Interim Railway Undertaking (RU) Subsystem Requirements Specification for Connected Driver Advisory System (C-DAS)

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Approved By Digital Railway

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Scope Identification

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Version History

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1 Introduction

1.1 Overview

1.1.1 Background

A Driver Advisory System (DAS) is a tool to help improve the information available to the driver so as to aid efficient operation of the train. Its use originated in the heavy haul freight sector where long heavy trains, travelling long distances between receding opportunities or passing loops, could gain significant benefits by optimising arrival times and running speeds. More recently its use has spread to passenger fleets.

Three variants of DAS are being considered on the GB railway:

• Standalone DAS (S-DAS) is a driver advisory system which has all data downloaded to trains at or prior to journey start. Product support for S-DAS is already established and examples are in use on the GB railway as part of passenger operations.

• Networked DAS (N-DAS) is a driver advisory system which can communicate with an RU facility capable of providing updates to train schedule and/or routing information and (in certain cases) to speed restriction data. Product support for N-DAS is emerging, and examples are in use on the GB railway as part of passenger operations.

• Connected DAS (C-DAS) is a driver advisory system with a communications link to and from each area’s Traffic Management System. This variant supports Traffic Management’s train regulation activities through the provision of schedule, routing and speed restriction updates to trains, and also receipt of information from trains. In an area not controlled by a Traffic Management system C-DAS may operate with initial data (as per S-DAS), or with the most recent updates received from Traffic Management or from an RU facility (i.e. as per N-DAS). Products for C-DAS are beginning to be developed and are expected to be rolled out on the GB railway over the next few years.

1.1.2 Benefits of DAS

Any DAS implementation (S-DAS, N-DAS, or C-DAS) would be expected to deliver benefits in the quality, cost and efficiency of train operation, while still meeting all times specified in the schedule.

With S-DAS the expected benefits are:

• Improved Safety
  – Train regulated to the working timetable encountering fewer restrictive signals
  – Overall lower sectional running speeds
  – Advance warning of locations where speed restrictions change
  – Lower approach speeds to PSRs / stations / known conflict points with extended coasting
  – Reminder of next station calling point, thus reducing missed stations / overruns

• Improved fuel efficiency (up to 15% reduction on diesel trains)
• Improved capture of delay attribution data
• Reduction in wear and tear
  – Reduced braking / lower speed
  – Lower running speeds.

However benefits are not realised unless trains are on schedule (or nearly so), i.e. typically ~75% of passenger journeys on major routes.

With C-DAS the expected benefits are all of those anticipated for S-DAS and in addition:

• Improved recovery from disruption (due to ease of communicating revised schedule to trains)
• Train regulation to revised schedule
• Support for regulation to optimise for network capacity or performance (based on fewer delays due to red signals)
• Support for improved conflict resolution (based on trains’ predicted running)
Fuel savings potentially on nearly 100% of journeys.
In addition, both S-DAS and C-DAS variants will potentially support future anticipated requirements to optimise energy consumption based on locally available electrical power or power tariffs.

1.2 Purpose
The purpose of this document is to capture the subsystem requirements allocated to the Railway Undertaking (RU) subsystem of a Connected Driver Advisory System (C-DAS) to inform C-DAS procurement for forthcoming franchises.

1.3 Scope
This document is the RU System Requirements Specification for a Connected Driver Advisory System which is capable of operating in cooperation with the Traffic Management system being developed for the GB Digital Railway. It forms part of a set of requirements and supporting documents:

1. C-DAS System Requirements
2. C-DAS RU Subsystem Requirements (RU Trackside + Onboard elements) – this document
3. C-DAS IM Subsystem Requirements (IM Trackside element)
4. C-DAS External Interface Requirements [RD22]
5. C-DAS IM-RU Interface Specification [RD11]
7. C-DAS Assumptions Register [RD26]
8. C-DAS Hazard Record [RD24]

The C-DAS requirements set has been developed in accordance with the process laid out in the C-DAS Requirements Management Plan [RD23]. Every effort has been made to ensure that the requirements are supplier and product agnostic, to allow for the maximum flexibility in how requirements are met.

This version of the document is limited to C-DAS operations involving multiple unit train sets which are not-ETCS fitted; a later version will include also requirements relevant to C-DAS operation on ETCS fitted trains, and to variable formation trains both ETCS fitted and not ETCS fitted.

1.4 Exclusions and Requirements Status
This Interim version of the document is limited to C-DAS operations involving multiple unit train sets. C-DAS operation on ETCS-fitted trains is not precluded, but issues associated with integrating C-DAS on ETCS-fitted trains are not addressed.

A later version of the document will address C-DAS integration on ETCS-fitted trains, and will also include requirements to support C-DAS operation on:

- Variable formation trains (whether ETCS-fitted or not ETCS-fitted)
- Bi- or multi-modal trains.

The following Open Points await input from external sources:

- CDX.01 RAM targets for C-DAS
- CDX.02 System response time requirements.

The requirements are informed by several Assumptions (see [RD26]), and the Working Assumptions for a set of unresolved Issues (see [RD25]), which have been agreed with Digital Railway but are not yet fully validated.

The document reflects input from a wide range of stakeholders including DAS product suppliers and customers, but has not yet been reviewed by Digital Railway stakeholders.

1.5 References
Where no version is stated, the most recent version should be used unless otherwise stated.
1.6 Abbreviations and Terminology
Abbreviations and terminology are defined in the Glossary in section 5.

1.7 Requirements Format
Requirements are presented in this document in the following form:

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<th>Unique Requirement Identifier</th>
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</thead>
<tbody>
<tr>
<td><strong>Status:</strong></td>
<td>Normative/Application-Specific/Preferred.</td>
</tr>
<tr>
<td><strong>Rationale:</strong></td>
<td>The justification for a requirement.</td>
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</table>
HF Measure: Identifies a requirement that is managing a human factors/ergonomics risk.

Safety Measures: Identifies a requirement which is managing safety risk and identifies the associated hazards (C-HXX). Hazards are captured and maintained in the Hazard Record [RD24].

Guidance: Supplementary information to support requirement interpretation and application.

References of the form CA-xx are to entries in the C-DAS Assumptions Register [RD26], and references of the form CD2.yy are to entries in the C-DAS Issues Log [RD25].

