & Safety

None.

3.2.9 Operational Readiness

None.

3.2.10 Maintenance and Diagnostics

Safety
 The introduction of the ETCS Trackside shall reduce exposure of staff to track safety risk. CRS-ETCS(T)-28

Status: Normative

Rationale: The safety of all staff is paramount. Every minute they are on or near the line (on track or alongside) exposes them to risk. ETCS implementation should reduce the exposure of staff by removing equipment requiring routine maintenance or renewal, or which is likely to need repair.

Guidance: The removal of signals and minimising of lineside signs will reduce staff exposure to safety risks.

The ETCS Trackside shall record all safety-critical messages sent and received. CRS-ETCS(T)-29

Status: Normative

Rationale: To allow analysis of the system in the event of an incident or 'wrong-side' failure, all safety-critical messages sent or received must be recorded.

Guidance: Safety-critical messages are those which authorise the ETCS Onboard to undertake an action and messages from the ETCS Onboard used by the system or signaller to make safety-critical decisions. Messages to Trackside objects and status messages from Trackside objects used for safety-critical purposes are included. Messages to be recorded include those between the ETCS Trackside and ETCS Onboards, to and from the Traffic Management System, to and from Trackside objects, such as points or level crossings, and to and from adjacent ETCS Tracksides. Where practical, further information should be recorded to support incident and defect investigation, including sub-system changes of state.

The ETCS Trackside shall provide for the playback of recorded safety critical-messages. CRS-ETCS(T)-30

Status: Normative

Rationale: To enable rapid investigations into incidents and wrongside failures, maintenance staff need to be able to recall saved data in a user-friendly form.

Reference	153821-NWR-SPE-ESE-000007
Issue/Ver:	3.0
Date:	18/03/2019

Guidance: The tools available to maintenance staff should allow the easy filtering of data, stepping through of messages, etc.
Use of the replay tool must not require the recording system to be disabled nor affect any stored data.

The ETCS Trackside shall support remote condition monitoring and diagnostics. CRS-ETCS(T)-54

Source: SoS CRS Review

Status: Normative

Rationale: To enable the prompt identification of failures and to avoid staff needing to go trackside to identify the failed item.

Guidance: Many failures are not apparent to the user or service affecting; however, these need to be rectified before a further failure leads to loss of system availability. Systems should enable the early detection of trackside components which are failing/not performing within the normal time/power frames.
In the event of a failure, maintenance staff should be able to access diagnostic data to establish the cause of the failure. This will minimise access needs and enable staff to take the correct replacement Line Replaceable Units.
The Deployment Project Team will need to confirm the Remote Condition Monitoring (RCM) information that needs to be provided, how it will be sourced, and who will need to access it.

The ETCS Trackside shall support remote ETCS Trackside component resets. CRS-ETCS(T)-65

Source: SoS CRS Review

Status: Normative

Rationale: To avoid staff needing to go trackside to undertake a reset.

Guidance: Where practical, it should be possible for maintenance staff to initiate the reset/restoration of a lineside component without attending site when it is in a failed/locked out state.

Upon initialisation of computer based elements of the ETCS Trackside, an automatic self-test shall be undertaken with the results being made available to the maintainer. CRS-ETCS(T)-57

Source: SoS CRS Review

Status: Normative

Rationale: To enable the prompt identification of failures and enable rectification.

Guidance: When computer-based systems are reset or initialised, they should undertake checks that the system is functioning correctly.
A short power interruption may not fully reset computer-based systems. During a self-test, the system should check the availability of processors, the condition of internal memory, the availability of other storage devices and the status of interfaces. An indication should be available to the maintainer that the self-test is being undertaken.
The completion of self-testing and consequent normal operation of the equipment should be indicated to the maintainer without the need for diagnostic or test equipment (e.g. system healthy indication).

Reference	153821-NWR-SPE-ESE-000007
Issue/Ver:	3.0
Date:	18/03/2019

If the self-test is not completed satisfactorily, indications or diagnostics must be provided to support the maintainer in identifying what action is required to restore the system to service.

The ETCS Trackside shall distribute reports of failure of the ETCS Trackside or communication systems to identified maintenance and operational staff. CRS-ETCS(T)-46

Source: ConOps-ETCS-00290, ETCS-00330 & ETCS-01070

Status: Normative

Rationale: To enable the prompt identification of failures and enable rectification.

Guidance: Many failures are not apparent to the user or service affecting; however, these need to be rectified before a further failure leads to loss of system availability. Items to be considered include:

- Balise consistency and read errors;
- Increase in the rate of loss of communication session;
- Change in the communication delay for radio messages;
- Intermittent failures of train detection; and
- Intermittent failures of point detection or a significant change in operating time.

