



Digital Railway Requirements Framework

Prepared By:
Jonathan Evans
Lead Integration Validation Engineer

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Reviewed By:
David Nicholson
System Integration and Interface Manager

DJN-131118-0031

Date: 13th November 2018

Approved By:
Rubina Greenwood
Head of System Requirements and Integration

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

Version History

Issue	Date	Comments
0.1	31/07/18	First draft for internal discussion
0.2	06/08/18	Second draft for stakeholder review
0.3	29/08/18	Third draft incorporating results of stakeholder review as documented in comments sheet 153819-NWR-PLN-ESE-000011 v0-2_C
1.0	31/08/18	First formal issue, incorporating closure of residual comments from stakeholder review as documented in comments sheet 153819-NWR-PLN-ESE-000011 v0-2_C
1.1	28/09/18	Updated to align with SR&I Technical Note No.1 (153819-NWR-MEM-ESE-000001) and address residual comments as documented in comments sheet 153819-NWR-PLN-ESE-000011 v0-2_C
1.2	07/11/18	Updated to DJN comments on version 1.1
2.0	13/11/18	Formal issue of approved document

Exclusions

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

1. None identified.

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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. Development of DR Requirements can continue in accordance with the processes set out in the existing Level B & C Requirements Management Plan [RD11] prior to any alterations being made to the Requirements Management Plan to reflect the governance structure of the Digital Railway System Authority rather than the former ERTMS Systems Body governance arrangements to which it currently refers.

Dependencies

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

1. This document is dependent upon the documents listed as Dependent References.

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ABBREVIATIONS 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 [RI1]. Specific definitions associated with this document are as follows:

DR Requirements

The requirements that constrain how a DR System or System of Systems can be deployed, i.e. the requirements which form part of the “How” level of the triangle in Figure 1.

DR Requirements for [System X]

The totality of the DR Requirements for System X including requirements at both system and sub-system level.

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REFERENCES

Dependent References

An update to one of these references requires an update to this document

- RD1 Digital Railway – Introduction to the Requirements Structure, 153819-NWR-PLN-ESE-000012, Version 1.0
- RD2 Digital Railway – System of Systems (SoS) System Definition, 153819-REP-DRP-ESE-000002, Version 4.0
- RD3 Digital Railway Programme – System of Systems Architecture, 153819-NWR-DRG-ESE-000003, Version 4.0, 16th October 2018
- RD4 Digital Railway – System Management Plan, 153819-NWR-PLN-MPM-000002, Version 6.0, 18th June 2018
- RD5 Digital Railway System Authority Requirements, Configuration and Issues Management Working Group Draft Terms of Reference, (no reference number), Version 0.2, 19th June 2018
- RD6 Digital Railway – GB Generic Interface Requirements Specification, 153821-NWR-SPE-ESE-000013, Version 1.0, 23rd April 2018
- RD7 Digital Railway – ETCS Onboard System Definition, 153821-NWR-REP-ESE-000005, Rev.1.0, 27th March 2018
- RD8 Digital Railway – European Train Control System (ETCS) Trackside System Definition, 153821-NWR-REP-ESE-000006, Rev.1.0, 19th March 2018
- RD9 Traffic Management System Definition, 153821-NWR-REP-ESE-000004, Rev.1.0, 29th March 2018
- RD10 Digital Railway – Connected Driver Advisory System (C-DAS) System Definition, 153821-NWR-SPE-ESE-000009, Rev.1.0, 11th April 2018
- RD11 Digital Railway Level B & C Requirements Management Plan, 153819-NWR-PLN-ESE-000001, Issue 2.0, 17th August 2017
- RD12 Regulation (EU) 2016/919 of 27 May 2016 on the technical specification for interoperability relating to the ‘control-command and signalling’ subsystems of the rail system in the European Union
- RD13 Digital Railway System Authority Issues Management Plan, (no reference number), Issue 7.0, 17th July 2018
- RD14 Digital Railway – System Assurance Plan, 147883-NWR-PLN-ESS-000004, Issue 1.0, 1st March 2018
- RD15 Digital Railway – SR&I Technical Note No.1, 153819-NWR-MEM-ESE-000001, Issue 2.0, 26th September 2018
- RD16 Digital Railway Programme – Configuration Management Plan (details to be confirmed once document available)

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Informative References

These references have no material bearing on the content of this document.

- RI1 Digital Railway – Glossary of Terms and Abbreviations, 153819-NWR-SPE-ESE-000001, Issue 1.1, 31st August 2018
- RI2 ETCS - Baseline 3 - GB System Requirements Specification NEPT/ERTMS/REQ/0005, Version 4.2 dated 31st March 2017
- RI3 ETCS - Baseline 3 - GB Trackside Sub-system Requirements Specification NEPT/ERTMS/REQ/0006, Version 2.2 dated 31st March 2017
- RI4 ETCS - Baseline 3 - GB Onboard Retrofit Sub-system Requirements Specification NEPT/ERTMS/REQ/0007, Version 3.2 dated 31st July 2017
- RI5 ETCS - Baseline 3 - GB Onboard New Trains Sub-system Requirements Specification NEPT/ERTMS/REQ/0038, Version 2.2 dated 31st July 2017
- RI6 ETCS - Baseline 3 - GB Telecoms Sub-system Requirements Specification NEPT/ERTMS/REQ/0008, Version 3.0 dated 31st March 2017
- RI7 ETCS - Baseline 3 - GB Operations Sub-system Requirements Specification NEPT/ERTMS/REQ/0009, Version 2.0 dated 31st March 2017
- RI8 Interim Digital Railway Traffic Management Requirements Specification, DR/TM/REQ/0003 Issue 1.7.1 dated 31st May 2017
- RI9 Interim System Requirements for Connected Driver Advisory System (C-DAS), C-DAS Requirements 153821-NWR-REQ-ESG-000001 Issue 1.1 dated 2nd June 2017
- RI10 Interim Railway Undertaking (RU) Subsystem Requirements for Connected Driver Advisory System (C-DAS), C-DAS Requirements 153821-NWR-REQ-ESG-000007 Issue 1.1 dated 2nd June 2017
- RI11 Interim Infrastructure Manager (IM) Subsystem Requirements for Connected Driver Advisory System (C-DAS), C-DAS Requirements 153821-NWR-REQ-ESG-000008 Issue 1.1 dated 2nd June 2017
- RI12 Interim Exported Subsystem Requirements for Connected Driver Advisory System (C-DAS), C-DAS Requirements 153821-NWR-REP-ESE-000003 Draft Issue 0.8 dated 14th December 2017
- RI13 Rail Industry Standard - Interface Requirements for Connected Driver Advisory System, RIS-0711-CCS, Issue 1 draft 1a, July 2018
- RI14 Rail Industry Standard – ERTMS/ETCS Baseline 3 Onboard Subsystem Requirements: Retrofit, RIS-0797-CCS, Issue 1, September 2018
- RI15 Rail Industry Standard – ERTMS/ETCS Baseline 3 onboard Subsystem Requirements: New Trains, RIS-0798-CCS, Issue 1, September 2018
- RI16 The Common Safety Method for Risk Evaluation and Assessment (CSM RA) regulation, Commission Regulation (EU) 402/2013, 30th April 2013
- RI17 The Common Safety Method for Risk Evaluation and Assessment (CSM RA) regulation amendment, Commission Regulation (EU) 2015/1136, 13th July 2015
- RI18 Digital Railway – Integrated Concept of Operations, 000000-NWR-PLN-MPM-000005, Issue 1.0, 15th May 2018
- RI19 Digital Railway – System of Systems Basis of Design, 153819-NWR-REP-ESE-000002, Issue 1.0, 27th April 2018
- RI20 RSSB Railway Group Standards Code, RGSC01, Issue 4, 3rd June 2013

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- RI21 RSSB Standards Manual, RGSC02, Issue 3, 3rd June 2013
- RI22 Digital Railway Programme – Interface Description Document, 153819-NWR-RCD-ESE-000001, Version 4.0, 27th April 2018
- RI23 ETCS – Baseline 3 – GB ETCS-Ready Onboard Sub-system Requirements Specification, NEPT/ERTMS/REQ/0039, Issue 1.0, 15th June 2017

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1. Introduction

1.1 Background

The Digital Railway Programme (DRP) is intended to deliver transformative improvements in performance and capacity on Britain’s railways by providing the means to accelerate the deployment of digital control technologies.

A systems engineering approach has been adopted to determining and expressing the objectives, intended outcomes and critical features of the Digital Railway (DR) systems as suites of requirements. A structure has been adopted for these requirements to assist in understanding which industry bodies are accountable for which elements of the overall requirements suite and to provide clarity of the inter-relationships between the requirements. Figure 1 below provides a high-level overview of this structure. More detail can be found in the Introduction to the Requirements Structure document [RD1] which also explores the relationships between the different sets of requirements.