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

- **Normative**
  - Necessary to achieve 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 C-DAS application. It is expected that where a requirement is applicable, it will be supported.

  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.

  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.
2 System Architecture and Interfaces

This section summarises the primary functions of the C-DAS, lists the functionality of its constituent subsystems, and outlines the C-DAS external and internal interfaces by functional purpose. These interfaces are shown on Figure 2-1 below.

2.1 System Overview

The section is intended to help the user understand the boundary and scope of the system and its constituent subsystems.

2.1.1 Purpose

The overall purposes of the C-DAS are (in order of priority): to assist in delivery of the Working Timetable, to support traffic regulation and to aid energy efficiency.

The primary functions of the C-DAS are:

- To calculate recommended energy-efficient speed profiles which allow trains to meet scheduled Timing Points and which are consistent with Infrastructure Geography, Line Speeds (including speed restrictions) for the given train, and the train characteristics and capabilities.
- To monitor train progress towards the next Timing Point, changing the recommended speed profile as required.
- To display advisory information to the driver.
- To provide trains’ location and speed to Traffic Management.
- To notify Traffic Management when a train cannot meet its schedule.
- To provide changes to Train Specific Data to Traffic Management.
- To generate data for rail network performance analysis.
- To notify Traffic Management of changes in the operating state of C-DAS on individual trains.

2.1.2 System architecture

The C-DAS system architecture comprises two subsystems:

- The C-DAS IM Subsystem, which comprises a single off-train element (C-DAS IM Trackside) operated by Network Rail as Infrastructure Manager (IM);
- The C-DAS RU Subsystem, which comprises:
  - An off-train element (the C-DAS RU Trackside) operated on behalf of a Passenger or Freight operator, referred to as a Railway Undertaking (RU);
  - An on-train element (the C-DAS Onboard) on each C-DAS fitted train in an RU’s fleet.

The C-DAS RU Trackside communicates with its C-DAS Onboards via mobile telecommunications, the details of which fall outside the scope of this specification and are agreed between the RU and the C-DAS product supplier.

Figure 2-1 below shows the C-DAS reference architecture.

The apportionment of the functionality between the C-DAS RU Subsystem and the C-DAS IM Subsystem is outlined in the following subsections.
2.1.3 C-DAS RU Subsystem

The C-DAS Onboard element of the C-DAS RU subsystem will be responsible for:

1. All interactions with the driver
2. Managing on-train C-DAS set-up
3. Calculation and display of advisory information
4. Exporting current Train Specific Data at set-up and in the event of change
5. Monitoring current running line, train location and speed
6. Exporting run-time train location and speed, and arrival forecasts
7. Journey records (logging)
8. Synchronising time with the selected trusted local time source.

The C-DAS RU Trackside element of the C-DAS RU subsystem will be responsible for:

1. Managing run-time communications with a set of C-DAS Onboards, including message acknowledgements and keep-alive functionality.
2. Checking that versions of data used for calculation of advisory information are current.
3. Acquiring speed restriction data relevant to the trains it manages.
4. Providing data to the C-DAS Onboards of the trains it manages.
5. Backhauling journey logs from individual C-DAS fitted trains.
6. Synchronising time with the trusted local time source.
7. Supporting the C-DAS IM-RU Interface Specification defined in [RD11], by:
   a. Establishing and maintaining communications with the C-DAS IM Trackside;
   b. Run-time data transfer between each C-DAS Onboard and the C-DAS IM Trackside in both directions, including re-formatting between any proprietary format and the messages specified in the IM-RU Interface Specification;
c. Maintaining data alignment between itself and the C-DAS IM Trackside in respect of data relevant to the trains it manages;

d. Obtaining Infrastructure Geography and Static Speed Profiles and published TSR data from the IM’s data systems;

e. Supporting set-up of individual trains by
   - Providing data, including an initial schedule to the C-DAS onboard
   - Conveying data from the C-DAS Onboard to the C-DAS IM Trackside.

2.1.4 C-DAS IM Subsystem
The C-DAS IM Subsystem will be responsible for:

1. Supporting the C-DAS IM-RU Interface Specification defined in [RD11], including:
   a. Managing all aspects of the interface between each of the C-DAS RU Subsystem and LINX/ Traffic Management;
   b. Run-time data transfer between LINX and C-DAS RU Subsystems in both directions, including re-formatting between LINX service formats and the messages specified in the IM-RU Interface Specification;
   c. Maintaining data alignment between an individual C-DAS RU Subsystem and LINX / Traffic Management in respect of speed restriction data, and of schedule and Train Specific Data for individual trains;
   d. Obtaining schedule updates for C-DAS Onboards and dispatching them to the corresponding RU Subsystem;
   e. Obtaining TSRs and ESRs from LINX and dispatching them to C-DAS RU Subsystems;
   f. Supporting C-DAS set-up of individual trains by exchanging relevant data with LINX / Traffic Management

2. Synchronising time with the selected trusted local time source.

2.2 External Interfaces
The following sections outline the C-DAS external interfaces. Refer to the C-DAS External Interface Requirements Specification [RD22] for requirements on external systems. Note that no requirement has been identified for input to the C-DAS IM Subsystem by the Infrastructure Manager’s staff.

2.2.1 Driver interface
This interface is shown as 2.2 on Figure 2-1. It is expected to support the following functionality.

2.2.1.1 Set-up
1. To enable the driver to enter / confirm Set-up data.

2.2.1.2 Run-time
1. To display information to the driver.
2. To enable the driver to enter / select / confirm input (e.g. running line, delay attribution).
3. To enable the driver to enter C-DAS controls (e.g. manual suppression of display).

2.2.2 Interfaces with LINX / Traffic Management
These interfaces are shown as 2.4 on Figure 2-1.

2.2.2.1 Set-up interfaces
2.2.2.1.1 LINX/Traffic Management to C-DAS IM Subsystem
Interfaces between C-DAS and LINX/Traffic Management consistent with [RD5] are required for the following to allow C-DAS customisation data to be provided by the C-DAS IM Subsystem to C-DAS fitted trains.

The data required includes:

1. Planned schedule for all relevant trains.
2. Train Specific Data for non-ETCS fitted trains.

2.2.2.1.2 C-DAS IM Subsystem to LINX/Traffic Management

An interface consistent with [RD5] is required in order that C-DAS can provide Traffic Management with current data.

