

Digital Railway Requirements – C-DAS Infrastructure Manager Subsystem

Prepared by:
Thomas Harrison
Lead Architect – C-DAS

TH-280319-0011

Date: 28/03/2019

Reviewed by
David Nicholson
System Integration and Interface Manager

DJN-29032019-0103

Date: 29/03/2019

Approved by
Rubina Greenwood
Head of System Requirements & Integration

RNG-290319-0094

Date: 29/03/2019

Industry Review by:
Andrew Simmons
Chair of Requirements, Issues and Configuration Management
Working Group

Date:

Working together for a better railway:



Rail Delivery Group



NetworkRail



Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

Electronic file reference:

Disclaimer:

Group Digital Railway has used its best endeavours to ensure that the content, layout and text of this document are accurate, complete and suitable for its stated purpose. It makes no warranties, expressed or implied, that compliance with the contents of this document will be sufficient to ensure safe systems of work or operation. Group Digital Railway will not be liable to pay compensation in respect of the content or subsequent use of this document.

© Copyright 2019 Group Digital Railway

This document is the property of Group Digital Railway. It shall not be reproduced in whole or in part without the written permission of Group Digital Railway.

Document owner: Head of System Requirements and Integration

Version History

Issue	Date	Comments
0.1	01/02/2019	First draft of document for Level 1 assurance review
0.2	08/02/2019	Issued to RICMWG for review
0.3	15/03/2019	Updated to address RICMWG “safety”, DRIIAT and RICARDO comments
0.4	18/03/2019	Updated to address DRIIAT comments
0.5	19/03/2019	Updated to address significant Level 1 assurance comments
0.6	25/03/2019	Version sent for signature
0.7	27/03/2019	Updated to address Level 1 assurance comments
1.0	29/03/2019	Signed version

Exclusions

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

1. The requirements in this document may not fully mitigate an open hazard (C-H125) in the hazard record and further analysis is required. Any organisation seeking to use this document to procure a C-DAS will need to determine whether the situation that is described by C-H125 is relevant to its circumstances. If C-H125 is relevant, the organisation must identify and implement such additional mitigation measures as it considers necessary to control this hazard to a tolerable level. (See Appendix A:)
2. This document has been submitted for Level 3 assurance in accordance with the System Management Plan [RD1]. 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). A response has been made to address the comments which is reflected in this version of the document. However, confirmation has not yet been received that these responses are considered to be satisfactory which may result in amendments to a future revision of this document.

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. None identified.

Dependencies



Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

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. None identified.

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

Content

ABBREVIATIONS AND DEFINITIONS.....	5
REFERENCES.....	5
1 INTRODUCTION.....	6
1.1 Purpose	6
1.2 Scope.....	6
1.3 Update Policy.....	7
1.3.1 Changed Requirements	7
1.3.2 New Requirement.....	7
1.4 Requirements: Form, Applicability and Identification	7
1.4.1 Requirement Functionality.....	7
1.4.2 Basic Requirement Form.....	7
1.4.3 Safety Requirement.....	8
1.4.4 Unique Identifier	8
1.4.5 Normative / Application-Specific / Preferred / Generic Product status.....	8
1.5 Requirements Assurance	9
1.6 Requirements Change.....	9
1.7 Areas for Development.....	9
2 SUBSYSTEM REQUIREMENTS - FUNCTIONAL.....	9
2.1 Operating Context.....	9
2.2 Operational Data.....	9
2.3 Reporting	12
2.4 Messaging and Telecommunications	13
2.5 Time Synchronisation	14
2.6 Faults and Failures	15
2.7 Logging.....	16
3 SUBSYSTEM REQUIREMENTS - NON-FUNCTIONAL.....	17
3.1 Safety.....	17
3.2 Security.....	17
3.3 Reliability, Availability & Maintainability	17
3.4 Performance	19
3.5 Design and Development	21
APPENDIX A: AREAS FOR DEVELOPMENT	23
APPENDIX B: EXPORTED REQUIREMENTS	25
C-DAS Requirements on Traffic Management.....	25
C-DAS Requirements on Business Systems	28
C-DAS Requirements on LINX.....	33
APPENDIX C: LINKING TO CUSTOMER REQUIREMENTS.....	35

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

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 [R11].

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 - System Management Plan, 153819-NWR-PLN-MPM-000002, Issue 8.0
- [RD2] Digital Railway – Requirements Management Plan, 153819-NWR-PLN-ESE-000006, Issue 2.0
- [RD3] C-DAS Customer Requirements Specification, 153821-NWR-SPE-ESE-000010 v2.0
- [RD4] C-DAS Railway Undertaking Subsystem Digital Railway Requirements, 153821-NWR-SPE-ESE-000015-1 v1.0
- [RD5] Interface Requirements for Connected Driver Advisory System. RIS-0711-CCS.
- [RD6] System of Systems Preliminary Hazard Analysis. 147883-NWR-REP-ESS-000007.v 2.1
- [RD7] C-DAS Phase 2 – Hazard Record (Phase 1 and 2 Combined) v22 28Jan 2019.xlsx, 153821-NWR-REG-MPM-000001
- [RD8] C-DAS Safety Analysis, 153821-NWR-REG-MPM-000001
- [RD9] DR Tech – System of Systems (SoS) RAID Log. 153821-NWR-REG-ESE-000001

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.

- [R11] DR Glossary, 153819-NWR-SPE-ESE-000001.
- [R12] Digital Railway Requirements Framework, 153819-NWR-PLN-ESE-000011, Issue 2.0.
- [R13] Digital Railway – Introduction to the Requirements Structure, 153819-NWR-PLN-ESE-000012, Issue 1.0
- [R14] Digital Railway Requirements Change Control Process. 153819-NWR-SPE-ESE-000004
- [R15] Interim System Requirements Specification for Connected Driver Advisory System (C-DAS). 153821-NWR-SPE-ESG-000001.

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

1 INTRODUCTION

1.1 Purpose

This document provides a specification that is intended to promote effective implementation of the C-DAS Infrastructure Manager (IM) Subsystem. It is applicable to both retrofit and new-build installations and provides requirements that are optimised for operation on the GB rail network and will support the GB rail industry in achieving the outcomes described in the Digital Railway (DR) Requirements Framework [RI2].

As stated in the industry-agreed and issued DR Requirements Management Plan [RD2], the document provides the DR Requirements which have been developed as part of a suite of requirements covering all elements required to optimise performance and operation of a digitally-enabled railway.

This document forms part of a suite of related specifications for both the C-DAS and the DR System of Systems (SoS) as described in the DR Introduction to the Requirements Structure document [RI3]. Further details of the parent requirements that drive the development of this specification are included within the following specifications:

- C-DAS Customer Requirement Specification [RD3].
- C-DAS Railway Undertaking Subsystem Digital Railway Requirements [RD4].

The document is set out in the form of standard requirements with the C-DAS IM Subsystem Requirement (DRR-CIM-n) identifier, followed by rationale and guidance notes, where appropriate.