Due to the signalling split between the ETCS Trackside and ETCS Onboard a cross-industry DRACAS process should be adopted.

3.2.11 Competence and Training

Safety

The ETCS Trackside shall not be brought into operation or operated without competent maintenance staff being available to maintain it. CRS-ETCS(T)-31

Status: Normative

Rationale: Signalling systems are safety-critical and any maintenance activities must be undertaken in a controlled manner by competent personnel.

Guidance: This includes first line response staff and on-call experts from equipment suppliers. The organisation must be able to call on independent expert staff to investigate incidents and accidents.

3.2.12 Whole Life Costs

The whole-life costs of the ETCS Trackside shall be lower than that for the equivalent lineside signalling system. CRS-ETCS(T)-32

Status: Normative

Rationale: Maintenance of Trackside assets (including failure rectification and routine replacement) is an ongoing cost in the whole-life cost analysis of the system. Either asset life needs to be longer or the cost of asset renewal needs to be substantially reduced.

Reference	153821-NWR-SPE-ESE-000007
Issue/Ver:	3.0
Date:	18/03/2019

Guidance: Each project should establish the costs of maintaining the current infrastructure on a whole-life basis (routine preventative maintenance, fault attendance, routine replacements, asset life).
An application may require a demonstration that the whole-life costs of maintenance in the future will reduce.
Whole-life cost needs to consider the management of obsolescence and support for ageing equipment.

The costs of amending the ETCS Trackside shall not exceed the costs of undertaking similar amendments to the current lineside signalling system. **CRS-ETCS(T)-33**

Status: Normative

Rationale: The railway is continually being upgraded and altered to meet changing business needs. The costs of those changes need to be no higher than they are for current technology and should ideally be lower.

Guidance: Costs of alteration include the work itself, project management, and lost opportunities due to time taken to undertake the work.
Where alterations require the services of specialist suppliers, each deployment project should put in place support arrangements for the asset management organisation, allowing for changes over the life of the asset.

3.2.13 Other

None.

3.3 Process Requirements

3.3.1 Target Setting

Projects shall establish the Mean Time Between Service Affecting Failures (MTBSAF) of the current signalling infrastructure and set targets for the ETCS Trackside. **CRS-ETCS(T)-35**

Status: Normative

Rationale: The objective is that the overall availability of the railway should not be reduced; to be able to meet this objective, the current performance needs to be established.

Guidance: The MTBSAF is a measure of how often a failure of the system leads to an impact on the train service.
Establishment of targets needs to take account of the split of the system between Trackside and Onboard in order to achieve railway system availability which is no worse than on the current infrastructure.
Failures affecting the service running can be managed through redundancy, condition monitoring or product selection.

Projects shall establish the availability of the current infrastructure and set targets for the ETCS Trackside. **CRS-ETCS(T)-36**

Status: Normative

Reference	153821-NWR-SPE-ESE-000007
Issue/Ver:	3.0
Date:	18/03/2019

Rationale: The objective is that the availability of the railway for normal service should not be decreased.

Guidance: The availability can be affected by failures, changes or routine maintenance. Availability can be increased by reducing the number of failures which affect the system through design, redundancy, product selection, and condition monitoring.
The time when the system is unavailable during routine maintenance (including scheduled replacements of components) should be reduced.

The whole-life costs of managing the existing signalling infrastructure over its rated life shall be established and targets set for the ETCS Trackside.

CRS-ETCS(T)-37

Status: Normative

Rationale: Existing assets have a whole-life cost and the target for the ETCS Trackside should be to reduce the costs over an equivalent period.

Guidance: Projects should be assessed on the whole-life cost of the works, which covers inception, design, construction, maintenance, and disposal.
Costs should include the provision of the signalling system, the provision of spares, tools and training, routine maintenance and renewals, specified, predictable minor amendments, and disposal.

3.3.2 Standards

None.

3.3.3 Engineering Management

None.

3.3.4 Governance and Approvals

All necessary approvals shall be in place before the ETCS Trackside is Placed into Service.

CRS-ETCS(T)-55

Source: SoS CRS Review

Status: Normative

Rationale: There are legal requirements surrounding the approvals of system elements which need to be satisfied.
It needs to be established that the system meets the safety, operational and technical requirements applicable to the application.

Guidance: Each deployment project should establish an approvals matrix for the project considering (but not limited to):

- Notified Body (NoBo) certification of interoperable components;
- Product Acceptance (including EMC/EMI compatibility);
- Designated Body (DeBo) review of National Technical Rules compliance;
- Assessment Body (AsBo) reviews of process and safety analysis;
- Independent Safety Assessor (ISA) reviews of the System;
- NR (or other IM) Acceptance Panel authorisations, including Safety Review Panels for novel items or applications;
- Operational Readiness assessment (including maintenance facilities and

Reference	153821-NWR-SPE-ESE-000007
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- competency); and
- Compatibility checks with Onboards.