The data content of this interface are the items listed in section 2.3.1.2.

2.2.2 Run-time interfaces

Interfaces between C-DAS and LINX/Traffic Management consistent with [RD5] are required for the following to support run-time information exchange.

2.2.2.2.1 LINX/Traffic Management to C-DAS IM Subsystem

1. Schedule and routing updates for all relevant trains.
2. Non-published TSRs and ESRs.
3. Train location requests.

2.2.2.2.2 C-DAS IM Subsystem to LINX/Traffic Management

1. Train location and speed.
2. Changes to Train Specific Data (e.g. arising from defects).
3. Predicted arrival / passing times for Timing Point locations.
5. Train confirming receipt of schedule update.
6. Delay attribution code.

2.2.3 Interfaces with Train Data Systems

These interfaces are shown as 2.7a and 2.7b on Figure 2-1. They are required in order to provide fixed train data to C-DAS fitted trains.

2.3 C-DAS IM-RU Interface

The IM-RU interface is the interface between the C-DAS RU Subsystem and the C-DAS IM Subsystem; its purpose is to enable different suppliers to develop C-DAS products that will all integrate in the same way with Network Rail systems. The interface was originally published as [RD11] and forms the basis of an open Rail Industry Standard currently in development.

The IM-RU Interface Specification supports the data flows outlined in the following subsections.

2.3.1 Set-up interfaces

These interfaces form part of the set shown as 2.3a on Figure 2-1.

2.3.1.1 C-DAS IM Subsystem to C-DAS RU Subsystem

This interface is used for passing data intended for the C-DAS Onboard

1. Train schedule.
2. Train Specific Data (for variable formation train).
3. List of trains with given Train Running Number.
2.3.1.2  C-DAS RU Subsystem to C-DAS IM Subsystem
This interface is used for passing data received from the C-DAS Onboard
1. Set-up data: Driver ID, Train Running Number, Train Specific Data (multiple unit train sets).
2. Train Specific Data (including power mode if applicable).

2.3.2  Run-time interfaces
These interfaces form part of the set shown as 2.3a on Figure 2-1.

2.3.2.1  C-DAS IM Subsystem to C-DAS RU Subsystem
This interface is used for passing data intended for the C-DAS Onboard
1. Schedule data and schedule updates pertaining to an individual train, including changes to schedule times and / or stopping pattern. It may also include changes to minimum dwell time and schedule timing tolerances.
2. Routing updates pertaining to the train.
3. TSRs and ESRs pertaining to Traffic Management areas.
4. Requests for the train to report its location and speed.

2.3.2.2  C-DAS RU Subsystem to C-DAS IM Subsystem
This interface is used for passing data received from the C-DAS Onboard
1. Changes to Train Specific Data (e.g. arising from defects).
2. Train location and speed reports.
3. Predicted arrival / passing times at Timing Point locations.
5. Delay attribution code.

2.3.3  Initialisation interfaces
These interfaces are shown as 2.3b on Figure 2-1.

2.3.3.1  Infrastructure Manager data systems to C-DAS RU Subsystem
1. Infrastructure Geography.
2. Static Speed Profiles.
3. Published TSRs for relevant areas and routes.
4. Applicable timetable for relevant trains (optional).
3 Subsystem Requirements - Functional

3.1 Operating context

The C-DAS RU Subsystem shall calculate advisory information using the most recent data to which it has access.

**Status:** Normative

**Rationale:** So that the advisory information calculated by the C-DAS Onboard reflects the most up to date data available.

**Guidance:** Infrastructure Geography and Static Speed Profile information may be permanently available to the C-DAS Onboard, but trains may not always have access to latest schedule or speed restrictions, depending on the quality of communications between C-DAS and LINX, and between C-DAS elements, particularly between C-DAS Onboard and RU Trackside.

**Guidance:** When operating in an area controlled by an infrastructure-based Traffic Management system, the C-DAS RU subsystem will:

a. Accept updates to train schedule, route and speed restrictions supplied by the Traffic Management system

b. Calculate advisory information using the most recent data to which it has access

c. Supply information to the C-DAS IM Trackside about the progress of individual trains.

**Guidance:** If required by the RU to operate in a non- Traffic Management area where there are communications between the C-DAS Onboard and the C-DAS RU Trackside, the C-DAS RU Subsystem will:

a. Accept any updates to train schedule supplied by an RU facility;  
b. Calculate advisory information using the most recent data to which it has access  
c. Supply information to the C-DAS IM Trackside about the progress of individual trains.

When communication between the C-DAS RU subsystem elements is resumed after loss, each element shall attempt to acquire and make available current data.

**Status:** Normative

**Rationale:** So that the C-DAS RU subsystem elements acquire the most up-to-date data.

**Guidance:** This concerns communication between the C-DAS RU trackside and C-DAS Onboard, and not between C-DAS Onboards.

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

**Status:** Normative

**Rationale:** So that the C-DAS RU subsystem acquires and makes available the most up-to-date data.
3.2 Installation Data

The C-DAS RU Subsystem shall acquire Infrastructure Geography and Static Speed Profile data for relevant routes and train types / ETCS train categories directly from IM business systems via a standard interface.

**CSSR-255**

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<td>Rationale:</td>
<td>This is to ensure that the C-DAS acquires data that has originated from a single authoritative source.</td>
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<tr>
<td>Guidance:</td>
<td>The standard interface is defined in [RD11].</td>
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For data sets that are stored persistently, a means shall be provided for the C-DAS RU Subsystem to verify prior to use that the data set is valid.

**CSSR-258**

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<tbody>
<tr>
<td>Rationale:</td>
<td>To ensure that in TM areas the data used by C-DAS and TM systems is consistent.</td>
</tr>
<tr>
<td>Guidance:</td>
<td>Validating that a persistently stored data set is valid means confirming that it is the latest version available from the data source, that it is not corrupted and is complete, and that it is for the correct area. Prior to use means before a train commences a journey during which elements of the persistently stored data may be used – it is not expected that validation would be required for individual elements within a persistently stored data set before they are used during a journey.</td>
</tr>
<tr>
<td>Guidance:</td>
<td>This validation may involve checking that the version number in each case, together with the identity of the data partition if relevant, matches that of the master source of the data.</td>
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The C-DAS RU Subsystem shall provide a secure facility to allow any C-DAS data stored on the C-DAS Onboard to be updated remotely.