Requirements exported to external systems from the IM Subsystem are included in Appendix B.. These requirements have a DRR-CEX-n identifier, followed by rationale and guidance notes where appropriate.

1.2 Scope

This document sets out requirements which describe how the C-DAS IM Subsystem is to be implemented in order to optimise its application on the GB rail network and to promote consistency between applications where this has been identified as being in the best long-term interests of the GB rail industry. It complements, constrains, and should be applied in conjunction with, the Customer Requirements Specification for the C-DAS System [RD3] which sets out what the C-DAS System is intended to achieve.

These requirements are intended to enable the C-DAS IM Subsystem to operate in conjunction with an interfacing system within the DR SoS and the wider railway. They are not expected to prevent the C-DAS IM Subsystem operating with other digital systems outside the DR SoS.

This document contains only generic requirements that are applicable to multiple deployments of the C-DAS IM Subsystem. The Contracting Entity, or their appointed Agent is responsible for specifying any deployment-specific requirements as described in the Introduction to the Requirements Structure document [RI3].

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

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

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

1.3 Update Policy

This Requirement Specification is to be reviewed regularly and updated, where required, as the programme progresses. Requirements may need to be changed or new requirements written.

1.3.1 Changed Requirements

Requirements within the database may need to be changed because:

- the requirement is wrong;
- the requirement is valid but cannot be satisfied;
- there is ambiguity or lack of clarity;
- the requirement has been incorporated into a Standard or another contractually authorised document; or,
- the requirement has become normal Infrastructure Manager (IM) / Railway Undertaking (RU) practice.

1.3.2 New Requirement

Additionally, a new Requirement may be necessary to:

- mitigate a new hazard, risk or issue;
- satisfy a sponsor's change of scope;
- satisfy emerging needs; or,
- create a 'parent' for a necessary subsidiary requirement.

1.4 Requirements: Form, Applicability and Identification

1.4.1 Requirement Functionality

Requirements may be functional or non-functional:

- **Functional Requirements** - Technical details that define what a system needs to accomplish, i.e. how the suppliers' equipment will be applied, what it needs to do, and what processes, procedures and rules need to be in place to achieve it.
- **Non-Functional Requirements** - Constraints on the design or implementation, such as performance, security, competence, training, and reliability requirements.

1.4.2 Basic Requirement Form

All requirements are in the following form:

<i>Safety</i>
Requirement text.
Unique Identifier

Status: Normative/Application-Specific/Preferred/Generic Product. (See Section 1.4.5 below).

Rationale: Shows applicability of the requirement.

Guidance: Supplementary information to support Requirement interpretation and satisfaction.

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

1.4.3 Safety Requirement

Where a requirement has been associated with a Safety Measure, this is identified. The rationale lists the hazards addressed by the safety measure – these hazards are contained within the C-DAS Hazard Record [RD7].

1.4.4 Unique Identifier

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

1.4.5 Normative / Application-Specific / Preferred / Generic Product status

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

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

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

- Application-Specific
 - A requirement which may not be relevant or applicable to every implementation of the C-DAS IM Subsystem. It is expected that, where a requirement is applicable, it will be applied.

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

- Preferred
 - A requirement of lower importance which, whilst not essential, the industry would prefer were satisfied. It is expected that, where a requirement is applicable, it will be applied.

Satisfaction of preferred requirements in compliance with this document is not expected to be a requirement of individual delivery contracts unless explicitly specified within the relevant contract.

- Generic Product
 - A feature required to enable the core purposes of the system to be realised; or,
 - A feature that is necessary to minimise future development of the product for other projects; or,
 - A feature required to enable all the Reference Design topics (where these exist) to be satisfied.

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

Satisfaction of generic product requirements in compliance with this attribute is a requirement of a C-DAS IM Subsystem product for acceptance into the GB market.

1.5 Requirements Assurance

Requirements assurance has been explained in the Preliminary Hazard Analysis Report [RD6].

1.6 Requirements Change

The Requirements Change Control Process [RI4] will be used to raise Change Requests (CRs) to amend existing requirements or add new requirements.

1.7 Areas for Development

Noting that this document represents the best understanding of the needs of GB's rail network at the time of publishing, it is recognised that there are a number of areas where the document may be deficient. New deficiencies may be identified as understanding of the C-DAS IM Subsystem develops, as well as areas being closed out through further work being undertaken. The current known areas of deficiency are listed in Appendix A:

2 SUBSYSTEM REQUIREMENTS - FUNCTIONAL

This section documents the minimum functional requirements for the C-DAS IM Subsystem. There is no intent to preclude the inclusion of additional features agreed between the C-DAS product supplier and the IM.

2.1 Operating Context

When communication between the C-DAS IM Subsystem and the C-DAS RU Subsystem is resumed after loss, the C-DAS IM Subsystem shall attempt to acquire and make available current data.

DRR-CIM-497b

- Status:* Normative
- Rationale:* So that the C-DAS RU Subsystems and Traffic Management acquire the most up-to-date data from each other.
- Guidance:* Data will need to be acquired from the C-DAS RU subsystem with which communication has been resumed and made available to LINX, and data acquired from LINX made available to the C-DAS RU Subsystem.

2.2 Operational Data

The C-DAS IM Subsystem shall obtain from LINX and deliver to the C-DAS RU Subsystem details of all speed restrictions.

DRR-CIM-271

- Status:* Normative

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

Rationale: To support consistency between data used by C-DAS and other systems, including Traffic Management.

Guidance: Speed restriction data will be supplied in a Traffic Management area by Traffic Management, and in a Non-Traffic Management area sourced from the appropriate Business System. If the proposed Central Temporary Speed Restriction planning and implementation tool is implemented, then it may serve as a common source of all speed restrictions for all affected systems. A consequence of this requirement is that the C-DAS RU Subsystem will be responsible for selecting speed restrictions relevant to its operational routes and trains. Speed restrictions refers to Temporary and Emergency speed restrictions.

The C-DAS IM Subsystem shall obtain from LINX and deliver to the C-DAS RU Subsystem all plans and individual train schedules which are relevant to that C-DAS RU Subsystem.

DRR-CIM-265

Status: Normative

Rationale: To provide the C-DAS RU Subsystem with the appropriate information from which Individual train schedules can be identified.

Guidance: These may include any or all of Applicable Plan (22h00 plan), VSTPs, Current Plan and individual train schedules. The information provided is used by the C-DAS RU Subsystem to obtain an initial schedule for each C-DAS journey, or to replace a previously acquired schedule for the journey. C-DAS is placing a requirement on LINX to be able to select for dispatch to a C-DAS RU Subsystem only the data relevant to its trains. The implementation might use the identity of the RU (as per the CIF file) and/or the Path Identifier.

The C-DAS IM subsystem shall obtain from LINX and deliver to the C-DAS RU Subsystem all Special Conditions of Travel information which is relevant to that C-DAS RU Subsystem.