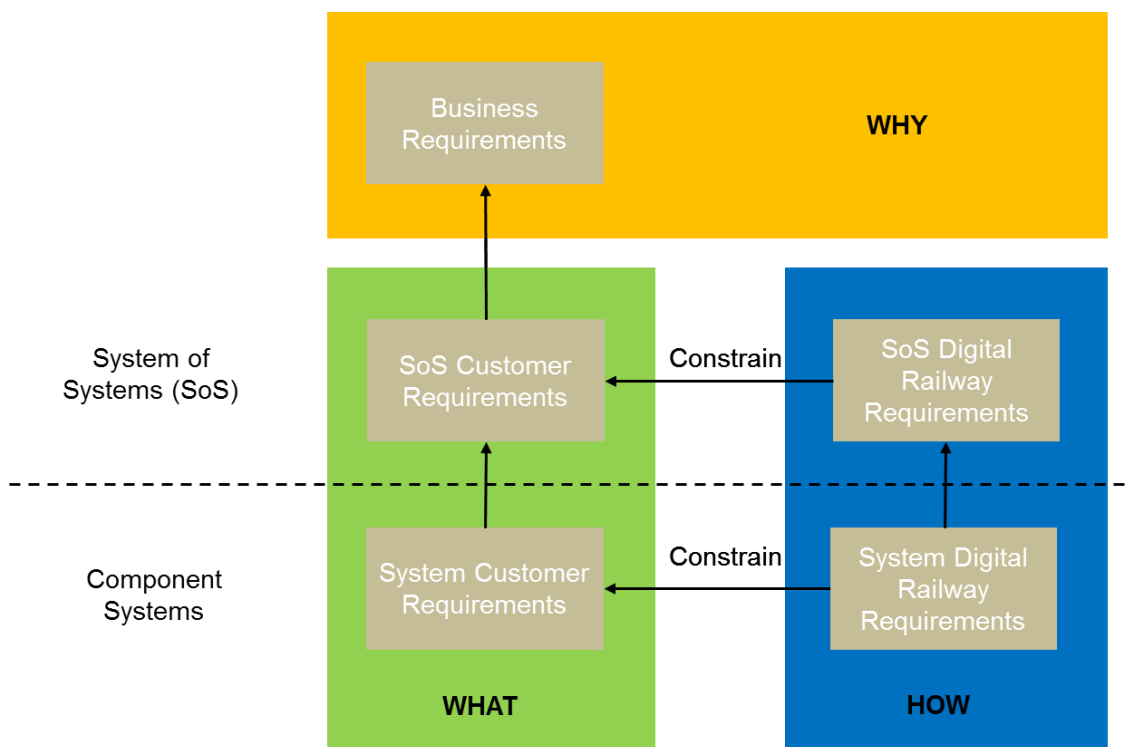


Figure 1 Digital Railway Programme Requirements Structure

References in this document to a “system” include both the relevant digital technology and the people and process aspects necessary to operate it successfully and the requirements suites also encompass the people and process requirements necessary to enable the industry to gain the benefits of deploying digital technologies as well as covering the digital technologies themselves.

This document is focused on the DR Requirements element of the structure which was, at one stage, known as the Engineering Rules element. This document reflects the agreements reached across the DRP in respect of the DR Requirements which are documented in the SR&I Technical Note No.1 [RD15].

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DR Requirements are needed to support the GB rail industry in achieving the following outcomes:

- 1) Compliance with European and GB legislation (e.g. the Railway Interoperability Regulations and the Railway and Other Guided Transport Systems Regulations)
- 2) Adoption of a compliance-based approach to the management of system interfaces between duty holders that supports operational consistency across the network using a single common Rule Book
- 3) The adoption of an outcome-based approach to benefits realisation by deployment projects
- 4) Minimised life cycle costs
- 5) A sustainable rail network and sustainable duty holder businesses

It is also important that, in securing the above outcomes, the DR Requirements do not unnecessarily constrain the ability of the supply market and duty holders to innovate.

Establishing complete, accurate and proportionate DR Requirements is therefore fundamental to the success of the GB rail industry in adopting the Digital Railway.

1.2 Purpose

The purpose of this document is to provide a high-level overview of the framework within which the DR Requirements will be developed and managed covering:

- 1) What constitutes a DR Requirement
- 2) The structure of the DR Requirements suite
- 3) The current status of DR Requirements and their origins
- 4) The activities that will be undertaken to elicit and mature DR Requirements
- 5) The processes by which the elicited DR Requirements will be assured
- 6) The governance arrangements by which the DR Requirements achieve industry endorsement
- 7) The processes and governance for amendments to the DR Requirements once industry endorsement has been achieved
- 8) The application of DR Requirements by deployment projects
- 9) The relationship between DR Requirements and Standards
- 10) Timelines for DR Requirements activities
- 11) Roles and responsibilities in respect of DR Requirements

Figure 2 below shows the relationship between this document (highlighted in orange) and other key documents.

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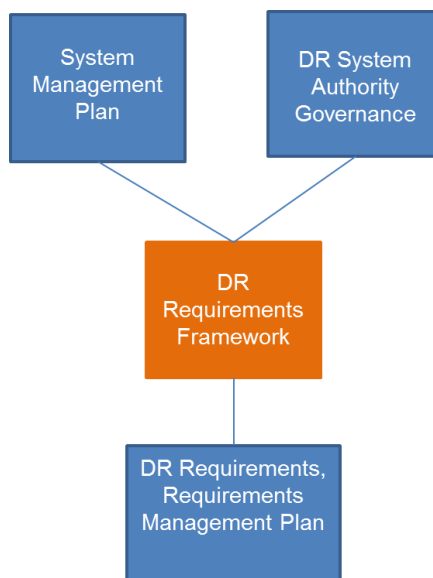


Figure 2 Document Relationships

This document is a child of the System Management Plan [RD4] providing more detail about the activities related to the DR Requirements. It is also a child of DR System Authority (DRSA) documentation that will set out the governance arrangements which the DRSA will apply to the DR Requirements. The DRSA documentation is currently being developed in parallel with this document and thus definitive references to this cannot be provided in this version.

This document is the parent for the DR Requirements (DRR), Requirements Management Plan [RD11].

1.3 Scope

The scope of the Requirements Structure for DR comprises the requirements for the digital Command, Control and Signalling (CCS) systems that are within scope of the DRP.

The digital CCS systems may be deployed in a number of potential configurations and, ultimately, it is expected that the Requirements Structure for DR will need to accommodate all of these. The DR Requirements Framework is intended to be sufficiently generic in its overall processes to accommodate all the potential configurations.

However, the System Requirements and Integration (SR&I) team within DR is currently remitted to develop requirements relevant only to a specific system architecture which is called the DR System of Systems (SoS). The DR SoS and its component digital CCS systems are defined within the DR SoS System Definition [RD2]. The DR SoS is represented diagrammatically by the elements within the dotted box shown on the Architecture diagram in Figure 3 below, which is taken from the System of Systems Architecture document [RD3].

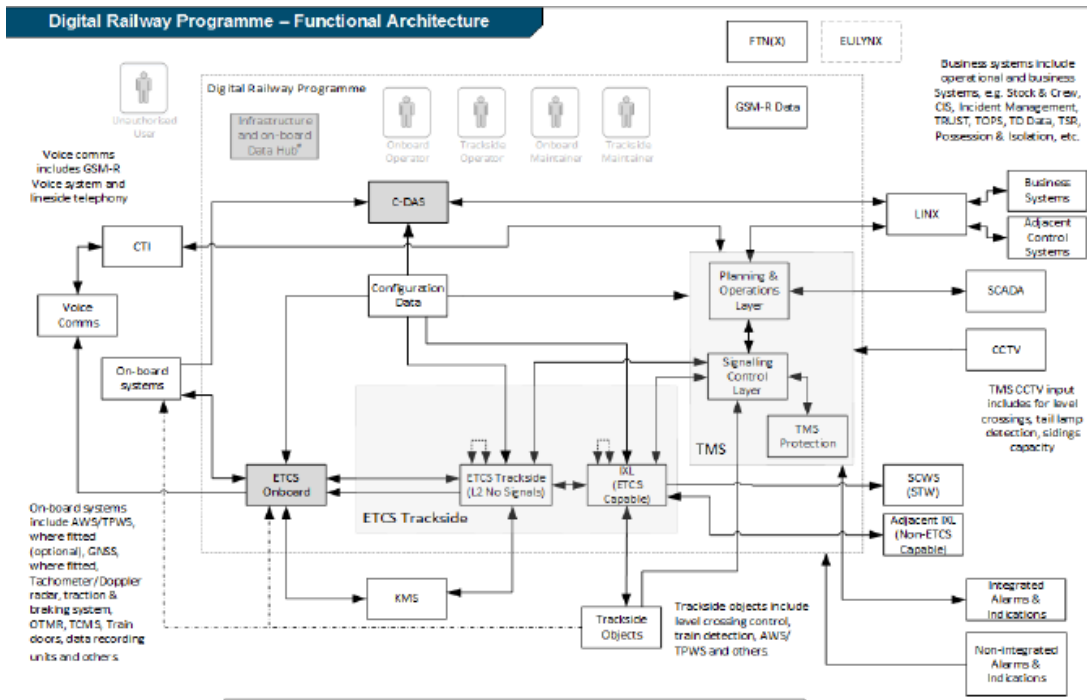


Figure 3 System of Systems Architecture

As can be seen, the DR SoS comprises the following digital CCS systems:

- European Train Control System (ETCS), which can be further sub-divided into Onboard and Trackside elements, with the Trackside being the Level 2 without signals configuration
- Traffic Management System (TMS) in an interfaced configuration
- Connected Driver Advisory System (C-DAS)

Consequently, the SR&I team will only be responsible for developing the DR Requirements necessary to deliver the DR SoS (including exported requirements on systems outside the DR SoS boundary) in the scope of the current development project work and the description of timelines, roles and responsibilities, etc. in this document reflects this.