**CSSR-797**

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<tr>
<td>Rationale:</td>
<td>To support update of Installation Data.</td>
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3.3 Operational Data

3.3.1 Schedule

The C-DAS RU Subsystem shall obtain a train’s initial schedule as part of the on-train set-up process.

**CSSR-266**

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<tr>
<td>Rationale:</td>
<td>The C-DAS Onboard needs an initial schedule in order to be able to operate.</td>
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<td>Guidance:</td>
<td>This is done by extracting the relevant schedule from the Plans obtained by the C-DAS RU Subsystem. A Current Plan (generated by Traffic Management) should be used where available, in preference to a Plan generated by Network Rail’s planning system.</td>
</tr>
<tr>
<td>Guidance:</td>
<td>Plan and schedule information will be available from the C-DAS IM Subsystem via the standard interface defined in [RD11]. A Current Plan (generated by Traffic Management) will generally be available</td>
</tr>
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</table>
for a train which performs set-up in a Traffic Management area from
the C-DAS IM Subsystem via the standard interface defined in
[RD11].

Guidance: In order to expedite set-up in a Non-Traffic Management area the C-
DAS RU Trackside might maintain a copy of the Applicable Timetable.

The C-DAS RU Subsystem shall identify the initial schedule for a journey from the Train Running Number each time the Train Running Number changes.

Status: Normative
Rationale: To ensure the C-DAS acquires the schedule applicable to the train journey.

Where more than one schedule can be associated with a particular Train Running Number, the C-DAS RU Subsystem shall be capable of determining the correct schedule for the train in question.

Status: Normative
Rationale: Current GB alphanumeric train running numbers (TRNs) are not unique within a 24hr period and therefore it is necessary to be capable of identifying the correct schedule for a train that shares a TRN with another train to avoid incorrect advisory information being presented to the driver and incorrect information being transmitted to Traffic Management

Guidance: Information is available to support this from the C-DAS IM Subsystem via the standard interface defined in [RD11].

Guidance: Determining the correct schedule could be achieved through a comparison of the reported train location and current time against the schedule information, and/or the presentation of relevant information from the available schedules (for example journey start and destination information) to the driver for selection or verification.

The C-DAS RU Subsystem shall obtain schedule updates from the C-DAS IM Subsystem for trains which have C-DAS in service.

Status: Normative
Rationale: So that the C-DAS uses the up-to-date train schedule.

The C-DAS RU Subsystem shall notify the C-DAS IM Subsystem when a schedule update has been received by the relevant C-DAS Onboard.

Status: Normative
Rationale: So the Traffic Management system is informed that the train is operating with the updated schedule.

3.3.2 Linespeed Profiles

The C-DAS RU Subsystem shall obtain details of all speed restrictions via a standard interface.

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

Guidance: TSRs will be available from the IM’s data systems via the standard interface defined in [RD11]. TSRs and ESRs which affect any parts of Traffic Management areas will be available from Traffic Management via the C-DAS IM Subsystem over the standard interface defined in [RD11]. ESPs applicable to non-Traffic Management areas are not expected to be available but could be made available via an RU specific entry interface.

The C-DAS RU Subsystem shall construct linespeed profiles for individual trains from Static Speed Profile and selected speed restriction data in line with the following rules:

a. The linespeed profile shall reflect Static Speed Profile and speed restrictions appropriate to the train, the journey being undertaken, and the direction of travel in line with the train type(s)/ETCS train categories relevant to that train, and the ETCS operating level.

b. Where an individual speed restriction is being modified, the chronologically later data overrides the previous data.

c. Except where an individual speed restriction is being modified, a speed restriction imposing a lower speed limit for a given train over a given area of track always overrides a speed restriction imposing a higher speed limit for that train on that area, regardless of the type of speed restriction or of the order in which they were created.

d. When an individual speed restriction is removed, any other speed restrictions which apply to the same area of track are retained.

Status: Normative

Rationale: To ensure that C-DAS on an individual train is utilising safe and correct linespeed profile information in the calculation of the advisory speed profiles for the journey being undertaken.

Guidance: Thus, for example a blanket speed restriction does not override any existing TSR or ESR which imposes a lower speed limit; and removing a blanket speed restriction from an area leaves in force any TSRs and ESRs (and PSRs) which apply to the area.

Guidance: The linespeed profile for a train is generated by overlaying any speed restrictions (TSRs, ESRs and blanket speed restrictions) on to the Static Speed Profiles. This must be done in such a way that the revised linespeed profile can be correctly calculated if a speed restriction is subsequently modified or removed. Depending on the protocol by which speed restrictions are made available by LINX / Traffic Management, the C-DAS RU Subsystem may have to retain details of speed restrictions in order to calculate linespeed profiles.

Guidance: On non-ETCS fitted lines, the Sectional Appendix will specify a standard speed and may include in addition one or more differential speeds which cater for different train types. A train may belong to more than one train type, and may also change the set of train types to which it belongs during a journey, e.g. as a consequence of a change of formation or a fault. The Permissible Speed for the train is the highest speed applicable to the train types to which it belongs. Rules for determining the applicable train type and differential speed are documented in GE/RT8000-SP.

For Traffic Management areas the C-DAS RU Subsystem shall use speed restriction data provided by Traffic Management in preference to speed restriction data obtained from the IM’s data systems.

Status: Normative
Rationale: To support consistency between data used by C-DAS and Traffic Management.

Guidance: TSRs will be available from the IM’s data systems prior to set-up. TSRs and ESRs which affect any parts of Traffic Management areas will be available at run-time from Traffic Management. ESRs applicable to non-Traffic Management areas are not expected to be available.

The C-DAS RU Subsystem shall ensure that, subject to any limitations in communications, the applicable linespeed profile is available to a train before the train operates on the relevant part of the rail network.

CSSR-275

Status: Normative
Rationale: So that the advisory speed is calculated on the basis of the up-to-date linespeed profile.

Guidance: The overlay may be performed by the C-DAS RU Trackside and delivered to the train; or the data may be delivered to the train and performed by the C-DAS Onboard. Whichever approach is adopted, it should generally be possible to deliver the relevant data to a C-DAS train subject to any limitations of communications between track and train.