DRR-CIM-527

Status: Normative

Rationale: To provide the C-DAS RU Subsystem with operational information, that is consistent with information used by Traffic Management, and provided to the driver through the 'Special Conditions of Travel' form (RT3973), for use in the calculation and display of advisory information, and the display of non-advisory information.

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

The C-DAS IM Subsystem shall obtain from LINX and deliver to the C-DAS RU Subsystem schedule updates which are relevant to that C-DAS RU Subsystem.

DRR-CIM-277

- Status:* Normative
- Rationale:* So that the C-DAS uses the up-to-date train schedule.
- Guidance:* In Traffic Management areas schedule updates will be sourced from Traffic Management. In Non-traffic Management areas schedule updates will generally not be available.
C-DAS is placing a requirement on LINX to be able to select for dispatch to a C-DAS RU Subsystem only the data relevant to its trains. The implementation might use the identity of the RU (as per the CIF file) and/or the Path Identifier.

The C-DAS IM Subsystem shall obtain from LINX and deliver to the C-DAS RU Subsystem a list of train services with given Train Running Number which are relevant to that C-DAS RU Subsystem.

DRR-CIM-277a

- Status:* Normative
- Rationale:* To enable C-DAS to determine the individual train service from a non-unique Train Running Number so as to avoid incorrect advisory information being presented to the driver and incorrect information being transmitted to Traffic Management.
- Guidance:* Current GB alphanumeric Train Running Numbers are not unique within a 24hr period. It is therefore necessary to be capable of identifying the correct schedule for a train that shares a Train Running Number with another train. C-DAS is placing a requirement on LINX to be able to select for dispatch to a C-DAS RU Subsystem only the data relevant to its trains. The implementation might use the identity of the RU (as per the CIF file) and/or the Path Identifier.

The C-DAS IM subsystem shall obtain from LINX and deliver to the C-DAS RU Subsystem all available Train Specific Data for train services which are relevant to that C-DAS RU Subsystem.

DRR-CIM-277b

- Status:* Normative
- Rationale:* To support the automatic population of C-DAS RU Onboard train specific data and to ensure consistency between C-DAS, ETCS and TMS, by using the data for the same train type / ETCS Train Categories.
- Guidance:* The data is expected to be provided by an RU-owned business system using data assembled from Consisting Systems and the R2 system. C-DAS is placing a requirement on LINX to be able to select for dispatch to a C-DAS RU Subsystem only the data relevant to its trains. The

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

implementation might use the identity of the RU (as per the CIF file) and/or the Path Identifier.

The C-DAS IM Subsystem shall deliver to LINX notifications which it receives from the C-DAS RU Subsystem that a schedule update has been received by the relevant C-DAS Onboard.

DRR-CIM-280

- Status:* Normative
- Rationale:* So the Traffic Management system is informed of the identity of the schedule with which the individual train is operating.
- Guidance:* If the Traffic Management system does not receive the notification it will not be able to determine whether the information was or was not received by the Onboard.

In Traffic Management areas the C-DAS IM Subsystem shall use data that is consistent with that used by Traffic Management.

DRR-CIM-526

- Status:* Normative
- Rationale:* To support train regulation decisions generated by the Traffic Management system.
- Guidance:* Means used to satisfy this requirement might include:
- a. Acquiring data obtained from the same source as Traffic Management. This would also support C-DAS operation in Non-Traffic Management areas if required.
 - b. Receiving data from Traffic Management.

2.3 Reporting

The C-DAS IM Subsystem shall deliver to LINX the data messages received from the C-DAS RU Subsystem.

DRR-CIM-374

- Status:* Normative
- Rationale:* To make information reported by C-DAS available to Traffic Management or other systems which can use it to improve operations.
- Guidance:* These are the data messages received from the C-DAS RU Subsystem via the C-DAS standard interface specified in RIS-0711-CCS (Interface Requirements for Connected Driver Advisory System) [RD5], namely:
- a. Train Registration Data
 - b. Train Specific Data
 - c. Changes to Train Specific Data
 - d. Train location and speed
 - e. Predicted train arrival data
 - f. C-DAS operational state on individual trains
 - g. Delay attribution data.
- Delivery to LINX will utilise LINX services.

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

2.4 Messaging and Telecommunications

The C-DAS IM Subsystem shall dispatch each data message it receives as soon as allowed by the relevant communications link.

DRR-CIM-383a

Status: Normative

Rationale: To avoid delays in making data available to user Subsystems and systems.

The C-DAS IM Subsystem shall be able to receive messages at any time allowed by the relevant communications link.

DRR-CIM-384a

Status: Normative

Rationale: To avoid delays in making data available to user Subsystems and systems.

The C-DAS IM Subsystem shall transmit and receive the data messages specified in the C-DAS standard interface to and from the C-DAS RU Subsystem.

DRR-CIM-385a

Status: Normative

Rationale: To support the standard interface, and hence enable development of C-DAS products independently of development of Network Rail systems.

Guidance: The C-DAS standard interface is specified in RIS-0711-CCS (Interface Requirements for Connected Driver Advisory System) [RD5] which also specifies the quality of service characteristics of the interface.

The C-DAS IM Subsystem shall construct and de-construct the data messages specified in the C-DAS standard interface.

DRR-CIM-386a

Status: Normative

Rationale: To support the standard interface, while also allowing C-DAS product suppliers to maintain proprietary data formats for internal processing.

Guidance: The C-DAS standard interface is specified in RIS-0711-CCS (Interface Requirements for Connected Driver Advisory System) [RD5].

The C-DAS IM Subsystem shall construct and invoke the appropriate LINX service call for each message it receives from a C-DAS RU Subsystem.

DRR-CIM-389

Status: Normative

Rationale: To translate between the messages defined in the C-DAS standard interface RIS-0711-CCS (Interface Requirements

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

for Connected Driver Advisory System) [RD5] and the specified protocol for using LINX.

The C-DAS IM Subsystem shall construct and invoke the appropriate LINX service call for all data required by a C-DAS RU Subsystem.

DRR-CIM-390

Status: Normative

Rationale: To translate between the messages defined in the C-DAS standard interface RIS-0711-CCS (Interface Requirements for Connected Driver Advisory System) [RD5] and the specified protocol for using LINX.

Safety

The C-DAS IM Subsystem shall include Path Identifiers in C-DAS messages.

DRR-CIM-392a

Status: Normative

Rationale: In order to help ensure that data is routed to and received by the correct C-DAS RU for a specific Onboard.
Safety Measures: C-H4

Guidance: The Path Identifier is provided to C-DAS as part of the schedule data during set-up. C-DAS is placing a requirement on LINX and Traffic Management to maintain the Path Identifier for any C-DAS data message relating to an individual train. The C-DAS RU Subsystem uses this value to identify the individual Onboard.

The C-DAS IM Subsystem shall confirm receipt of messages from the C-DAS RU Subsystem as specified in the C-DAS standard interface.