Other projects, outside of the SR&I team, may be working on DR Requirements for other configurations but these activities are outside the scope of this document, although the governance arrangements described in section 6 will be common to all generic DR Requirements activities.

1.4 Document Maintenance

This document will be reviewed when one of the following events occurs:

- The DR SoS boundary (as defined in [RD2]) changes
- The boundary between systems within the DR SoS (as defined in [RD7], [RD8], [RD9] and [RD10]) changes
- Other architectural combinations of the digital CCS systems are brought into scope
- The industry governance bodies relevant to the DR Requirements change
- A technical review identifies opportunities for process improvements in the light of lessons learnt
- At the direction of the Head of SR&I, as the document owner

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- Six months have elapsed since the last review of this document
- 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 (probably the DRSA)
- When DRP organisation structures change, impacting on the distribution of responsibilities set out in this document

Any changes identified as being needed arising from a review of this document will be incorporated. This document will then be re-issued following endorsement by the signatories identified on the cover sheet.

2. Characteristics of DR Requirements

The DR Requirements act as constraints on the solutions adopted to implement the Digital Railway to enable the achievement of the outcomes identified in section 1.1. They are, as illustrated in Figure 1, about expressing “how” something is to be achieved. In contrast, the Customer Requirements express “what” needs to be achieved and it can thus be seen that the Customer Requirements and DR Requirements are distinct but complementary suites.

SR&I Technical Note No. 1 [RD15] defines “how” requirements, and thus the DR Requirements, as:

- Providing constraints on the realisation and/or implementation under consideration
- Providing opportunities for business benefits to be delivered
- Becoming national standards (e.g. Rail Industry Standards) once they have achieved a sufficient level of maturity
- Being sufficient for integration and inter/intra-operability. In other words, they do not prevent a supplier from providing an innovative solution, provided that it can be successfully integrated into the wider railway context in accordance with these constraints

The same document also notes that it is expected that the initial deployment projects will contribute to the development of these requirements as each project identifies areas of uncertainty.

Constraints may be needed to determine which potential solutions are acceptable where alternative solutions exist. An instance of this for the ETCS might be where the GB rail industry has identified that a particular option from the range permitted by the CCS Technical Specification for Interoperability, [RD12], is the preferred way of managing a situation or, conversely, must not be used. This could include items arising from Baseline Compatibility Assessments, National Values, etc.

In particular, the adoption of a compliance-based approach is critically dependent upon having some measures against which to demonstrate compliance. Traditionally, in the GB rail industry, this role has been fulfilled by standards and it is the industry’s intention that suitable standards will exist in the future to manage the digital CCS systems once their deployment has become normal practice within the industry. Those future standards will be informed by the DR Requirements and the industry’s experiences of deploying them on the network.

The DR Requirements will support the verification and validation activities that must be undertaken in order to achieve the approvals and authorisations needed at various stages in the life cycle of a digital CCS system in order to progress to the next stage. In order to do so, the DR Requirements must be “testable”; i.e. there must be a clear method of unambiguously demonstrating that each DR Requirement has been met.

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The following sections consider the characteristics of the DR Requirements that are relevant to various stages in the life cycle.

2.1 Generic Product Approval

DR Requirements supporting the generic product approval activities define how the product must be capable of behaving and how it must interface and interact with other systems. They are used to form the product specifications against which the product will be assessed in accordance with the relevant duty holder's processes.

DR Requirements in this area might constrain the "look and feel" of a product in order to support consistent operational experience for the end users either at a national level (e.g. provision of routing information to the driver via the ETCS) or at a duty holder level (e.g. C-DAS HMI configuration). The DR Requirements in this area include the applicable principles that the system must abide by in order to support safety, reliability and performance objectives, for example, the interlocking principles, or for C-DAS, the rules governing when the display must be suppressed, or for TMS, the criteria to be used to determine that the plan needs to be refreshed.

DR Requirements specifying interfaces between systems, sub-systems or enabling systems are also relevant at this stage and may ultimately be expressed as Form, Fit and Functional Interface Specifications (FFFIS) to enable system elements from different suppliers to be used on a "plug and play" basis. However, the work currently being undertaken by the SR&I team is unlikely to be able to progress beyond Functional Interface Specifications (FIS) taking account of the time available and the current maturity of the interface requirements.

The achievement of functional DR Requirements in this area may be demonstrated through the use of Operational Test Scenarios (OTSS) and the testing of the product against reference systems in a Systems Integration Laboratory or Test Yard environment.

The ETCS Trackside Sub-system Requirements Specification [R13] contains a number of requirements categorised as being "generic product" that align to this stage of the life cycle and it is envisaged that a similar categorisation could be applied to the ETCS Onboard Sub-System Requirements documented in the relevant Rail Industry Standards (RISs) [R14] and [R15] as well as the specifications for other digital CCS systems.

The target audience for these DR Requirements are those specifying, designing and approving generic products.

2.2 Deployment Specification

DR Requirements associated with this life cycle stage cover the processes to determine the needs of the particular deployment and should typically be delivered at the outset of a project to inform the subsequent design processes. Information specifications, setting out what information must be captured and to what degree of accuracy, might emerge as a result of this.

The outputs of the processes undertaken at this stage within a deployment project may determine which DR Requirements are relevant to the deployment in question at a later stage.

The target audience for these DR Requirements are those specifying deployment projects.

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2.3 Deployment Design

DR Requirements relevant to the deployment design stage enable the configuration of the approved generic products to meet the specific needs of the deployment project in question.

This could include design rules and constraints on the application design; for example in the ETCS Trackside Sub-System Requirements, identifying constraints on balise positioning in order to manage the Train Position Confidence Interval within specified limits on the approach to a particular infrastructure feature.

The target audience for these DR Requirements are those designing and approving deployment projects.

2.4 Deployment Readiness

DR Requirements associated with this life cycle stage set out the processes by which the railway is prepared for the implementation of the digital CCS systems. This includes aspects such as:

- Railway system integration – integrating the digital CCS systems into the wider railway system context
- Operational readiness – preparing new procedures and training operational personnel in their use
- Maintenance readiness – training maintenance personnel on the new equipment and agreeing asset accountabilities
- Equipment installation
- Testing, approvals and authorisations processes

The target audience for these DR Requirements are deployment project teams, their suppliers, the duty holders who will operate and maintain the digital CCS systems in service and those involved in authorising the commencement of service use of the digital CCS systems.

2.5 In Service Management

DR Requirements associated with this life cycle stage set out the processes for maintaining and updating the digital CCS systems once they are in service. This will include managing compatibility of systems on a continuing basis, configuration management, etc.

The target audience for these DR Requirements are the duty holders responsible for managing the digital CCS systems in service.

3. Structure of DR Requirements Suite

This section provides an overview of how it is envisaged that the DR Requirements suite will be structured. Elements of this are already populated as will be discussed in section 4.

The Introduction to the Requirements Structure document [RD1] envisages that DR Requirements exist at both the DR SoS and individual digital CCS system levels. Each digital CCS system will be further decomposed into a set of sub-systems for which DR Requirements will also exist.

The DR Requirements will be presented in a series of Requirements Specifications, following a similar format to the existing suite of DR Requirements for ETCS.

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The DR Requirements will include requirements that need to be exported to interfacing systems (outside of the DR SoS) in order to enable the digital CCS systems to deliver their intended benefits, including safety and security.

3.1 DR SoS

There will be a DR Requirements Specification for the DR SoS for those DR Requirements for the DR SoS which are not specific to interfaces, supported by Interface Specifications for each of the interfaces required by the DR SoS architecture. This arrangement will support the aspiration for the Interface Specifications to achieve FFFIS status in due course.

3.2 ETCS

There will be an ETCS System level DR Requirements Specification containing requirements that are applicable to the whole of the ETCS as an integrated system. It will be supported by Sub-system level DR Requirements Specifications for the following sub-systems of ETCS:

- Onboard (split into two separate documents covering retrofitting to existing trains and new build trains)¹
- Trackside
- Telecommunications
- Operational

3.3 TMS

There will be a System level DR Requirements Specification containing requirements that are applicable to the whole of the TMS as a single system. It will be supported by Sub-system level DR Requirements Specifications for the following sub-systems of TMS:

- Control Layer
- Planning Layer
- Telecommunications
- Operational

3.4 C-DAS

There will be a System level DR Requirements Specification containing requirements that are applicable to the whole of the C-DAS as an integrated system. It will be supported by Sub-system level DR Requirements Specifications for the following sub-systems of C-DAS:

- Railway Undertaking (RU)
- Infrastructure Manager (IM)
- Operational
- Exported requirements

¹ The need for separate DR Requirements Specifications for the ETCS Onboard sub-system has been superseded by the publication of two equivalent Rail Industry Standards by RSSB as discussed in section 4.2.