3.4 On-train set-up

3.4.1 Set-up process – All trains

The C-DAS Onboard set-up process shall be performed only in an active driving cab.

CSSR-294

Status: Normative
Rationale: It is not operationally appropriate for C-DAS to operate in an inactive cab.

Guidance: The process of acquiring a full set of set-up parameter values required for a particular journey is known as Full set-up. It is the RU’s responsibility to decide how C-DAS set-up fits within the hierarchy of train systems start-up, and it is also the RU’s responsibility to decide on the action to be taken by the driver in the event that the C-DAS Onboard cannot acquire data from the C-DAS Trackside subsystems at start-up, for example if communications cannot be established.

Guidance: How the C-DAS RU Subsystem identifies the active cab is application-specific.

Guidance: This does not preclude the C-DAS Onboard associated with an inactive driving cab from receiving updates to software or persistently stored data sets.

The C-DAS RU Subsystem shall provide the capability to allow change to any of the set-up parameters independently i.e. without requiring any of the others to be re-acquired.

CSSR-286

Status: Normative
Rationale: To avoid having to go through the whole set up process when only particular changes are required, to minimise the impact on performance due to C-DAS onboard set-up times.
Guidance: The process of changing any of the set-up parameter values is known as Partial Set-up.

Guidance: Changing set-up parameters caters for splitting or joining or changing orientation of passenger trains, or loading / unloading / coupling / un-coupling for freight.

Guidance: Where Driver ID is required to be entered, the ability to change Driver ID mid journey supports a change in driver without the full setup process having to be repeated. Meeting this requirement might for example use a holdover feature such that C-DAS remains operative for a period after the cab is shut down; this would also allow the Partial Set-up process to be used when the driver closes and re-opens the desk. The provision of such a holdover function should be considered against any potential benefits of the new driver having to repeat the Full Setup process, for example re-entry or verification of faults that impact on train capability.

Guidance: It is recommended that manual changes to set-up information only be permitted when the train is at a stand to avoid driver distraction.

The C-DAS RU Subsystem shall support the correction of errors during on-train acquisition of set-up information without the whole set-up process having to be repeated.

CSSR-287

Status: Normative
Rationale: To avoid having to repeat the whole set-up process due to an error.
Guidance: The acquisition of set-up information could be automatic or manual.
Guidance: It is recommended that manual correction of set-up information only be permitted when the train is at a stand to avoid driver distraction.

The C-DAS RU Subsystem shall allow the on-train set-up process (Full or Partial) to be performed during a journey.

CSSR-295

Status: Normative
Rationale: So that changes to set-up data can be completed during a journey to ensure that the C-DAS is utilising the correct data sets in the performance of its functions.
Guidance: The process of acquiring a full set of set-up parameter values is known as Full set-up. The process of changing any of the set-up parameter values is known as Partial Set-up.
Guidance: It is recommended that manual changes to set-up information only be permitted when the train is at a stand to avoid driver distraction.

3.4.2 Set-up data

Before a train commences a journey, the C-DAS RU Subsystem shall acquire the following set-up data as part of an on-train set-up process:
- Train Running Number for the service.
- Train Specific Data (consist and capability data) for the train undertaking the service.

CSSR-296

Status: Normative
Rationale: Train Running Number supports the C-DAS RU Subsystem in identifying the schedule, and possibly the elements of the
Infrastructure Geography and Static Speed Profile and speed restriction data applicable to a particular service. Train Specific Data which defines the consist and capability of the train may be necessary to identify applicable elements of the SSP and, along with the schedule data, for the calculation of advisory information and the provision of non-advisory information specific to the service being undertaken.

Guidance: This acquisition of set-up data could be:
a. Automatic from on- or off-train systems
b. Manually entered by the driver, or
c. A combination of automatic and manual processes, for example, automatic acquisition of data that is presented to the driver for manual validation.

Guidance: In circumstances decided by the RU it may be permitted for Train Specific data to be retained by the C-DAS system from the previous journey and presented to the driver for confirmation. Examples of such circumstances might include when the processing unit of the C-DAS Onboard is shared between two cabs. A list of what might be included in Train Specific Data is provided in Appendix C.

Guidance: Train Specific Data parameter values could be defined as a number of Train Consist and Capability Tables ('presets') which are identified by an index parameter. The index parameter is unique to a combination of train formation and capability, and is selected by the driver or acquired from another on-train system as part of set-up on a fixed formation train. Each index parameter identifies the relevant parameter values from the Train Consist and Capability Table ('preset'). This approach to defining and acquiring Train Specific Data parameter values reduces the amount of data required to be entered or acquired at set-up, reducing set-up time and minimising the occurrence of data entry errors. This approach could also be used on locomotives that usually form part of variable formation trains but which may form part of commonly used "fixed" formations.

Where required by the RU, the C-DAS RU Subsystem shall acquire information as part of setup that identifies the driver of the service.

CSSR-288

Status: Application-specific
Rationale: To support the identification of the driver undertaking a journey for purposes particular to the RU.

Guidance: This acquisition of driver identification (Driver ID) data could be:
a. Automatic from an RU crew management system or from other on- or off-train systems
b. Manually entered by the driver, or
c. A combination of automatic and manual processes.

Guidance: This information could be utilised as a means of restricting C-DAS access to drivers that are competent to operate with the system. It may also support the provision of journey performance information to individual drivers on completion of a journey or set of journeys.

Guidance: The RU is responsible for defining the format of the Driver ID. In specifying the Driver ID format, consideration should be given to it being supportable within the constraints placed by the ETCS specifications.

The C-DAS RU Subsystem shall support current GB alphanumeric Train Running Numbers.

CSSR-498

Status: Normative
Rationale: Train Running Numbers will be used to identify the particular train service and to identify the applicable schedule data. Current GB alphanumeric Train Running Numbers are expected to remain in use for the foreseeable future.

Guidance: In GB, the TRN currently consists of a four-digit alphanumeric number (for example, 1L26), which contains three pieces of information:

a. The class of train.
b. An indication of destination and possibly stopping pattern.
c. The Train's identification or line of route.

Guidance: TRNs in GB are not unique and can be used more than once within the same 24-hour period, and/or for services on different routes. This can result in duplicate TRNs appearing in a signaller's area of control. However, as the control areas increase through the introduction of a traffic management layer and much larger signalling control centres, duplicate TRNs may become more operationally problematic. Therefore, it is likely that GB will gradually migrate towards the European all numeric TRN, as these are designed to be unique, thus eradicating the possibility of duplicate TRNs. This migration towards all numeric TRNs will probably take many years.