DRR-CIM-393a

Status: Normative

Rationale: To ensure that schedule data, speed restriction data and Train Specific Data used by C-DAS is aligned with the corresponding data used by the Traffic Management.

Guidance: The C-DAS standard interface is specified in RIS-0711-CCS (Interface Requirements for Connected Driver Advisory System) [RD5].

2.5 Time Synchronisation

Safety

The C-DAS IM Subsystem shall synchronise time on each of its constituent elements with Network Time Servers linked to a trusted local time source.

DRR-CIM-398a

Status: Normative

Rationale: To be consistent with Network Rail's Traffic Management system
Safety Measures: C-H21

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

2.6 Faults and Failures

The C-DAS IM Subsystem shall be able to detect and report to LINX a loss of communications with a C-DAS RU Subsystem.

DRR-CIM-403

- Status:* Preferred
- Rationale:* To provide the state of the C-DAS RU Subsystem so as to enable a person or system to take the appropriate action (e.g. to compensate for trains not being capable of receiving updates to their schedules).
- Guidance:* The mechanism to support the identification of a loss of communication with a C-DAS RU Subsystem is documented in RIS-0711-CCS (Interface Requirements for Connected Driver Advisory System) [RD5].

The C-DAS IM Subsystem shall, where applicable, be able to self-diagnose faults and, when faults are detected, log the faults, and output a notification to local and remote systems as required.

DRR-CIM-436a

- Status:* Preferred
- Rationale:* To support maintainability of the system and contribute to achieving availability targets.
- Guidance:* Fault information should be:
- a) specific, to make it possible to identify the cause quickly
 - b) appropriately prioritised, based on the nature and potential impact of the fault
 - c) worded succinctly, whilst clearly indicating the nature and location of the fault;
 - d) directed at the most suitable person to address the fault
 - e) delivered promptly.
- Faults and failures detected by C-DAS can be published via LINX.

A means shall be provided local to the actual equipment that will enable on-site maintenance staff to determine if the IM Subsystem is running normally or is in a failed state.

DRR-CIM-M8

- Status:* Normative
- Rationale:* To support the maintenance organisation in the provision of effective and efficient maintenance.

The IM Subsystem shall provide a notification to inform the maintenance organisation in the event that the system becomes degraded or performance is worsening.

DRR-CIM-M16

- Status:* Normative
- Rationale:* To support the maintenance organisation in the provision of effective and efficient maintenance.

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

Guidance: This can be a notification, system alert or message which is sent when performance is not at its optimum or degrading overtime.

2.7 Logging

The C-DAS IM Subsystem shall record any messages sent to or received from interfacing systems.

DRR-CIM-523

Status: Normative

Rationale: To support incident investigation.

Guidance: Interfacing systems include the C-DAS RU Subsystem and LINX. It is recommended that records are maintained for at least the previous 48hours.

The C-DAS IM Subsystem shall record any changes in its own operational state.

DRR-CIM-524

Status: Normative

Rationale: To support incident investigation.

Guidance: It is accepted that this may not be possible in certain failure modes. It is recommended that records are maintained for at least the previous 48hours.

Data recorded by the C-DAS IM Subsystem shall be time-stamped.

DRR-CIM-525

Status: Normative

Rationale: To support synchronisation of C-DAS recorded data with data from other sources for incident and network performance analysis.

Guidance: It must be possible to understand how the whole system has behaved (including those who operate it) in order to determine the underlying cause/s of an incident or performance failure. Therefore, data must be collected and synchronised from the C-DAS Subsystems. Information relating to the human element would be managed through review of written records and interviews, as well as actions at the human machine interfaces recorded by Subsystems.

It shall be possible to interrogate C-DAS IM Subsystem fault logs both remotely and locally.

DRR-CIM-437a

Status: Normative

Rationale: To support the maintenance organisation in the provision of effective and efficient maintenance.

Guidance: Consideration may be given to using the provisions of NR/L1/SIG/50021_02.

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

3 SUBSYSTEM REQUIREMENTS - NON-FUNCTIONAL

3.1 Safety

The C-DAS IM Subsystem shall not compromise the safe operation of any interfacing system when operating correctly or when in a degraded state of operation.

DRR-CIM-425a

Status: Normative

Rationale: A C-DAS IM Subsystem fault or failure must not create safety issues in other systems.

3.2 Security

The C-DAS IM Subsystem shall be secure against cyber threats.

DRR-CIM-428a

Status: Normative

Rationale: To protect the availability, integrity and confidentiality of the system.

The C-DAS IM Subsystem shall be physically secure against unauthorised physical access, damage or interference.

DRR-CIM-429a

Status: Normative

Rationale: To prevent unauthorised physical access, damage or interference to Digital Railway premises and information.

3.3 Reliability, Availability & Maintainability

The C-DAS IM Subsystem shall, as a minimum, meet the apportioned Reliability, Availability and Maintainability (RAM) requirements for C-DAS set by the deployment project.

DRR-CIM-432a

Status: Normative

Rationale: To meet the required performance targets for the Subsystem.

Guidance: RAM targets for the IM Subsystem will be derived from overall system RAM requirements set by the deployment project.

The C-DAS IM Subsystem shall be developed to need minimal maintenance and for low Mean Time To Repair (MTTR) times.

DRR-CIM-438a

Status: Normative

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

Rationale: To support effective and efficient maintenance and to reduce the down time of the equipment.

Guidance: This includes but is not limited to:
a) The use of Line Replaceable Units
b) No or limited requirement to configure replaceable components
c) No or limited preventative maintenance
d) No requirement for bespoke tools for routine maintenance.
This can be achieved through a Risk Based Maintenance process to establish the minimum safety maintenance regime. Analysis will be used to identify additional performance tasks. Where possible equipment should be maintenance free.
Mowbray's Reliability Centred Maintenance is currently the preferred method for analysis. See NR/L1/SIG/50021_03.

Maintenance resources shall be made available to maintenance staff prior to the system coming into service, updated in Network Rail format where applicable.

DRR-CIM-M3

Status: Normative

Rationale: To support effective and efficient maintenance and to reduce the down time of the equipment.

Guidance: This includes tools, maintenance interface equipment, documentation, training materials and training, and asset management systems such as ELLIPSE, FMS. Regarding maintenance documentation an Operations and Maintenance (O&M) manual does not constitute this but helps towards meeting this requirement.

A Maintenance strategy shall be developed prior to the equipment coming into service.

DRR-CIM-M4

Status: Normative

Rationale: To determine how the requirements of the maintenance organisation shall be met.

Guidance: Consideration should be given to the provisions of NR/L3/EBM/089 and NR/L1/SIG/50021_03 Section 9.

System boundaries for ownership and maintenance responsibility shall be clearly defined.

DRR-CIM-M6

Status: Normative

Rationale: Permits a clear understanding of ownership and accountabilities for ownership.

Guidance: Consideration should be given to the provisions of NR/L1/SIG/50021_03 clause 8.