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Additionally, the interface between the IM and RU sub-systems is defined by a RIS, RIS-0711-CCS [RI13] which has been drafted by the Rail Safety and Standards Board (RSSB) in collaboration with the SR&I team and is scheduled for publication in December 2018.

The opportunity to eliminate the C-DAS Exported Requirements Specification by inclusion of the relevant requirements in other elements of the overall DR Requirements suite (e.g. at the DR SoS level) will be explored.

4. Current Status

This section sets out details of the current status of existing DR Requirements and provides an overview of how they were elicited.

It is recognised that, as a consequence of the way in which the industry has developed the digital CCS systems in the past, the existing Requirements Specifications contain requirements that are relevant to the DR SoS and also requirements that are relevant only to system configurations that are outside the scope of the DR SoS (for example ETCS Level 2 overlay). In order to protect the industry's investment in the DR Requirements which are outside the scope of the DR SoS, they will continue to exist within the appropriate Requirements Specifications when these documents are modified by the SR&I team.

Any deployment project looking to deviate from the DR SoS architecture and use the DR Requirements relevant to the other configurations will need to assure themselves that the requirements specific to the other configurations are complete and accurate. Any deployment project in this situation is advised to contact the DRSA for further guidance in this regard.

4.1 DR SoS

There are no pre-existing DR Requirements for the DR SoS. However, the withdrawn Interface Description Document [RI22], which was developed through consultation with the subject matter experts for each of the digital CCS systems, contains relevant material regarding message flows required at system interfaces which will be extracted and further developed to form part of the DR Requirements for the DR SoS.

4.2 ETCS

The existing ETCS System and Sub-System Requirements, which become the DR Requirements for ETCS, are a mature suite which was formally endorsed by the GB rail industry in 2017 following industry consultation processes administered by the former ERTMS Systems Body (ESB). This suite is subject to configuration control as a result. The requirements are contained within [RI2], [RI3], [RI6], [RI7], [RI14] and [RI15]. The latter two of these are RISs which were created by RSSB from earlier ETCS Onboard Sub-System Requirements Specifications, [RI4] and [RI5].

These requirements were derived from a range of sources including a reference design process, the requirements used for the Cambrian ETCS Early Deployment Scheme and systems engineering best practice. OTSs are being generated in response to some of the requirements and they will form part of the Acceptance Criteria to be used by duty holder product approval processes and deployment projects.

Whilst these requirements are a mature suite a number of areas have emerged since 2017 where it is evident that further work is required. These include:

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- Interlocking functionality was not within the scope of the ETCS System Definition when the System Requirements for ETCS were first developed but is now within the scope of the ETCS Trackside System Definition [RD8] and, therefore, DR Requirements for the ETCS Trackside Sub-system need to be developed in this area
- Reflecting the development of the OTS which has identified areas for improvement in the existing DR Requirements for ETCS

In addition to covering the ETCS Level 2 without signals configuration required for the DR SoS, the existing DR Requirements suite for ETCS also includes, or is being currently amended by other projects outside of the SR&I team, to provide requirements relating to the following configurations which are outside the scope of the DR SoS:

- ETCS Level 2 overlay
- ETCS Hybrid Level 3 without signals
- ETCS Hybrid Level 3 overlay
- Interfaces to Automatic Train Operation (ATO)

No alterations will be made to (and no linking to the Customer Requirements will be identified for) the requirements that are specific to the above-listed configurations by the SR&I team in the context of the DR SoS remit and they will remain in the Requirements Specifications when re-published, subject to any changes made by other projects.

There is also an existing specification, the ETCS-Ready Onboard Sub-System Requirements Specification [RI23], which details the requirements for preparing a train for the fitment of ETCS at a later date. Whilst not part of the core ETCS DR Requirements suite, this document is complementary to the core suite and may also require revision to maintain alignment and address emerging issues.

4.3 TMS

An interim DR TMS Requirements Specification [RI8], documenting DR Requirements for the integrated TMS configuration exists at a relatively immature state and there is a partially completed integrated TMS reference design that was intended to assist with maturing these requirements. Neither [RI8] nor the TMS reference design have been through any formal industry assurance or approval process so far. These documents will be used as a starting point for the continuing development of the DR Requirements for TMS. The interim DR TMS Requirements Specification [RI8] will be withdrawn when a more fully developed set of DR Requirements for TMS becomes available.

It is believed that a proportion of the content of the existing interim DR TMS Requirements Specification belongs, in reality, at the Customer Requirements level.

The requirements within the interim DR TMS Requirements Specification were elicited through a filtering and lessons learnt process on the requirements suites developed for initial TMS deployment projects at Romford, Cardiff and Three Bridges, together with consultation with subject matter experts for TMS and interfacing systems.

4.4 C-DAS

The existing interim DR C-DAS System and Sub-System Requirements, which become the starting point for the DR Requirements for C-DAS, are an incomplete but reasonably mature suite (the primary omission being Operational Sub-System Requirements) and are documented within four specification documents; [RI9], [RI10], [RI11] and [RI12], supported by a draft RIS, RIS-0711-CCS [RI13]. The DR C-DAS Requirements Specifications received an interim process review by the System Requirements Steering Group (SRSG) in

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accordance with the relevant Requirements Management Plan [RD11] in December 2017 but have not completed the full industry assurance and approvals processes. The draft RIS is scheduled for publication in December 2018.

The requirements within these Specifications were elicited through operational scenario workshops, consultation with operational and technical subject matter experts within the GB rail industry and DAS suppliers, building upon the experiences with existing “stand-alone” DAS products across a range of Railway Undertakings. Trials have also been undertaken of some elements of the C-DAS functionality which have contributed to the maturing of the DR Requirements suite for C-DAS.

These specifications will be updated as the DR Requirements for C-DAS are further developed with additional specifications added to the suite as necessary; for example to contain the C-DAS Operational Sub-system DR Requirements.

5. Development Methodology

This section provides an overview of the intended methodology for deriving and confirming completeness of the DR Requirements, i.e. the “how” requirements within the structure shown in Figure 1. The Systems Management Plan [RD4] provides more detail of the engineering management processes that will be applied. There is an existing Requirements Management Plan [RD11] which covers the DR Requirements level material (formerly known as Level B – System, and Level C – Sub-System, Requirements) which may require an update to reflect the current governance arrangements. All the activities described in this section will be led by the SR&I team with the support and engagement of suppliers and deployment projects.

The GB rail industry has expressed a desire for the DR Requirements to transition into standards once they have achieved a suitable level of maturity. This will include the creation or amendment of RISs managed by RSSB. To minimise the overall cost to the industry of this approach it is important the process used to generate the DR Requirements is of equivalent robustness to RSSB’s process as set out in the Railway Group Standards Code [RI20] and Standards Manual [RI21] so that the transition can be accomplished with the minimum of rework. The process should include:

- involvement of appropriate Subject Matter Experts, including representation of affected duty holders, in eliciting DR Requirements
- identification of lessons learnt and good practice from previous deployments of similar systems
- consultation with affected industry stakeholders on the DR Requirements generated (this is covered in section 6 below)

In principle, the same basic considerations apply to the elicitation of DR Requirements for the DR SoS and each digital CCS system within it. However, because of the differing nature and maturity of the existing requirements, the level of activity required varies. Section 5.1 focuses on the common themes across all elements and section 5.2 considers the specific issues and activities associated with particular elements.

5.1 General

5.1.1. Requirement Attribution within the Requirements Structure

One of the key considerations in migrating the existing material into the requirements structure for DR is ensuring that the attribution is appropriate – essentially, ensuring that each requirement is sitting in the appropriate place in the structure for its intended purpose (e.g.

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whether it is a “what” or a “how” requirement). A review will be undertaken by Subject Matter Experts familiar with the requirements structure and the existing Customer and DR Requirements Specifications to ensure that all the requirements that are necessary to support the outcomes identified in section 1.1 are correctly located within the DR Requirements suite. This may result in requirements transferring between the Customer and DR Requirements suites.

The requirements attribution activity must respect the safety hazard analysis work such that linkages to appropriate risk controls are maintained.

Appendix A of this document contains further guidance on the characteristics of DR Requirements through the examination of a number of candidate requirements; this is intended to assist the levelling process and the drafting of any new or amended requirements. The principal considerations for whether a particular requirement is a DR Requirement is whether it is necessary to support the achievement of the outcomes identified in section 1.1 and whether it expresses how something should be done.

In addition, [RD1] contains examples of requirements from each element within the structure depicted in Figure 1 associated with a particular element of system functionality to guide this activity.