3.3.5 Other

Temporary Shunting areas and their controls shall be identified and documented. CRS-ETCS(T)-38

- Status:* Normative
- Rationale:* Shunting areas need to be defined and the associated trapping protection to be in place to protect the running line when the area is active.
- Guidance:* Shunting areas should be based on operational need. Each area needs to have a set of associated controls covering trapping protection and routes into and out of the area. In designing shunting areas, the different operations that take place within them need to be considered and it may be necessary to have controls enabling adjacent shunting areas to be activated.

The ETCS Trackside shall issue Movement Authorities which normally avoid the need for trains to stop in undesirable locations. CRS-ETCS(T)-66

- Source:* ETCS Reference Design process
- Status:* Normative
- Rationale:* To reduce the secondary risks to people or performance that may arise if a train stops in certain locations.
- Guidance:* Undesirable locations will be determined on an application-specific basis. The risks that might arise in the event that a train stops in, or attempts to restart, from certain locations, should be considered and mitigated. Examples of potentially undesirable stopping locations include tunnels, viaducts and neutral sections.

Each ETCS Trackside solution shall minimise the amount of bespoke design in each deployment and maximise the opportunity for automated design. CRS-ETCS(T)-67

- Source:* ETCS Reference Design process
- Status:* Normative
- Rationale:* To reduce whole life costs and project timescales.
- Guidance:* The products used should be capable of meeting all the requirements of ETCS applications on GB railways irrespective of whether features are used on a specific project. This avoids development work for each project on first deployment and for subsequent changes. Requirements should be developed for standard ETCS Trackside products including all the facilities needed on the GB railway so that development and authorisation of the products can be achieved once.

Reference	153821-NWR-SPE-ESE-000007
Issue/Ver:	3.0
Date:	18/03/2019

Safety

Interaction between ETCS Trackside sub-systems and between the ETCS Trackside and other systems, equipment, processes and people shall not give rise to unacceptable safety risks.

CRS-ETCS(T)-68

Source: ETCS Reference Design process

Status: Normative

Rationale: To maintain safe operation of the ETCS Trackside and interfaced systems.

Guidance: 'Interaction' includes environmental compatibility and electromagnetic compatibility. It includes both interactions where there is an intentional interface with other systems, and equipment and interaction where there is no intentional interface. 'Other systems and equipment' include other railway infrastructure systems and non-railway systems.

Reference	153821-NWR-SPE-ESE-000007
Issue/Ver:	3.0
Date:	18/03/2019

4 Associated Information

4.1 Open Points

The open points for this generic Customer Requirements Specification are tabulated in Table **Table 1** below.

Table 1 Open Points

Number	Issue	Description	Identified in Version	Closed in Version
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Reference	153821-NWR-SPE-ESE-000007
Issue/Ver:	3.0
Date:	18/03/2019

1	Application of ETCS Level 2, no signals to GB railway network	The DR Programme will be publishing guidance to deployment projects on how to apply ETCS to the GB railway including: a) the identification and recording of operational needs, b) the layout of block sections and stopping locations, c) the provision of ETCS Stop and Location markers, d) the provision of routes and degraded facilities, e) the design of shunting areas and facilities.	1.0	
2	Management of train speed	The GB network currently applies a range of speed profiles and restrictions based on the type of train. The train types do not readily match the information which can be transmitted by ETCS (axle load, cant deficiency, train category). The output of a DR Programme workstream to address this open point is currently awaited.	1.0	
3	Management of Temporary Speed Restrictions	The information regarding applicable temporary speed restrictions is required across the System of Systems. ETCS Trackside assumes that this information will be provided in a data form from another system with the direct interface being with Traffic Management. The format of the data and the information provided has not been finalised. (CRS-ETCS(T)-16).	2.0	

Reference	153821-NWR-SPE-ESE-000007
Issue/Ver:	3.0
Date:	18/03/2019

4.2 Assumptions

The assumptions made in connection with this generic Customer Requirements Specification are tabulated in **Table 2** below.

Table 2 Assumptions

Number	Issue	Assumption	Identified in Version	Closed in Version
1	Metric speed units	It is assumed that ETCS Level 2 operation will be undertaken utilizing metric units including: a) entry of metric distances and speeds by drivers, b) display of metric distances and speeds to the driver, c) entry of metric speeds for temporary restrictions by the signaller or others, d) display of metric distances and speeds to the signaller.	1.0	

4.3 Dependencies

The dependencies associated with this generic Customer Requirements Specification are tabulated in **Table 3** below.