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

A Data Recording, Analysis and Corrective Action System (DRACAS) shall be implemented

DRR-CIM-M11

Status: Normative

Rationale: To support the fault cycle and reliability growth throughout the life of the equipment.

Guidance: This requirement could be met by including C-DAS within existing company or industry DRACAS.

A suitable spares provision shall be established, and support contracts put in place prior to the apparatus coming into service.

DRR-CIM-M12

Status: Normative

Rationale: To facilitate the smooth transition of ownership between a project and the maintenance organisation.

Guidance: Consideration should be given to the provisions of L3/SIG/30051.

3.4 Performance

The C-DAS IM Subsystem shall be operational at all times when LINX is running.

DRR-CIM-522

Status: Normative

Rationale: To provide adequate support for on-train C-DAS operations.

The deployment project shall define the expected one-way latencies for the C-DAS IM Subsystem to process messages received from the C-DAS RU Subsystem and deliver the corresponding data to LINX.

DRR-CIM-440c

Status: Normative

Rationale: To achieve operationally acceptable response times.

Guidance: The table below provides an indication of one-way latency targets that could be used (see text in **bold and italic**) for proposed latency values to meet this requirement. The values in the table are based on:

- a. The assumption that Traffic Management will generally perform plan / replan for a time window greater than 15 minutes ahead, and no less than 5 minutes ahead. This allows cross-system latency requirements to be less demanding than if Traffic Management updates were generated for a shorter interval ahead;
- b. The performance of an existing C-DAS system which is in operational use;
- c. Simulations which show the effect on capacity and energy consumption depending on when updates to the C-DAS Onboard Subsystem are delivered.

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

Worst case latency targets for the overall DR system of systems have yet to be determined.

Table 1 - Time partitioning for cross system latencies from the C-DAS IM Subsystem

	Expected (seconds)	Max (seconds)	Expected (seconds)	Max (seconds)
C-DAS IM Trackside data retrieval from LINX	2	3		
C-DAS IM Trackside message processing and transmission to C-DAS RU Trackside	1	2		
C-DAS RU Trackside processing and transmission to C-DAS Onboard	4	25		
C-DAS Onboard processing	3	10		
C-DAS Onboard dispatch of Acknowledgement and transmission to RU Trackside			4	25
C-DAS RU Trackside processing			1	2
C-DAS RU Trackside message transmission to C-DAS IM Trackside			1	2
<i>C-DAS IM Trackside message processing and data delivery to LINX</i>			2	3
TOTAL (1-way)	<10 (80%)	40 (95%)	<8 (80%)	32 (95%)
TOTAL (round-trip)	<18 (80%)	72 (95%)		

The deployment project shall define the expected one-way latencies for the C-DAS IM Subsystem retrieving data from LINX and dispatching the corresponding messages to the C-DAS RU Subsystem.

DRR-CIM-440d

Status: Normative

Rationale: To achieve operationally acceptable response times.

Guidance: The table below provides an indication of one-way latency targets that could be used (see text in ***bold and italic***) for proposed latency values to meet this requirement. The values in the table are based on:

- The assumption that Traffic Management will generally perform plan / replan for a time window greater than 15 minutes ahead, and no less than 5 minutes ahead. This allows cross-system latency requirements to be less demanding than if Traffic Management updates were generated for a shorter interval ahead;
- The performance of an existing C-DAS system which is in operational use;
- Simulations which show the effect on capacity and energy consumption depending on when updates to the C-DAS Onboard Subsystem are delivered.

Worst case latency targets for the overall DR system of systems have yet to be determined.

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

Table 2 - Time partitioning for cross system latencies from the C-DAS IM Subsystem

	Expected (seconds)	Max (seconds)	Expected (seconds)	Max (seconds)
C-DAS IM Trackside data retrieval from LINX	2	3		
C-DAS IM Trackside message processing and transmission to C-DAS RU Trackside	1	2		
C-DAS RU Trackside processing and transmission to C-DAS Onboard	4	25		
C-DAS Onboard processing	3	10		
C-DAS Onboard dispatch of Acknowledgement and transmission to RU Trackside			4	25
C-DAS RU Trackside processing			1	2
C-DAS RU Trackside message transmission to C-DAS IM Trackside			1	2
C-DAS IM Trackside message processing and data delivery to LINX			2	3
TOTAL (1-way)	<10 (80%)	40 (95%)	<8 (80%)	32 (95%)
TOTAL (round-trip)	<18 (80%)	72 (95%)		

3.5 Design and Development

It is assumed that contract documentation will specify the relevant design standards to which the C-DAS supplier will be required to demonstrate compliance.

The C-DAS IM Subsystem shall be developed in accordance with industry good practice with regard to all hardware or software development, test and release processes, including support by full configuration control of its hardware, software and document components.

DRR-CIM-446a

Status: Normative

Rationale: To support effective operation throughout the system life.

Guidance: This requirement will be validated by audit of the development process.

Safety

The C-DAS IM Subsystem shall be developed and implemented to a safety integrity of SIL-1.

DRR-CIM-424a

Status: Normative

Rationale: To achieve a Tolerable Hazard Rate in line with the C-DAS Safety Analysis [RD8].

Guidance: Guidance on the processes for demonstrating SIL-1 are defined in EN 50128 (railway applications – software for railway control and protection) and EN 50129 (railway applications – communication, signalling and processing

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

systems – safety related electronic systems for signalling).
This SIL allocation is based upon there not being automatic
train protection (ATP) active on all C-DAS trains.

Appendix A:

Areas for Development

No.	Issue	Description	Identified in version	Closed in version
1	Hazard C-H125	Hazard C-H125 (see [RD7]) arises from the non-provision of signalling information to C-DAS and the risk of the driver following advisory information over the signalling information on the approach to a signal at danger. The C-DAS project is awaiting the convening of a Hazard forum to determine whether measures proposed to mitigate Hazard C-H125 are sufficient to reduce the resulting risk to a tolerable level. If not, changes to requirements may be required.	0.1	
2	C-DAS in coasting areas	Through coasting areas (damaged OLE etc), currently, drivers are requested to speed up on the approach to the area, lower the pantograph and coast through to the other side. C-DAS would need to know of dead sections in advance and adjust the speed advice accordingly. Currently there is no provision for this, and C-DAS will likely be suppressed (either manually or automatically) on the approach to the coasting area where a driver will rely on existing procedures to manage operations	0.1	0.3
3	Level 1 Assurance Review	A review was undertaken of the C-DAS System Requirements [RI5]. It was determined that this document was not required, and its requirements moved to the IM & RU Subsystem Requirements documents instead. At this point in time, a full review of the Subsystem requirements remains to be completed.	0.2	1.0
4	C-DAS understanding the ETCS Level in overlay areas	On ETCS fitted trains that will operate over conventional and ETCS fitted lines, C-DAS needs to identify the speed units and profiles applicable to the ETCS operating level (i.e. NTC 1, 2, 3). For operations in NTC only or ETCS Level 1, 2 or 3 only areas the ETCS level can be determined from the infrastructure geography. However, in overlay areas only ETCS knows what level it is operating in. Therefore, without a direct interface to ETCS Onboard, no reliable method has been agreed for identifying the level or to provide adequate mitigation for not knowing the level. Requirement DRR-CRU-799 provides potential methods to identify the level however no analysis has yet been performed to identify a preferred solution.	0.3	
5	Requirement Status review	The requirements in this document require a review to establish an appropriate status. Some	0.4	

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

		requirements have been attributed Application Specific against a specific definition of Application Specific at the time and may not align with the definition in section 1.4.5.		
6	Train identity	The use of four character headcodes vs. 8 digit Train Running Numbers requires resolution at a System of Systems level.	0.7	

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

Appendix B: Exported Requirements

There is no direct interface between the C-DAS IM Subsystem and Traffic Management or Business Systems; all messages are shared over LINX.