The C-DAS RU Subsystem shall support a migration to 8-digit TSI-compliant Train Running Numbers.

<table>
<thead>
<tr>
<th>Status</th>
<th>Normative</th>
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<tbody>
<tr>
<td>Rationale</td>
<td>To future proof the C-DAS against a future migration of TRN format.</td>
</tr>
<tr>
<td>Guidance</td>
<td>TRNs in GB are not unique and can be used more than once within the same 24-hour period, and/or for services on different routes. This can result in duplicate TRNs appearing in a signaller's area of control. However, as the control areas increase through the introduction of a traffic management layer and much larger signalling control centres, duplicate TRNs may become more operationally problematic. Therefore, it is likely that GB will gradually migrate towards the European all numeric TRN, as these are designed to be unique, thus eradicating the possibility of duplicate TRNs. However, this migration towards all numeric TRNs is likely to take many years.</td>
</tr>
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</table>

The C-DAS RU Subsystem shall identify the schedule applicable to a train service from the Train Running Number information acquired as part of set-up.

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<tr>
<th>Status</th>
<th>Normative</th>
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<tbody>
<tr>
<td>Rationale</td>
<td>Schedule data for a particular service is identified by TRN.</td>
</tr>
<tr>
<td>Guidance</td>
<td>Because current GB alphanumeric TRNs are not unique and can be used more than once within the same 24-hour period there may be duplicate TRNs each with an associated schedule. Identifying the correct schedule for a particular train may therefore require additional input parameters, for example train location and time, to be utilised.</td>
</tr>
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</table>

The C-DAS RU Subsystem shall provide a means for confirmation that the schedule it has acquired is correct to be provided as part of set-up.

| Status       | Normative |
Rationale: Allows for additional confirmation that the acquired schedule is correct.

Guidance: This validation may involve manual confirmation from the driver based on the provision of additional details of the service, e.g. origin and destination locations and times.

Guidance: This may be particularly important where current GB Alphanumeric TRNs are used to identify the schedule and there are other services with the same TRN.

The C-DAS RU Subsystem shall have the capability to retain on-train set-up data for a pre-defined interval when the driver’s desk is closed (‘holdover capability’).

CSSR-304

Status: Application-specific
Rationale: To avoid the need to re-acquire set-up data when the driver’s desk is re-opened after being temporarily closed.

Guidance: Drivers are, on occasion, required to leave the driving cab to perform other duties, for example to reset a passenger alarm or operate safety systems. At driver handover, drivers may also close the driving desk to retain their driving keys with another driver taking over and continuing the journey.

If required by the RU, the C-DAS RU Subsystem on a passenger train shall allow the train orientation to be confirmed or corrected as part of set-up.

CSSR-299

Status: Application-specific
Rationale: To enable C-DAS to identify changes to the normal location of specific coaches, for example buffet cars, PRM access ramps or first-class sections. This could support Traffic Management’s provision of passenger information and to support station services.

Guidance: It is likely that this would be manually input by the driver.

The C-DAS RU Subsystem shall provide a means for Train Specific Data for an individual train to be amended in line with any known train defect.

CSSR-305

Status: Application-specific
Rationale: To enable the C-DAS to acquire the current data for train capability in the event of a train defect to ensure advisory information accurately reflects the capability of the train.

Guidance: Defects might include reduced traction, isolated brakes, impaired tilt system or faulty doors, which may limit maximum speed and / or result in reduced acceleration or deceleration, or increased dwell time. A list of what might be included in Train Specific Data is provided in Appendix C.

Guidance: Amendments to Train Specific Data could be obtained:
a. Automatically from on- or off-train systems
b. Manually entered by the driver, possibly from a menu of defects and using an internal look-up table to derive the Train Specific Data value which the driver could be prompted to confirm.
c. A combination of automatic and manual processes, for example, automatic acquisition of data that is presented to the driver for manual validation.

Guidance: Consideration could be given to retaining amendments to train specific data due to train defects between journeys to ensure that train defect information is not omitted during the next setup process.
Alternatively, it may be considered appropriate to clear amendments between journeys if driver handover procedures are considered to adequately ensure that train defect information is not lost.

The C-DAS RU Subsystem shall permit Onboard operation to be enabled only if all the following conditions are met:

a. Set-up information has been acquired
b. Train schedule for the current journey has been identified
d. All the application data required to be available to the C-DAS Onboard has been acquired and confirmed to be current
e. Time has been synchronised with Network Time Servers linked to a trusted local time source.

**Status:** Normative  
**Rationale:** To ensure that the C-DAS Onboard cannot operate unless it has all the data it requires to perform to specification.

The C-DAS RU Subsystem shall indicate to the driver if the conditions for onboard operation to be enabled are not met.

**Status:** Normative  
**Rationale:** So that the driver is made aware if the C-DAS has not acquired or identified any part of the necessary data so that the requisite corrective actions can be taken.  
**Guidance:** It is the responsibility of the RU to specify the appropriate actions.

### 3.5 Advisory information calculations

The C-DAS RU Subsystem shall calculate advisory information for each train on which the C-DAS Onboard is operational, which is consistent with:

- The schedule to which the train is operating;
- The Infrastructure Geography for the route and track on which the train is operating;
- The linespeed for the route, track, and train type/ETCS train category, including all speed restrictions for which data is available;
- Train specific data i.e. the physical characteristics and capabilities of the train.
- The current location and speed of the train.

**Status:** Normative  
**Rationale:** To enable energy-efficient train operations within the constraints of the required network performance, and the capabilities of the infrastructure and train.  
**Guidance:** This will require the ability to identify the line the train is currently operating on and select the Infrastructure Geography and linespeed data corresponding to that line.  
**Guidance:** Accurate identification of the line the train is operating on supports the mitigation of hazards resulting from providing incorrect advisory information, particularly where the advisory information is presented to the driver in the form of a speed value to drive at. Providing advice for a line other than the one on which the train is operating might occur if there were to be a change of running line that had not
been notified to the C-DAS by Traffic Management, and will occur in non-TM areas if a train is routed away from the line identified in the currently held schedule data.