5.1.2. Requirements Traceability within the DR Requirements Structure

Alongside the attribution activity, it will be necessary to provide traceability from the DR Requirements to the Customer Requirements. This will be achieved by identifying the linkages between each suite. Traceability will also be provided between the Sub-system level requirements and their parent System level requirements within each suite. It is anticipated that this will assist with confirming completeness both of the attribution activity and of each Requirements Specifications. There is the potential for new requirements to be introduced to both the Customer and DR Requirements as part of this activity.

The examples in [RD1] provide further guidance on appropriate linking of requirements to support this activity.

5.1.3. Functional Apportionment

The SR&I team has used enterprise architecture techniques to model the changes to overall railway functionality introduced by the DR SoS based on the DR Concept of Operations [RI18]. As part of this exercise the functionality required has been apportioned across the digital CCS systems. This apportionment is expressed through the DR Basis of Design document [RI19] and also determines what information must be imported by the DR SoS from external systems and what information is exported from the DR SoS to external systems. This apportionment may differ from the assumptions made in previous projects when the digital CCS systems were being developed independently. Consequently, there is a need to review and align the existing DR Requirements for each digital CCS system with the functionality which has been apportioned to the relevant system. There is, for example, no reason for there to be DR Requirements that constrain the way in which C-DAS performs a particular function if it has been determined that the function in question will be performed by TMS instead.

The enterprise architecture model may be further developed to support the derivation of the DR Requirements, particularly for the DR SoS.

Deployment projects seeking to deviate from the DR SoS architecture will need to consider how any functions that they require which are apportioned in the DR SoS to a digital CCS

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system that the deployment project is not providing will be implemented through other means. Similar considerations apply to using alternative configurations of a digital CCS system to that which is provided for within the DR SoS.

5.1.4. Safety Hazard Analysis

Each of the digital CCS systems has been subject to some degree of safety hazard analysis in accordance with the Common Safety Method for Risk Evaluation and Acceptance (CSM-REA) [RI16], as amended [RI17], in the derivation of the existing DR Requirements material; however, this was usually undertaken in the context of integrating that particular digital CCS system on a stand-alone basis into the wider railway system. More recently, the SR&I assurance team has focused on performing safety hazard analysis of the DR SoS as an integrated system, using the information from the individual digital CCS systems as a source of historic data.

The activities led by the SR&I team on the safety hazard analysis of the DR SoS will continue as necessary to reflect the developing requirements suites, particularly when any areas of functionality not previously considered are explored. This process may result in the identification of additional DR Requirements, amendments to the same, or the identification of existing DR Requirements as being Safety Requirements.

Safety hazard analysis work is expected to involve workshops with Subject Matter Experts appropriate for the topic under discussion from across the GB rail industry.

5.1.5. Lessons Learnt and Continuous Improvement

The DRP is keen to ensure that the DR Requirements are as well developed as possible and, to that end, will seek feedback on lessons learnt, good practice and areas of concern from:

- users of the existing DR Requirements suites
- projects deploying digital CCS systems both in GB and abroad
- suppliers developing digital CCS system products

This feedback will be used to facilitate the development and continuing improvement of the DR Requirements.

Once a baseline set of the DR Requirements has been established, the formal route for interested parties to highlight challenges and issues is through the DRSA Issues Management process, where the issues raised will be managed in accordance with the DRSA Issues Management Plan [RD13].

The SR&I team also intends to promote informal dialogue with users of the baseline set of DR Requirements which may assist with addressing minor issues and facilitate the expeditious resolution of issues that are submitted formally through the DRSA Issues Management process by enabling timely engagement with relevant Subject Matter Experts.

5.1.6. Supplier Engagement

Wherever possible during the development of the DR Requirements, the SR&I team will seek to involve suppliers and deployment project teams in the activities being undertaken to help ensure that the DR Requirements proposed are readily interpretable, proportionate, deliverable and do not unnecessarily constrain the potential for innovation. The DRP has received useful feedback in this regard through the Early Contractor Involvement (ECI) work streams and is seeking to build upon this. Ultimately, there is the potential for a collaborative

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approach to developing the DR Requirements between the SR&I team and the suppliers within the engineering management framework provided by this document, the System Management Plan [RD4] and DR Requirements Management Plan [RD11].

This engagement will be enabled through the initial deployment project contracts and thus the specific activities in which the suppliers are engaged will depend upon the degree of alignment between the deployment project procurement activities and the DR Requirements development programme. Alternatively, problem statements may be raised through the Joint Development Group (JDG) if a particular need for supplier input is identified that cannot be met through the deployment project route.

Supplier engagement will be facilitated by the DR deployment projects working with the SR&I team.

5.1.7. Consolidation of Requirements within each Level

Where requirements have been generated from multiple parallel sources, such as a reference design process involving parallel work streams on different topic areas, experience has shown the benefit of a consolidation exercise as a way of reducing a number of similar requirements into a smaller and, thus, more efficient overall set, and enabling the identification and elimination of inconsistency within the set. Where DR Requirements have been generated through multiple parallel sources and have not been consolidated previously, this approach will be adopted as part of finalising the proposed requirements suites.

Consolidation exercises will involve workshops with GB rail industry Subject Matter Experts appropriate for the topic under discussion.

5.1.8. Derivation of Acceptance Criteria for DR Requirements

Acceptance Criteria need to be established for each DR Requirement, as highlighted in [RD1] so that the users of the requirement in question understand what needs to be done to verify that the requirement has been correctly satisfied. A degree of confidence in the accuracy of the requirements is necessary to make it worth investing effort in establishing the Acceptance Criteria, but it is also recognised that prompt delivery will support deployment project tendering activities since the nature of the Acceptance Criteria (e.g. “test”, “demonstration” or “inspection”) could influence cost considerations. Therefore, the derivation of Acceptance Criteria will be undertaken on a progressive basis as the DR Requirements suites mature so that the time between the DR Requirements becoming available and the Acceptance Criteria for them becoming available is minimised.

The level of detail required to be demonstrated in response to the Acceptance Criteria for the DR Requirements (and thus the complexity of the Acceptance Criteria themselves) will be proportionate to the risks involved if the associated requirement were not correctly satisfied.

Where detailed Acceptance Criteria are needed for the DR Requirements, such as the OTSs for the ETCS, a greater level of effort will be needed to generate the Acceptance Criteria, but the intention to express them as a particular type of Acceptance Criteria (for example, detailed tests in the case of those requirements which will have associated OTS) can be identified at an early stage to assist with the tendering activity.

The Acceptance Criteria for the DR Requirements will be documented in Verification and Validation matrices which reference out to supporting documentation, for example the OTS, where appropriate due to the complexity of the Acceptance Criteria.

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Appendix A contains guidance on potential Acceptance Criteria for the example DR Requirements illustrated.

5.1.9. Assurance

Those accepting the DR Requirements, through the governance processes described in section 6, will need to be confident that the DR Requirements have been generated in accordance with a robust process by competent personnel. The assurance arrangements to provide this confidence are documented in the System Assurance Plan [RD14].

5.2 System-Specific Activities

The following sections describe the system-specific activities that need to be undertaken to bring each suite of DR Requirements to a common degree of maturity and completeness, given the differing starting points for each suite.

5.2.1. DR SoS

The expectation is that the DR Requirements for DR SoS will comprise mainly interface, non-functional, process and operational requirements.

The Interface Requirements Specification [RD6], as the parent document at the Customer Requirements level, will be used, together with the System of Systems Architecture [RD3] and the withdrawn Interface Description Document [RI22], as the starting point for the DR Interface Requirements element, which will be developed in consultation with relevant technical specialists for the affected systems within and outside of the DR SoS boundary. Human interfaces will be primarily identified through the Basis of Design [RI19] supported by the DR Operations team. These requirements are expected to be largely about defining the information that must flow between systems, the means by which the information is exchanged and, potentially, the format and structure of the message flows; there will thus be a need for engagement with data specialists within DR and the wider industry. The DR Interface Requirements will form the basis of the FIS discussed in section 2.1 and may ultimately be developed into FFFIS at a later date.

The development of non-functional DR Requirements within individual digital CCS systems may identify common themes that could potentially enable a consolidation of the non-functional requirements at the DR SoS level. However, in doing so, it is important to ensure that responsibilities, particularly in relation to performance targets, are not unexpectedly transferred between duty holders and onboard performance targets should not be consolidated with infrastructure ones. They will also arise from consideration of DR SoS level documentation, including Management Plans for non-functional areas (e.g. Human Factors, Configuration Management, etc.)

The operational requirements will be informed by the Operational Readiness work stream within DR, which is presently deriving Customer Requirements, and by common themes emerging across the Operational Sub-systems of individual digital CCS systems.