C-DAS Requirements on Traffic Management

Traffic Management shall be able to receive:

- a. Reporting messages from C-DAS RU Subsystems.
- b. Confirmation when a C-DAS Onboard has received a schedule update.
- c. Notification if the C-DAS IM Subsystem has lost contact with a C-DAS RU Subsystem.

DRR-CEX-101

Status: Normative

Rationale: So that Traffic Management receives information from C-DAS which it can use to support and enhance regulation, passenger support and stock & crew activities.

Guidance: Traffic Management will receive information by subscribing via LINX services for data published by C-DAS. These LINX services deliver the data content of the record types specified as "Internal Services" in [RD5]. Passenger train orientation is included within the Train Capability Data and Train Capability Update record types in order to support Traffic Management activities such as passenger information, PRM services and catering. Changes in Train Capabilities can arise as a consequence of faults (e.g. maximum train speed) or change of power mode. A change in power mode can be notified by driver or (optionally) detected automatically. Changes in Train Capabilities will generally be input by the driver and are provided to Traffic Management so that it doesn't base re-plans on (say) a train with full traction capability when the traction capability is degraded. Traffic Management has requested C-DAS to provide positive confirmation whenever a C-DAS Onboard receives and starts operating to a revised schedule. It is a known limitation that if a confirmation is not received there will be no way for Traffic Management to distinguish which message has been lost (i.e. the outbound Schedule or Schedule Update, or the inbound Confirmation).

Traffic Management shall provide C-DAS with the following data via LINX:

- a. Planning data.
- b. Speed Restriction Data.
- c. List of candidate train services with given Train Running Number.

DRR-CEX-103

Status: Normative

Rationale: So that the data C-DAS uses for advisory information calculations is the same as used by Traffic Management.

Guidance: Planning data can be any or all of Plans, Schedules and Schedule Updates, and may include VSTPs. C-DAS will receive information by subscribing via LINX



Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

services for data published by Traffic Management. These LINX services deliver the data content of the record types specified as "Internal Services" in [RD5]. If the set of candidate services is already available to C-DAS from planning data already being provided, then a separate, distinct service to support item c (Publish Candidate Train Paths) will not be required. Traffic Management will provide C-DAS with all Planning data relevant to RUs whose trains operate C-DAS, and C-DAS will be responsible for selecting and distributing data relevant to individual RUs or C-DAS Onboards. This requirement will be applicable to Speed Restrictions only until such time as the Central Temporary Speed Restriction planning and implementation tool is available. Until that time Traffic Management will provide C-DAS with all Speed Restriction data to which it has access, and C-DAS will be responsible for selecting Speed Restriction data relevant to individual C-DAS Onboards. See DRR-CEX-114 for Speed Restrictions sourced from the proposed Central Temporary Speed Restriction planning and implementation tool, and for Speed Restrictions relevant to non-Traffic Management areas prior to implementation of the tool.

Safety

Planning data provided from Traffic Management to C-DAS via LINX shall include the Path Identifier for each train.

DRR-CEX-60

Status: Normative

Rationale: To support correct routing of C-DAS messages to an individual train throughout its journey.
Safety Measures: C-H4

Guidance: Planning data can be any or all of Plans, Schedules and Schedule Updates, and may include VSTPs. The Path Identifier is allocated by NR's planning systems and used in all C-DAS communications between a C-DAS Onboard and other systems, e.g. Traffic Management.

Planning data provided by Traffic Management for use by C-DAS via LINX shall refer only to locations which have been pre-defined in the Timetable Planning System.

DRR-CEX-108

Status: Normative

Rationale: To provide C-DAS with the opportunity to optimise effectively.

Guidance: Planning data can be any of Plans, Schedules and Schedule Updates. C-DAS cannot optimise effectively if the train journey is over-constrained. Traffic Management is therefore required to limit Timing Points (locations on the schedule for which arrival, departure or passing times are specified) to locations which are on the working timetable, supplemented

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

by extra locations which are needed for regulation purposes and which have been agreed with the Infrastructure Manager.

Planning data provided from Traffic Management to C-DAS via LINX shall include all the information required to populate the Schedule and Schedule Update service records specified in RIS-0711-CCS (Interface Requirements for Connected Driver Advisory System).

DRR-CEX-15

- Status:* Normative
- Rationale:* So that C-DAS has the planning data identified as necessary for the safe calculation of advisory, and the provision of non-advisory, information.
- Guidance:* Planning data can be any or all of Plans, Schedules and Schedule Updates.
The data required includes:
- a. Schedule times at named locations at an appropriate granularity to support regulation on that part of the route. This is because where traffic density is high - e.g. 24 trains per hour - trains need to achieve times at timing points, especially passing points, which are accurate to 10 seconds or potentially less.
 - b. Running line for each part of the route covered by the planning data provided, described in relation to the Common Location Reference Frame.
 - c. Timing Tolerances at Timing Points wherever Traffic Management is able to provide them. Timing Tolerances allow C-DAS to optimise speed profiles beyond what is possible if trains are constrained to achieve exact times. Timing Tolerances will always be limited by the published timetable.

Speed Restriction data provided by Traffic Management to C-DAS via LINX shall include all the information required to populate the Speed Restriction service records specified in RIS-0711-CCS (Interface Requirements for Connected Driver Advisory System).

DRR-CEX-110

- Status:* Normative
- Rationale:* So that C-DAS can construct a speed profile which reflects the speed restrictions relevant to the currently planned route.
- Guidance:* The details of the data required include:
- a. Activate / modify / remove indicator.
 - b. Speed Restriction start and end points, described in relation to the Common Location Reference Frame.
 - c. Speed value and a means to identify the applicable speed units for each relevant conventional train type and/or ETCS train category, axle-load category, or power mode.

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

Traffic Management shall ignore any messages received from C-DAS which are not relevant to operations in its area or on the approaches to it.

DRR-CEX-109

Status: Normative

Rationale: So that receipt of unexpected or irrelevant messages is not treated as an error.