Table 3 Dependencies

Number	Issue	Dependency
1	GSM-R Availability	The ETCS Trackside assumes for its communication with the ETCS Onboard that: a) there will be no radio holes, b) that in the event of loss of safe communications this will be re-established within one retry cycle, c) that at all locations where Start of Mission is planned to occur connection will always be established with no more than one retry.

Reference	153821-NWR-SPE-ESE-000007
Issue/Ver:	3.0
Date:	18/03/2019

4.4 Constraints

The constraints associated with this generic Customer Requirements Specification are tabulated in **Table 4** below.

Table 4 Constraints

Number	Issue	Constraint
1	ETCS Level 2, no lineside signals	This document is restricted to the situation where train movements are solely controlled by ETCS within the application area with the following exceptions: a) at the boundaries of the ETCS area where transitions to and from lineside signaling occur, b) in shunting areas where the position of points and authorisation of movements over controlled infrastructure are indicated at the trackside.

Reference	153821-NWR-SPE-ESE-000007
Issue/Ver:	3.0
Date:	18/03/2019

Appendix A APPLICABILITY ASSESSMENT TEMPLATE

A.1 Guidance on Populating the Template

A deployment project wishing to record the results of their applicability assessment should copy this template into a new deployment project-specific document for population.

Insert project name into the relevant box near the top of the template.

For each Application-Specific requirement, insert the word 'Yes' in the 'Applicable' box if the issue or subject addressed by the requirement is relevant to the deployment project in question.

If the issue or subject addressed by an Application-Specific requirement is not relevant to the deployment project in question, insert the word 'No' in the 'Applicable' box.

It is not permissible to change the Applicability status of Normative requirements as these are mandatory on all deployment projects.

A.2 Feedback

Deployment projects are requested to send copies of their populated Applicability Assessment Templates to the Digital Railway System Requirements and Integration team. This will enable the team to assess the value that the industry is deriving from the Application-Specific requirements and will support future improvements to the generic Customer Requirements Specification.

A.3 Template

Deployment Project Applicability Assessment of GB Generic National Customer Requirements Specification for ETCS Trackside			
Deployment Project Name			
Requirement ID	Type	Status	Applicable

Reference	153821-NWR-SPE-ESE-000007
Issue/Ver:	3.0
Date:	18/03/2019

<Populate this column with requirement IDs for all requirements when generic CRS nearly completed>	<Populate this column with 'Functional', 'Non-Functional' or 'Process' for each requirement as appropriate>	<Populate this column with 'Normative' or 'Application-Specific' for each requirement as appropriate>	<For Normative requirements insert 'Mandatory', for App-Specific requirements leave blank>

Reference	153821-NWR-SPE-ESE-000007
Issue/Ver:	3.0
Date:	18/03/2019

Appendix B NEW CUSTOMER REQUIREMENTS TEMPLATE

B.1 Guidance on Populating the Template

A deployment project wishing to draft new Customer Requirements should copy this template into a new deployment project-specific document for population. New requirements should not be added to Appendix B of the generic Customer Requirements Specification itself.

Text in italics prefixed '*GN*' forms guidance for the user of this template.

Further guidance may be found in the DRP Requirements Management Plan [RD9].

B.2 Feedback

Deployment projects are requested to send copies of any additional Customer Requirements generated to the Digital Railway System Requirements and Integration team. This will enable the team to identify future improvements to the generic Customer Requirements Specification.

B.3 Template

<p><i>Safety</i></p> <p>The requirement text goes here.</p> <p><i>GN: It must be a clear, concise and unambiguous statement of what is required. It must include the word 'shall'.</i></p> <p style="text-align: right;">Unique-Identifier</p>
--

Source: Source statement goes here.

GN: This is a statement which identifies where the requirement originated to provide traceability of the requirement's origin. This could include references to a Concept of Operations, System of Systems Customer Requirements Specification, hazard record, or other document that sets out a high-level expression of what this system needs to achieve.

Status: Normative or Application-Specific.

GN: This will be 'Application-Specific' unless this template is being used to propose a change to the generic Customer Requirements Specification in accordance with the change process set out in section <1.x>.

Rationale: Rationale statement goes here.

GN: This explains why the requirement is needed and its application, including why the requirement exists, who it is for, what industry benefit could be achieved, what the constraints are, and any other essential detail. Cross-referencing to other documentation to avoid the need for lengthy explanations is acceptable.

Reference	153821-NWR-SPE-ESE- 000007
Issue/Ver:	3.0
Date:	18/03/2019

Guidance: Guidance statement goes here.

GN: The guidance statement contains any supplementary information that may be of value in assisting with the interpretation of the requirement or in determining how the requirement could be satisfied.

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