Guidance: The preference is that the determination of the current running line should be automatic but manual intervention is possible. An example of how manual intervention might work is through the display of "other advisory" information including the identity of the line the advisory information is for and providing the capability for the driver to enter the line the train is operating on.

The C-DAS RU Subsystem shall take account of the speed envelope that will be enforced by any automatic train protection system present when calculating running times and speed profiles.

**CSSR-317**

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<tr>
<th>Status:</th>
<th>Normative</th>
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<tr>
<td>Rationale:</td>
<td>To ensure that the advisory calculations consider all limitations on the speed profiles applicable to a train.</td>
</tr>
<tr>
<td>Guidance:</td>
<td>This concerns consistency with the speed profile input to the automatic train protection system speed supervision function, rather than the automatic train protection supervision profiles calculated from that speed profile input. There is no intent for C-DAS to take account of the supervision profiles because this would require knowledge of the signal state and any braking calculations performed by the ATP system.</td>
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</table>

The C-DAS RU Subsystem shall calculate advisory information based on the most recent data to which it has access, in respect of:
- Train Specific Data
- Train schedule
- Train running line
- Infrastructure Geography
- Static Speed Profiles and other speed restrictions.

**CSSR-318**

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<thead>
<tr>
<th>Status:</th>
<th>Normative</th>
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<tr>
<td>Rationale:</td>
<td>So that advisory information is based on the best available data in the current circumstances. This requirement also supports continued C-DAS operation in a non-TM area albeit without the ability to receive near-real time schedule updates.</td>
</tr>
<tr>
<td>Guidance:</td>
<td>This may be the data obtained and / or confirmed at Set-up, or modified with any updates received during the journey.</td>
</tr>
<tr>
<td>Guidance:</td>
<td>To meet this requirement, the C-DAS RU Subsystem will need to monitor the progress of each train towards its next Timing Point, and to determine when a train has been re-routed from the line specified in the train's current schedule.</td>
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The C-DAS algorithms shall calculate advisory information appropriate to the particular type of route, service pattern, and traffic type (passenger, freight etc.).

**CSSR-320**

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<tr>
<th>Status:</th>
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<tr>
<td>Rationale:</td>
<td>So that specific route characteristics are considered, to ensure effective and efficient advisory information for that operating environment.</td>
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<tr>
<td>Guidance:</td>
<td>The specific route characteristics are to be agreed with the RU.</td>
</tr>
</tbody>
</table>
The C-DAS RU Subsystem shall calculate advisory information which is consistent with expected driving profiles for acceleration and braking.

**Status:** Normative

**Rationale:** Assuming the train is operated at maximum acceleration and braking capability rather than how it is actually driven could lead to trains not being able to meet the schedule if these exceed the limits set in the RU’s professional driving policy.

The C-DAS RU Subsystem shall use schedule timing tolerances (where available), subject to the following conditions:

a. Arrival at a stopping station shall be no later than the publicly advertised arrival time
b. Departure from a stopping station shall be no earlier that the publicly advertised departure time.

**Status:** Normative

**Rationale:** To achieve improved performance (network capacity or energy) by not constraining trains to meet exact times at scheduled Timing Point Locations, but permitting them to arrive, depart or pass earlier or later within the tolerance set by TM.

**Guidance:** “Schedule timing tolerances” define the earliest and latest time which are acceptable, i.e. which do not adversely affect other trains. Schedule tolerances are not expected to be available in Non-Traffic Management Areas.

**Guidance:** Publicly advertised times will generally be those in the published timetable, but can also be as updated in the event of disruption.

### 3.6 Driver interface

#### 3.6.1 Advisory Information

The C-DAS RU Subsystem shall display advisory information that supports drivers in safely and efficiently satisfying the performance and energy usage requirements for the journey being undertaken.

**Status:** Normative

**Rationale:** To improve driving efficiency without compromising safety.

**Safety Measures:** C-H4, C-H8, C-H9, C-H10, C-H11, C-H27, C-H31

**Guidance:** The display of advisory information could be realised in many ways, including, but not limited to:

a. A time-based display of early or late running against the current schedule.
b. A speed based display utilising a graphical representation of current train speed against an advisory speed profile.
c. Text based advice of the speed to drive at, or to coast.

Advisory information could also include Countdown timers to the scheduled / expected station departure time so that the driver is made aware of the scheduled station departure time and can prepare accordingly.
Guidance: Indications from driver trials of DAS systems by various operators are that a text-based speed value was overwhelmingly preferred. The other two options were found to be difficult to interpret, distracting, and increased driver workload.

Where advisory information is speed based, the C-DAS RU Subsystem shall provide an indication of an approaching change to that advice.

CSSR-327

Status: Preferred
Rationale: To support drivers in preparing for a change in advice and to minimise driver distraction resulting from continuous monitoring of the C-DAS display.
Safety Measures: C-H30

Guidance: It is recommended that approaching changes to advice be displayed only when it is to take effect within a pre-defined time or distance. The time or distance should be such that approaching changes are displayed sufficiently early that the driver has time to respond. The display of approaching advice should also be consistent with the display refresh cycle so that the driver does not need to continually monitor the C-DAS display.

Where advisory information is in the form of an advice speed, the C-DAS RU Subsystem shall only display an advice speed (current or approaching change) which is no higher than the most restrictive speed for the train.

CSSR-325

Status: Normative
Rationale: To avoid advising the driver to exceed the maximum permitted speed for the train and the location.

Guidance: The most restrictive speed of the train is determined from maximum train speed, applicable static speed information and all relevant speed restrictions, and current train position.

Guidance: The RU should consider whether the C-DAS may display an advice speed value which is less than or equal to the most restrictive speed of the train, or only a speed which is strictly lower.

Where advisory information is in the form of an advice speed, the C-DAS RU Subsystem shall only display an advice speed (current or approaching change) which is higher than a pre-configured minimum advice speed for the train.

CSSR-261

Status: Normative
Rationale: To avoid advising the driver to drive at a speed that is not drivable.

The C-DAS RU Subsystem shall not advise drivers on when or where to brake.

CSSR-326

Status: Normative
Rationale: C-DAS is an advisory system and all responsibility for braking the train must remain solely with the driver.

The C-DAS RU Subsystem shall control the refresh of the advisory information display in line with pre-defined conditions agreed with the RU.