5.2.2. ETCS

As the DR Requirements for ETCS (documented in [RI2], [RI3], [RI6], [RI7], [RI14], [RI15] and [RI23]) are an existing mature set, the focus here is on the management of change rather than making a significant effort to derive “new” requirements (although some new

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requirements may emerge as the work streams progress). Known areas of technical change in addition to the common activities described in section 5.1, include:

- a) Integration of the ETCS with the other digital CCS systems within the DR SoS
- b) Inclusion of interlocking-related DR Requirements (where different from current practice, reflecting the wider system boundary for the ETCS Trackside sub-system covered by the DR SoS architecture)
- c) Addressing of residual open points identified in the DR Requirements Specifications for ETCS
- d) Addressing of the outcomes of operational scenario workshops, including the following open points:
 - o The potential to use a “zero temporary speed restriction” to protect an obstruction or portion of line,
 - o The potential for the signaller to use Radio Block Centre data to confirm that the line is clear during degraded mode working without the need to examine the line,
 - o Whether an on-sight movement authority can be maintained when proving of level crossing equipment is lost after the movement authority has been issued,
 - o The interaction of ETCS and ground frames,
 - o The potential to use ETCS train position reports to populate train describer information,
 - o Operation of snow ploughs and other situations where a vehicle needs to be propelled by an ETCS-fitted traction unit.
- e) Reflection of the outcomes of OTS development where this identifies that the existing DR Requirements for ETCS are sub-optimal
- f) Addressing of feedback from early deployments of the requirements (both ETCS Onboard and infrastructure projects)
- g) Incorporation of feedback from suppliers on the maturity, complexity and development risk of the requirements gained through the ECI and JDG work streams and deployment projects
- h) Incorporation of learning derived from GB engagement in European forums and from lessons learnt arising from deployments in other countries
- i) Development of application design requirements to support ETCS trackside scheme design activities
- j) Incorporation of feedback from RSSB on the conversion of [R14] and [R15] into RISs

In addition, outside the scope of the DR SoS and the SR&I team, other projects are making the following changes to the DR Requirements for ETCS and the SR&I team will need to engage with the other projects to ensure that the changes being made by the different parties are appropriately co-ordinated:

- Incorporation of Hybrid Level 3
- Incorporation of enablers for ATO

All the above changes, whether initiated by the SR&I team or other projects, need to be made through the change control process set out in [RD11] given that they impact an existing baselined requirements suite. This is discussed further in section 6.4.

In addition, the ETCS reference design requires updating to remain aligned with both the requirements suite and OTS. The ETCS reference design will feed into the generation of the ETCS Deployment Guide. The topic documents comprising the ETCS reference design are listed in [R12].

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5.2.3. TMS

The existing DR Requirements for TMS and the TMS reference design are based on the integrated configuration. One of the first activities to be undertaken moving forwards will be to transition to the interfaced configuration now required by apportioning functionality between the Control and Planning layers, and determining which interfaces with other systems are managed by which layer. This will then enable the DR Requirements for the interfaced TMS to be further developed, including for the interface between the Control and Planning layers.

Work on the TMS reference design will be restarted to provide a vehicle for completing the elicitation of the DR Requirements for the TMS. In setting out what the TMS must achieve, the TMS Customer Requirements will form input to this process that is comparable to the expression of the “User Needs” in the ETCS reference design. The completed TMS reference design will feed into the generation of the TMS Deployment Guide.

The TMS reference design process would involve engagement with appropriate Subject Matter Experts from the Infrastructure Manager signalling and control operations functions and Railway Undertaking control operations function.

As the operators of a TMS will be less likely to move between differing TMS deployments than drivers of trains are to experience operation over different ETCS Trackside deployments it is anticipated that there will be a reduced need for prescription in the DR Requirements for TMS compared to those for ETCS in order to achieve the consistency of operational experience outcome identified in section 1.1. For example, the use of colours for indications may be constrained to avoid the risk of mis-interpretation but the sequence of operations needed to perform a particular task may not be (whereas in ETCS, both may have been constrained).

It is expected that the DR Requirements for TMS will cover constraints on areas including:

- 1) interface requirements to other systems (including operational processes) to support safe and efficient operation in normal, degraded and emergency situations and also when business continuity measures have been invoked due to impairment of the normal control location
- 2) functional requirements where consistency is important in normal, degraded and emergency situations and also when business continuity measures have been invoked due to impairment of the normal control location
- 3) non-functional performance, reliability, availability, maintainability and safety requirements
- 4) considerations for business continuity and security
- 5) ergonomic issues, particularly for those TMS users engaged in safety critical tasks

5.2.4. C-DAS

There are a number of known areas that require further work to ensure that the DR Requirements suite for C-DAS (currently documented in [R19], [R110], [R111], [R112] and [R113]) is developed to a position where a first baseline can be achieved. In particular this includes:

- Integration of the C-DAS with the other digital CCS systems within the DR SoS
- Generating Operational Sub-system Requirements
- Resolving open points
- Determining solutions to close residual open hazards (this will require an additional hazard workshop)

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It is expected that the DR Requirements for C-DAS will cover similar areas to those listed in section 5.2.3 regarding the TMS (albeit that there may be limited need to consider the business continuity aspect).

6. Governance Arrangements for Generic DR Requirements

6.1 Governance Objectives

The purpose of the governance process is to ensure that the GB rail industry, in particular the duty holders within it, is satisfied that the DR Requirements proposed are appropriate, and will be effective in achieving the objectives of producing consistent inter- and intra-operable solutions across the GB railway network that can be effectively managed throughout their life cycle.

The DRSA thus has a key role in providing the governance framework for the DR Requirements.

This section provides an overview of key stages in the governance arrangements; more detailed descriptions will be captured in the relevant DRSA documentation as it is developed (for example the Issues Management Plan [RD13]) and the DR Requirements Management Plan [RD11]².

6.2 Initial Endorsement

Note that this section does not apply to the suite of DR Requirements Specifications for ETCS ([RI2], [RI3], [RI6], [RI7], [RI14], [RI15] and [RI23]) which has already progressed beyond this stage and is administered in accordance with section 6.4.

Each DR Requirements Specification will enter the governance process only when there is sufficient assurance evidence, in accordance with the System Assurance Plan [RD14], to satisfy the SR&I team that it has reached an appropriate level of maturity.

The first stage of the governance process is a process and content review by the DRSA's Requirements, Issues and Configuration Management Working Group (RICMWG). The RICMWG involves stakeholder representatives from across the GB rail industry and is thus representative of the users of the DR Requirements Specifications. This review is undertaken in accordance with the RICMWG's Terms of Reference (currently in draft format as [RD5]) to determine that the DR Requirements Specifications presented have been generated in accordance with robust processes which are set out in the DRR Requirements Management Plan [RD11], System Management Plan [RD4] and System Assurance Plan [RD14], have been appropriately and sufficiently consulted with stakeholders, and are of an appropriate level of detail and accurate to support the achievement of the outcomes set out in section 1.1.

The RICMWG review will assess whether the Requirements Specifications presented are ready for wider industry review and recommend the level at which that wider industry review should take place, the options for this being:

- a) Category 1 – Requirements Specifications to be considered by RICMWG members without wider industry consultation

² See assumption 1 regarding the current status of the DR Requirements Management Plan in respect of the governance arrangements.

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- b) Category 2 – Requirements Specifications to be considered by RICMWG members following consultation with selected industry stakeholders
- c) Category 3 – Requirements Specifications that require full industry consultation

The duration of any industry review will normally be 28 calendar days, but this may be varied in either direction by the RICMWG, depending on the volume and complexity of the DR Requirements Specifications in question.

Following the conclusion of any industry review period, the SR&I team will collate and address all comments received. The updated DR Requirements Specifications, together with the results of the industry review process, will be submitted to the RICMWG which will then make a recommendation as to whether the DR Requirements Specifications should be endorsed to the DR Chief Systems Engineer.

6.3 Initiators of Change

A desire for change may be identified by any stakeholder across the rail industry working with, or affected by, the DR Requirements. This may arise from a range of sources including:

- Practical experience from deployment projects and suppliers working with the DR Requirements
- Emerging themes within Deployment-specific DR Requirements suggesting gaps in the generic DR Requirements
- Lessons learnt and benchmarking with other railway administrations
- Incorporation of other digital CCS system configurations or combined architectures

Thus, the cycle of continuous improvement of the DR Requirements will be perpetuated following their initial endorsement.

The DRSA's Issues Management process, documented in [RD13], is the mechanism by which a stakeholder will initiate a formal request for change.

6.4 Governance of Change

All requests for change to the baseline sets of DR Requirements will be progressed through the DRSA Issues Management process, documented in [RD13] in the first instance to determine whether they are valid changes. Once the need for change has been agreed, the Requirements Change Control process in [RD11] will be followed. The latter process uses Change Request forms as the vehicle to document the proposed changes, the analysis of the impact of the changes and the approval of the changes.

These processes apply both to the introduction of new DR Requirements as well as amendments to, or deletions of, existing ones.

The objectives of these processes are to ensure that:

- any changes made preserve the ability of the DR Requirements to produce consistent inter- and intra-operable solutions across the GB railway network that can be effectively managed throughout their life cycle.
- the impact of changes on deployment projects using an earlier version of the DR Requirements are understood and mitigation measures implemented where appropriate.
- the impact of changes on other requirements (e.g. the Customer Requirements) and other documentation (e.g. the Deployment Guides) are understood and consequential changes initiated where appropriate.

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Change Requests relating to typographical changes/corrections only may be approved by a competent individual who has been granted delegated authority from the RICMWG to do so.