C-DAS Requirements on Business Systems

Business Systems shall provide initial Train Specific Data to C-DAS.

DRR-CEX-112

Status: Normative

Rationale: To ensure consistency between C-DAS, ETCS and (in Traffic Management areas) Traffic Management, by using the data for the same train type / ETCS Train Categories.

Guidance: The data is expected to be provided by an RU-owned business system using data assembled from consisting systems.
The C-DAS Onboard will be expected to acquire this data - or to confirm validity of previously acquired data - at the start of each journey and following any operation which affects train consist (split, join, freight load/unload) or train performance capability (e.g. arising from defects).
Mid-journey updates to Train Specific data, or Train Specific data which cannot be made available from business systems, will be notified by C-DAS to Traffic Management via LINX.
Examples of such data might include changes to consist (as above) or change to orientation for a passenger train.
Appropriate means to ensure data consistency between C-DAS and ETCS Onboards without requiring dual data entry might include sharing data between the respective Onboards, or management of input and changes to data by a third-party onboard element e.g. a Train Management System.

Where the initial schedule is not available from Traffic Management then business Systems shall have the capability to provide C-DAS with the Applicable (daily) Plan.

DRR-CEX-113

Status: Normative

Rationale: To expedite start-up of C-DAS Onboards in circumstances where an initial schedule is not available from Traffic Management.

Guidance: This requirement allows C-DAS to obtain the correct Path Identifier and corresponding Initial Schedule in circumstances where the information cannot be provided by LINX, e.g. in non-Traffic Management areas.
The data which is the subject of this requirement is the Daily Plan produced by the IM's Planning System at 10pm each

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

day for the following day's operations.

The service interface will in the future be specified in the "External Services" section of [RD5]. The data content will closely resemble the Schedule record specified in [RD5] "Internal Services". Business Systems will provide this data via the "External Interface" until such time as it can be provided as an "Internal Interface" i.e. via LINX.

Business Systems shall provide C-DAS with Speed Restriction data.

DRR-CEX-114

- Status:* Normative
- Rationale:* To provide C-DAS with speed restrictions (TSR and ESR) which are consistent with those used by Traffic Management and ETCS.
- Guidance:* It is planned that the source of TSR and ESR data will be a Central Temporary Speed Restriction planning and implementation tool from which other systems will receive Speed Restriction data via LINX. Until this system is implemented:
- a. C-DAS uses Published Speed Restrictions (obtained from an electronic version of the Weekly Operating Notices) for those areas where speed restrictions are not available from a live system. This is expected to include all non-Traffic Management areas. C-DAS is responsible for selecting from this source all Speed Restrictions applicable to non-Traffic Management areas and ignoring those which are for Traffic Management areas where more accurate and reliable versions will be provided by Traffic Management - see CEX-103.
 - b. The service interface will be as specified in the "External Services" section of [RD5].

Business Systems shall provide a means to allow C-DAS to identify a partition of the dataset for the GB rail network. in respect of each of:

- a. Infrastructure Geography.
- b. Static Speed Profiles.
- c. Applicable (daily) Plan.
- d. Published Speed Restrictions.

DRR-CEX-115

- Status:* Normative
- Rationale:* To enable an RU to be provided only with the datasets appropriate for its routes.
- Guidance:* The aim is to avoid requiring datasets to be re-acquired when there are changes only to parts of the national data which are not relevant to the RU's operations. Start-up and in-journey latency requirements specified for C-DAS data transfer are expected to result in Infrastructure Geography and Permissible Speed / Static Speed Profile data for a train's diagram being downloaded to C-DAS fitted trains prior to start of the train's first journey of the day. Since the contents of these datasets change only infrequently, the

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

expectation is that they will be retained persistently on the trains, and updated only when there has been some change to the data which could be relevant to the service operated by those trains.

The service interface to support this requirement will in the future be specified in the "External Services" section of [RD5].

The following partitioning options are expected:

- a. Infrastructure Geography – by network area.
- b. Static Speed Profiles – by network area and/or train type/ETCS train categories.
- c. Applicable (daily) Plan – by network area and/or RU.
- d. Planned Speed Restrictions – by network area.

Business Systems shall provide a means to allow users to identify the most recent versions of a dataset or partition.

DRR-CEX-116

Status: Normative

Rationale: So that C-DAS and/or its users can confirm whether previously acquired data is still current.

Guidance: The service interface to support this requirement will in the future be specified in the "External Services" Section of [RD5]. The service will be expected to be invoked in order to check when and for what reason a dataset has been updated and thus identify whether a new version of a dataset must be acquired.

Business systems shall identify each individual train journey by a Path Identifier.

DRR-CEX-33

Status: Normative

Rationale: To provide an identifier for a particular service which is unique across the GB rail network on a particular day.

Guidance: The requirement applies to all Plans and Schedules, including VSTPs provided by the Timetable Planning System.
Messages between C-DAS, Traffic Management and any other systems will retain and use the Path Identifier throughout the duration of the journey.

Safety

Plans and Schedules provided from Business Systems to C-DAS shall include the Path Identifier for each train.

DRR-CEX-60a

Status: Normative

Rationale: To support correct routing of C-DAS messages to an individual train throughout its journey.
Safety Measures: C-H4

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

Guidance: Planning data provided by Business Systems may include VSTPs.
This Path Identifier is allocated by NR's planning systems and used in all C-DAS communications between a C-DAS Onboard and other systems, e.g. Traffic Management (see also CEX-33).

Plans and Schedules provided from Business Systems to C-DAS shall include all the information required to populate the Schedule and Schedule Update service records.

DRR-CEX-56

Status: Normative

Rationale: So that C-DAS has the planning and schedule information identified as necessary for the safe calculation of advisory, and the provision of non-advisory, information.

Guidance: Planning data provided by Business Systems may include VSTPs.
The information required is:

- a. Schedule times at named locations at an appropriate granularity to support regulation on that part of the route. This is because where traffic density is high - e.g. 24 trains per hour - trains need to achieve times at timing points, especially passing points, which are accurate to 10 seconds or potentially less.
- b. Running line for each part of the route covered by the planning data provided, described in relation to the Common Location Reference Frame (see Open Point SoS.0064 in DR SoS RAID Log [RD9]).
- c. Timing Tolerances at Timing Points wherever Business Systems are able to provide them, as these have the potential to reduce energy consumption by allowing C-DAS to optimise speed profiles beyond what is possible if trains are constrained to achieve exact times. Timing Tolerances will always be limited by the published timetable.

This requirement is not currently satisfied for plans and schedules obtained from the CIF, which does not include full line information for the whole route, but line identities only on the approach to and departure from those timing points which are specified as part of the train schedule. A supplement to the Common Interface File is under consideration as a possible source for the missing information.

Speed Restriction data provided by Business Systems to C-DAS shall include all the information required to populate the Speed Restriction service records.