All other Change Requests will be considered and, if satisfactory, the RICMWG will recommend them to the DR Chief Systems Engineer for endorsement.

Once a Change Request has been approved, it will be reflected in the requirements database and will be incorporated into the next release of the relevant DR Requirements Specification. The RICMWG may recommend how rapidly an update to the relevant DR Requirements Specification is to be published.

The publication of updated DR Requirements Specifications needs to be communicated to affected parties, in particular deployment projects using, or planning to use, earlier versions of the DR Requirements Specifications concerned.

In addition, individual deployment projects may need to be informed of approved Change Requests against the DR Requirements in advance of updated DR Requirements Specifications being published where there is an urgent need for them to consider implementing the change; for example, to address an identified safety issue. The RICMWG will identify where this is the case and recommend that the approved Change Request is communicated to the affected deployment projects.

Communication with the affected deployment projects in relation to the publication of updated DR Requirements Specifications or approved Change Requests will be undertaken in accordance with the DRP Configuration Management Plan [RD16].

6.5 Deviating from Generic DR Requirements

The need for a particular deployment project to identify the generic DR Requirements relevant to it is explained in [RD1]. Whilst some of the DR Requirements are identified as “application-specific” or “preferred”, the purpose of this labelling is to assist with the process of identifying which requirements are relevant to a particular deployment and once the relevant requirements have been identified for a deployment they effectively become normative for that deployment to ensure that the objectives of inter- and intra-operability and effective life cycle management are realised.

During the period that the relevant DR Requirements remain outside the industry standards framework, should a deployment project identify a need, or have a desire, to deviate from a relevant generic DR Requirement, they need to highlight the issue to the Technical Authority for the duty holder responsible for the affected element of the deployment project. Where the Technical Authority for the relevant duty holder considers that the deviation has the potential to impact on elements of the system outside of their jurisdiction then they shall escalate it to the DRSA through the DRSA Issues Management process, documented in [RD13]. Deviation requests escalated to the DRSA will be managed through the RICMWG and will be assessed to determine that they do not adversely impact the potential to achieve the objectives of inter- and intra-operability and effective life cycle management, once any proposed mitigation measures are taken into account.

If a deployment project identifies a desire to deviate from a DR Requirement that specifies compliance with another standard, such as a RIS, then the project should continue to raise the issue with the Technical Authority for the relevant duty holder in the first instance to obtain their support prior to seeking a deviation against the referenced standard. Where the Technical Authority for the relevant duty holder considers that the deviation has the potential to impact on elements of the system outside their jurisdiction then they shall escalate it to the DRSA through the DRSA Issues Management process to obtain the support of the DRSA prior to the deployment project seeking a deviation against the referenced standard. The

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deployment project should not apply for a deviation against the mandated standard without the support of the Technical Authority for the relevant duty holder (and the DRSA where they are involved).

Where a request to deviate from the generic DR Requirements identifies an issue that is likely to be repeated across multiple deployment projects the preference is for the generic DR Requirements suite to be amended to cater for the issue rather than grant individual deviations to multiple deployment projects over time.

Once the relevant DR Requirements have transitioned into the industry standards framework, as discussed in the next section, deviations will be managed through the deviation process applicable to the standard in which the relevant requirement resides. There will continue to be a role for the DRSA in this process to ensure that system compatibility issues are appropriately considered in the deviation process.

6.6 Transition into Standards

The GB rail industry has expressed a desire for all of the generic DR Requirements to transition into standards once they have achieved a suitable level of maturity. This process has already commenced in the case of the ETCS Onboard Sub-System Requirements, [R14] and [R15], which were published as RISs, [R114] and [R115], by the RSSB in September 2018.

In accordance with the CSM-REA, [R116] and [R117], the DR Requirements for the component digital CCS systems will primarily have been assessed using the Explicit Risk Estimation (ERE) Risk Acceptance Principle (RAP) prior to their approval for use. The use of the ERE RAP reflects the novelty of the systems being developed.

It is expected that, when using the DR Requirements, initial deployments will still need to adopt the ERE RAP in relation to hazards which are mitigated through the application of the DR Requirements; this will help to demonstrate that the compliance approach is acceptance, support the justification that the generic requirements are fit for purpose and reflects the shortage of practical experience in their successful application. As time progresses and evidence of the successful application of the DR Requirements on the initial deployments grows, subsequent deployment projects will be able to use the Similar Reference System (SRS) RAP in relation to hazards which are mitigated through application of the DR Requirements.

In due course, sufficient evidence of the successful application of the DR Requirements across a range of deployments will exist to enable the use of the Code of Practice (COP) RAP in relation to hazards which are mitigated through application of the DR Requirements. Ideally, this is the point at which the DR Requirements should be transferred into standards, but it is recognised that there may be an industry desire to transfer them at an earlier stage given that it may take several years for sufficient evidence to accrue to enable the DR Requirements to be considered as a COP in CSM-REA terms.

The GB rail industry standards framework contains a number of categories of standard as follows:

- Railway Group Standards, containing National Technical Rules and National Safety Rules as defined by the Technical Specifications for Interoperability. These are managed by the RSSB.
- Rail Industry Standards, containing requirements that the rail industry has collectively agreed represent best practice and which duty holders are encouraged to adopt, where relevant, as part of their Safety Management Systems. These RISs are managed by the RSSB.

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- Duty holder company standards (e.g. Network Rail company standards), containing requirements which a duty holder has decided to implement for activities and assets within its business. These are managed by the duty holder concerned.

It is anticipated that the DR Requirements will largely be transferred into RISs, although some elements specific to the Infrastructure Manager's domain may become duty holder company standards for Network Rail. There may also be material that could transfer into duty holder company standards owned by Railway Undertakings.

There are two potential approaches to managing the transfer of the DR Requirements for a particular digital CCS system to standards:

- Complete suite transferring at the same time
- Individual requirements specifications transferring independently

The first approach facilitates the continued management of the DR Requirements for a digital CCS system in a consistent way, prior to and following their transfer into standards, thereby minimising the risk of divergence of requirements being managed under different industry change processes. However, it does potentially "hold back" mature requirements for one element of the digital CCS system from becoming standards whilst the rest of the suite develops to the same degree of maturity.

The second approach is that adopted in respect of the ETCS Onboard Sub-System Requirements being transferred into RISs whilst the remainder of the suite of DR Requirements for ETCS has remained fully under the control of the DRSA. This does, however, create the risk of divergence of requirements being managed under different industry change processes.

As the DR Requirements mature and experience is gained of the "pilot" arrangements with the ETCS Onboard Sub-System Requirements, the industry, through the RICMWG, will need to consider which approach to adopt for each suite of DR Requirements and when to start the transfer process for each suite of DR Requirements.

In addition to transferring the DR Requirements into the industry standards framework, there will be a need to modify or withdraw existing standards to ensure that there is no duplication or contradiction between existing standards content and the new standards content arising from the DR Requirements. This change activity on the existing standards will need to be aligned to the introduction of the DR Requirements into the industry standards framework.

When DR Requirements are to be transferred into RSSB-managed standards they will need to be accompanied by a suitable evidence pack to provide assurance that the processes for the elicitation, industry consultation and endorsement have been completed to a level which enables the RSSB Standards Committees to accept the material with minimal further work.

7. Governance Arrangements for Deployment-Specific DR Requirements

There is a need to ensure that any deployment-specific DR Requirements, generated by a specific deployment project, do not compromise achievement of the objectives of the generic DR Requirements either within the deployment project concerned or within other deployment projects. It is, therefore, envisaged that deployment projects will need to seek the approval of the DRSA for all deployment-specific DR Requirements. The DRSA Issues Management process in [RD13] is the mechanism through which deployment projects should seek this approval.

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To ensure that no deployment-specific DR Requirements are overlooked it is suggested that all projects should be required to make a submission through the Issues Management process, even if this is to confirm that they have no deployment-specific DR Requirements.

It is important that the organisations managing the generic DR Requirements documentation are aware of the deployment-specific DR Requirements being generated so that they can monitor trends and identify potential shortcomings in the generic DR Requirements or Deployment Guides that might warrant changes to these documents. The DRSA should, therefore, share the deployment-specific DR Requirements which have been approved through the Issues Management process with the organisations managing the generic DR Requirements documentation to enable this continuous improvement activity to take place. This could be achieved by maintaining a central repository for all such requirements to which the relevant parties have access.

8. Milestones and Dependencies

This section identifies the key milestones and timeline considerations in relation to the activities set out in sections 5 and 6.

An interim set of DR Requirements for Interfaced TMS is required by the end of November 2018.

Sets of DR Requirements for SoS, Interfaced TMS and C-DAS are required to have achieved their first industry approved baseline, in accordance with section 6.2, by the end of March 2019.

The DR Requirements for ETCS are required to have completed the change control process, in accordance with section 6.4, to align with the DR SoS by the end of March 2019.

The RICMWG meets on a 4-weekly basis and all items for consideration at a particular meeting must be with the RICMWG secretary no later than two weeks prior to the meeting date for inclusion on the agenda.

The normal duration for a category 3 industry review is 4 weeks.