DRR-CEX-110a

Status: Normative

Rationale: So that C-DAS can construct a speed profile which reflects the speed restrictions relevant to the currently planned route.

Guidance: The details of the data include:

- a. Activate / modify / remove indicator.

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

- b. Speed Restriction start and end points, described in relation to the Common Location Reference Frame (see Open Point SoS.0064 in DR SoS RAID Log [RD9])
- c. Speed value and a means to identify the applicable speed units for each relevant conventional train type and/or ETCS

Business systems shall provide a means to define arrival, departure and pass criteria for each Timing Point location on a train schedule.

DRR-CEX-R2

Status: Normative

Rationale: To provide an agreed means to be used by both Traffic Management and C-DAS to determine when a train arrives at, departs from, or passes a Timing Point location on its schedule.

Guidance: This is a requirement on Business Systems (e.g. NR's Possession Planning System) which affects the data they produce. The means to be defined is for use by Traffic Management and C-DAS, both as an input to calculations of the appropriate speed profile for a train approaching a Timing Point, and to determine when a train has actually arrived at, departed from or passed a Timing Point location. This requirement may be met by rules or otherwise, and affects how Timing Point Locations are mapped to the common location reference frame (see Open Point SoS.0064 in DR SoS RAID Log [RD9]).

For non-stopping Timing Points there does not appear to be a simple definition, and avoiding conflict at a non-stopping Timing Point at a junction might require passing to be defined in terms of occupancy clearing from a section of a route. Whatever criterion is agreed needs to be used both by Traffic Management when calculating timings that will avoid conflict, and by C-DAS when recommending speed profiles to support those timings.

The issue arises to a lesser extent for Timing Points which are scheduled stops, since it may be acceptable to define arrival at and departure from a scheduled stop in terms of respectively the front and rear of the train reaching a specific location.

Consideration should be given to defining Timing Points so as to support TM and C-DAS to deliver the optimum performance benefits. For example, the definition of Timing Points at or near signals, and scheduling trains to arrive at or depart those Timing Points to avoid trains having to stop at red signals that are scheduled to clear could have major performance benefits, both in terms of capacity and energy efficiency.

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

C-DAS Requirements on LINX

LINX shall provide services to support asynchronous, event-driven data transfer between the C-DAS IM Subsystem and Traffic Management TM.

DRR-CEX-104

<i>Status:</i>	Normative
<i>Rationale:</i>	To support asynchronous data transfer between C-DAS and TM systems in both directions.
<i>Guidance:</i>	<p>These LINX services deliver the data content of the record types of the asynchronous messages specified as "Internal Services" in [RD5] which are implemented as Publish / Subscribe services. Particular requirements in this document which LINX will be expected to support are:</p> <ol style="list-style-type: none"> Inclusion of a train's Path Identifier in every message which concerns the particular train; Use of the Common Location Reference Frame to provide operational running line as part of schedule data, and affected running lines for each speed restriction. Inclusion of scheduled timing point times at an appropriate granularity; Inclusion of Timing Tolerances where provided by the originating system.

LINX shall deliver messages sent by C-DAS to the appropriate instance(s) of Traffic Management (TM).

DRR-CEX-107

<i>Status:</i>	Normative
<i>Rationale:</i>	<p>So that C-DAS does not need to identify the TM system(s) which manage a particular part of the rail network. The requirement is allocated to LINX so as to reduce the likelihood of messages being routed to Traffic Management systems to which they are not relevant, and the nugatory processing that would be required to recognise and discard them in consequence.</p>
<i>Guidance:</i>	<p>It is the responsibility of LINX to distribute data received from C-DAS to any Traffic Management systems to which it is relevant, namely the TM area(s) that a C-DAS train is in or approaching. C-DAS will thus be required to publish any data message once only.</p>

LINX shall provide a service capable of making Delay Attribution information provided by C-DAS available to the Industry Train Event Date (ITED) system.

DRR-CEX-36

<i>Status:</i>	Normative
<i>Rationale:</i>	So that delay attribution information entered by the driver is made available for network performance analysis.

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

Guidance: This LINX service delivers the data content of the Publish Train Status. Delay Attribution record type specified as an "Internal Services" in [RD5].

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

Appendix C: Linking to Customer Requirements

The table below lists the Customer Requirements for C-DAS in [RD3]Error! Reference source not found. and identifies the Digital Railway Requirements within this document which constrain each Customer Requirement. This replicates the linking between the Digital Railway Requirements and Customer Requirements suites which is implemented in DOORS.

Note that only system level Digital Railway Requirements are included within the table; hierarchical linking between system and sub-system level Digital Railway Requirements is recorded in DOORS only.

Customer Requirement Number	Is Constrained by Digital Requirement Number(s)
CRS-C-1	DRR-CIM-497b DRR-CIM-265 DRR-CIM-398a DRR-CIM-440d DRR-CIM-440c DRR-CIM-384a DRR-CIM-383a DRR-CIM-271 DRR-CIM-265 DRR-CIM-277 DRR-CIM-277a DRR-CIM-374 DRR-CIM-497b
CRS-C-3	DRR-CIM-265 DRR-CIM-277 DRR-CIM-271 DRR-CIM-277a DRR-CIM-390
CRS-C-4	DRR-CIM-280 DRR-CIM-374 DRR-CIM-389
CRS-C-5	DRR-CIM-392a DRR-CIM-385a DRR-CIM-386a
CRS-C-8	
CRS-C-11	
CRS-C-12	DRR-CIM-385a DRR-CIM-386a DRR-CIM-393a DRR-CIM-280 DRR-CIM-271

Reference	153821-NWR-SPE-ESE-000015-2
Issue/Ver:	1.0
Date:	29/03/2019

	DRR-CIM-265 DRR-CIM-277 DRR-CIM-374 DRR-CIM-389 DRR-CIM-277a DRR-CIM-390 DRR-CIM-385a
CRS-C-15	DRR-CIM-425a
CRS-C-16	
CRS-C-19	DRR-CIM-428a DRR-CRU-429a
CRS-C-20	DRR-CIM-392a DRR-CIM-385a DRR-CIM-386a
CRS-C-25	DRR-CIM-432a DRR-CIM-438a
CRS-C-26	
CRS-C-27	DRR-CIM-392a DRR-CIM-385a DRR-CIM-386a
CRS-C-28	DRR-CIM-438a DRR-CIM-M3 DRR-CIM-M4 DRR-CIM-M6 DRR-CIM-M11 DRR-CIM-M12 DRR-CIM-522
CRS-C-29	DRR-CIM-425a
CRS-C-30	
CRS-C-31	DRR-CIM-438a DRR-CIM-446a
CRS-C-33	
CRS-C-34	
CRS-C-35	DRR-CIM-403 DRR-CIM-436a DRR-CIM-525 DRR-CIM-523 DRR-CIM-524
CRS-C-37	DRR-CIM-424a
CRS-C-38	

Digital Railway



Working together for a better railway:



Rail Delivery Group



NetworkRail