The scheduling and sequencing of the individual activities within section 5 should take account of the level of impact each activity will have across the DR Requirements suite as a whole and also the potential to impact on other sets of requirements such as the DR Customer Requirements. It is recommended, for example, that the attribution and apportionment activities are undertaken at an early stage to enable the sub-teams working on the DR Requirements for each digital CCS system to proceed with confidence. Activities where supplier involvement will be of particular value should ideally be scheduled to occur once the initial deployment projects have engaged their chosen suppliers.

9. Application of DR Requirements to Deployment Projects

The obligations and constraints (i.e. the equivalent of DR Requirements) which deployment projects working with existing CCS technologies are required to comply with are documented in standards and compliance with these standards is mandated by the Safety Management Systems of the duty holders concerned. Typically, deployment project contract documentation will specify which version of the industry catalogues of standards apply as the baseline for that contract.

As the DR Requirements exist, initially, outside of the industry standards framework, compliance with them is not necessarily explicitly specified in the Safety Management

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Systems of the duty holders concerned. However, compliance will be necessary in order to discharge some of the duty holders' legal obligations.

It is therefore critical that the contracts for each DR deployment project specify that the relevant DR Requirements are complied with and confirm the versions of the DR Requirements Specifications to be employed. To assist with this, the DRSA will generate and maintain a catalogue of these as part of its Configuration Management activities.

The DR deployment projects are responsible, in the first instance, for ensuring that the requirement to comply with the DR Requirements is included in each deployment project contract. Demonstrating that this has been done could form part of taking any deployment-specific DR Requirements through the DRSA governance processes set out in section 7.

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Appendix A EXAMPLE DR REQUIREMENTS

This appendix presents a selection of candidate requirements and considers whether or not they are appropriate as DR Requirements, identifying pertinent characteristics and best practice features of high-quality DR Requirements.

These requirements have been taken from existing requirements suites to act as examples, but identifier details have been replaced with “Example” details to avoid any risk of confusion in the event of the source requirement changing and to simplify referencing in this document.

A.1 Valid DR Requirements

A.1.1 System Level

The limits of shunting movements into an ETCS-fitted area from an unfitted area shall be marked and supervised.

Example 1

Status: Normative

Rationale: A train in Shunting (SH) has a supervised speed but is not issued a Movement Authority. An alternative method is therefore required to constrain the area in which movements may be undertaken.

Guidance: For designed shunt routes (such as into sidings or stabling locations, or for reversing a train onto a line returning in the direction from which it has come), the ETCS provides a ‘Danger for Shunting Information’ packet that can be permanently included in a balise message.

Topics: N1-2

Comment on Example 1

This is a valid DR Requirement as it describes how aspects of shunting movements are to be managed, i.e. it sets out constraints on managing shunting movements. It could potentially be improved to clarify how it is intended that the limit of the movement be marked.

The acceptance criteria associated with this requirement might seek confirmation that for each shunting area of this nature all limits along the railway have been marked (e.g. with a sign) and a train protection system implemented to protect the limit (either by balise message as described in the guidance or Train Protection and Warning System equipment if the movement could be made in Level NTC).

The TMS shall only implement planned line blockages and possessions that have all required approvals and identities

Example 2

Status: Normative

Rationale: So that only blockages and possessions with all correct permissions are enacted.

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Comment on Example 2

This is a valid DR Requirement as it describes a constraint upon the functionality of “implementing planned line blockages and possession” in the sense that “approvals and identities” are required. However, it would benefit from modification to clarify:

- how the provision of “approvals and identities” is to be implemented.
- what “required approvals and identities” are – potentially through the provision of a suitable guidance statement.

The acceptance criteria associated with this requirement might seek confirmation that when tested the TMS would not implement a line blockage that did not possess all of the necessary attributes.

C-DAS shall present information in such a way as to avoid distracting the driver from his/her priority driving tasks.

Example 3

- Status: Normative
- Rationale: Distracting the driver from priority driving tasks could result in hazards being realised.
- Guidance: Distraction could result from:
- High display refresh rates.
 - Brightness levels being unsuitable for the cab environment, or rapid switching between different brightness levels.
 - Overcomplicated or “fussy” display design that increases the time required for drivers to identify and process the presented information.

Comment on Example 3

This is a valid DR Requirement because it is about a constraint on how information is presented by C-DAS.

It is expected that this requirement would be supported by information in the relevant Deployment Guide to expand upon how the issues highlighted in the guidance could be addressed, which could include advice on generating or reviewing the Alarms Management Strategy for the driving cab environment.

The acceptance criteria associated with this requirement might seek an ergonomic assessment of the proposed design solution that confirms that best practice ergonomic design principles have been followed and assesses the distraction risk to be at an acceptable level.

A.1.2 Sub-System Level

The Trackside sub-system shall be designed so that the Train Position Confidence Interval will not exceed 200m when the train is within TSM on approach to a reduction in permissible speed.

Example 4

- Status: Normative
- Rationale: This minimises the early imposition of the target speed on the train.
- Guidance: The worst case values in Subset 041 should be assumed, combined with the relevant value of Q_LOCACC. The length of the TSM area can be assumed to be the relevant distance from Appendix X of GK/RT0075 plus a margin of 220m. Where differential speeds are applied, then all reasonable combinations should be considered.

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Topics: II

Comment on Example 4

This is a valid DR Requirement at the Sub-system level as it describes how the ETCS Trackside Sub-system is to be configured in order to manage the Train Position Confidence Interval on the approach to specific infrastructure features. This constrains aspects of the ETCS Trackside design.

The acceptance criteria associated with this requirement might seek evidence of inspection that the design has met the requirement or a test or demonstration that the required outcome is achieved. This could potentially involve the use of simulation techniques.

A risk assessment shall be undertaken to determine where 'Danger for Shunting Information' packets are to be transmitted. **Example 5**

Status: Application-Specific

Rationale: Shunt moves must be limited to prevent impact on critical assets or conflicting train movements.

Guidance: This is particularly relevant in frequently used shunting areas. A balance needs to be struck between preventing trains from travelling too far and the operational flexibility required for shunting movements.

Topics: G4-1

Comment on Example 5

This is a valid DR Requirement at the Sub-system level as it describes how the ETCS Trackside Sub-system design process is to determine where to provide balises containing particular message packets.

It may be appropriate to consider providing additional information in the ETCS Deployment Guide to support the deployment project in undertaking the risk assessment, for example, by expanding upon the risk factors to be considered. The guidance statement to the requirement itself could potentially be improved by clarifying who is expected to perform the risk assessment and at what stage in the development of the deployment project.

The acceptance criteria associated with this requirement might seek evidence that the risk assessment has been completed and its recommendations implemented in the design.

A.2 Invalid DR Requirements

The TMS shall allow an Area of Control to be assigned to an Operator. **Example 6**

Status: Normative

Rationale: So that an Operator can take control of a portion of the rail network.

Comment on Example 6

This should be a Customer Requirement as it sets out a core element of functionality which the TMS needs to possess in order to satisfy the Concept of Operations and does not describe or constrain how this functionality is achieved. It would benefit from the addition of a guidance statement which highlights the key issues to be considered in implementing this

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function, which might assist in identifying potential DR Requirements (for example around the re-direction of voice communications and other information streams, such as indications and alarms/alerts) that should be associated with this Customer Requirement.

C-DAS shall be capable of displaying other (non-advisory) information identified by the RU as supporting the driving task. **Example 7**

Status: Normative

Rationale: To support the driver in the driving task.

Guidance: Examples of non-advisory information include, but are not limited to:

- a. Current train consist and capability information, for example, displaying the number of cars in a consist to support identification of stopping locations or the train’s maximum permitted speed.
- b. The name of the next station stop or timing point.
- c. The scheduled arrival time at the next station stop or timing point.
- d. The estimated time of arrival at the next station stop or timing point.
- e. The scheduled departure time, and a countdown indication to the scheduled departure time when a train is at a stand in a departure station.
- f. The current estimated train location.
- g. Route look-ahead information, such as approaching stations and/or other timing points, speed limits and start and end locations for Static Speed Profiles and speed restrictions being used by the C-DAS.

Duty holders will be expected to identify detailed requirements relating to non-advisory information for a particular C-DAS application. The selection of which non-advisory information to display may vary according to the service type (passenger or freight).

On ETCS-Fitted trains, if the C-DAS and ETCS DMIs are to be integrated, then the non-advisory information will be constrained by the limitations of the ETCS DMI specification.

Comment on Example 7

This should be a Customer Requirement as it sets out an element of functionality which the C-DAS needs to possess in order to satisfy the Concept of Operations and does not describe or constrain how this functionality is to be achieved. Requirement example 3 is one particular constraint that would apply to the functionality of displaying this non-advisory information.

The guidance statement is considered to be an example of good practice for a Customer Requirement as it highlights issues to be considered and the potential need for associated DR Requirements to constrain the way in which this functionality is provided.

In this instance, there may be a case for deployment-specific DR Requirements as different Railway Undertakings may have different aspirations for the presentation of this information, which could potentially be implemented as part of their C-DAS Onboard solutions without adversely impacting on other systems or parties.

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