CSSR-328
**Status:** Normative  
**Rationale:** To allow for optimisation of advisory information display refresh rate for a particular service type to minimise driver distraction while allowing for sufficiently frequent updates to maximise performance.

**HF Measure:** Yes  
**Safety measure:** C-H30  
**Guidance:** The predefined conditions should allow the RU to choose between frequent (possibly small and/or transient) adjustments to the displayed advice speed that if followed would optimise energy usage, and less frequent changes that would not require the driver to monitor the advice display constantly.

**Guidance:** Options might include:
- a. Limiting updates to 5 mph (or 5km/h) intervals
- b. Setting a minimum time interval between consecutive advice changes, which will only be overridden when the receipt of new data results in a change to advisory information which takes effect within less than a pre-defined time or distance threshold.

**Guidance:** The determination of the appropriate refresh rates should include a driver workload review.

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The C-DAS RU Subsystem shall provide a means to indicate to the driver when the receipt of new data results in a change to advisory information (current and/or approaching changes) which takes effect within less than a pre-defined time or distance threshold.

**CSSR-329**

**Status:** Preferred  
**Rationale:** To draw to the driver's attention any changes in advisory information that have an imminent impact

**HF Measure:** Yes  
**Safety Measure:** C-H30

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The C-DAS RU Subsystem shall display an indication to the driver that supports the determination of where or when current advice will change (i.e. when the approach advice will become current).

**CSSR-330**

**Status:** Preferred  
**Rationale:** So that the driver isn't tempted to check continuously whether the advisory information has changed or is about to change.

**HF Measure:** Yes  
**Safety Measures:** C-H30  
**Guidance:** This indication could be achieved via a countdown or similar functionality to indicate where the approach advice is to become current, and could typically be dependent on a configurable time or distance to go until the change in advisory information.

**Guidance:** The form of the indication should consider the risks associated with distracting the driver from other priority tasks. For example, a countdown to a change in advisory information is one possibility for meeting this requirement, although countdown displays are known to draw and maintain attention.

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

**CSSR-343**
Status: Normative

Rationale: Displaying selected, non-advisory, information may enable the driver to compare his/her knowledge with the data being used by the C-DAS, and thus to evaluate the C-DAS advice. It may also support the driver in the completion of other driving tasks, for example identifying the correct stopping location in a station platform.

HF Measure: Yes

Safety Measures: C-H1, C-H2, C-H3, C-H4, C-H8, C-H9, C-H10, C-H11, C-H20, C-H25,

Guidance: The RU will identify the non-advisory information to be displayed and any associated rules (e.g. frequency of update of current location). Non-advisory information that could be considered for display includes, but is not limited to:

a. Journey segment information: next Timing Point and next station or other stop, each with scheduled arrival time; current running line, current location;

b. Current time, This may be dependent on the availability of another in-cab local time display which aligns with TM time

c. Route look-ahead: Distance scale, Timing Point and station locations, Permissible Speeds with start and end locations, TSR speeds with start and end locations, and ESR start and end locations;

d. Train consist / formation, traction type and train weight, maximum speed, length, current power mode (where applicable), indicators of reduced train performance capabilities: e.g. speed, traction, braking, tilt, door performance.

Guidance: Displaying selected non-advisory information may enable the driver to distinguish the following three situations and to react accordingly to the C-DAS advisory information:

a) The non-advisory information display coincides with what the driver already knows; in this case the display serves to reinforce that knowledge.

b) The non-advisory information display shows information that is not yet known to the driver; in this case the display prepares the driver for upcoming changes. (Examples might include: a schedule update, or an ESR which has already been boarded.

c) The non-advisory information display does not reflect driver knowledge; in this case the display serves to notify the driver that the C-DAS data is not fully up to date, with the result that driver knows to discount C-DAS advisory information in favour of driver knowledge. (Examples might include: train rerouted from fast to slow line or vice versa, a change to stopping pattern, a TSR where the lineside signage differs from published details, or a new ESR whose data has not yet been made available to the C-DAS.)

Guidance: Displaying non-advisory information may also mitigate risk by highlighting anomalies (e.g. driver data entry errors, or the line for which the advisory information is applicable differing from the train’s current location) thus in effect prompting the driver to take appropriate action.

Guidance: It is recommended that there is a clear visual distinction between the advisory and non-advisory information displays. Where a route look-ahead display is provided, it is recommended that a means be provided to distinguish speed restriction information (TSR, ESR, BSR) from Permissible Speed information. Consideration could also be given to providing a visual distinction between different types of speed restriction.
If required by the RU, the C-DAS RU Subsystem shall have the capability to provide feedback to drivers on their driving efficiency after the end of the journey.

**CSSR-346**

**Status:** Application-specific

**Rationale:** Because this could be useful for the drivers and encourage use of the system.

**HF Measure:** Yes

**Guidance:** This is intended to be solely for the driver’s benefit and could include time keeping against schedule and/or fuel consumption.

The C-DAS RU Subsystem shall automatically display any speed based advisory information in the same units (mph or km/h) as used on the in-cab speedometer.

**CSSR-512**

**Status:** Normative

**Rationale:** To avoid providing conflicting information to the driver

**Safety Measure:** C-H121

**Guidance:** Trains which are ETCS-fitted will display speed information in km/h or mph depending on ETCS operating level and the unit requirements of the area in which the train is operating, in accordance with GE/RT8402: ERTMS/ETCS DMI National Requirements. Trains which operate on High Speed 1 route (St. Pancras International – Eurotunnel Boundary plus associated lines) display speeds in km/h. Almost all other trains operating on other routes display speeds in mph. For speed display detail see route specific contract documentation.

**Guidance:** Display units will be specified within the Infrastructure Geography

The C-DAS RU Subsystem shall display distance information in the units defined in route specific contract documentation.

**CSSR-513**

**Status:** Normative

**Rationale:** To avoid providing conflicting information to the driver

The C-DAS RU Subsystem shall automatically switch between on-train display units for speeds and distances.

**CSSR-331**

**Status:** Normative

**Rationale:** To avoid increasing driver workload and minimise the risk of incorrect or delayed manual selection of on-train display units.

**Guidance:** Automatic means without requiring driver intervention

### 3.6.2 Suppress and Unsuppress

The C-DAS RU Subsystem shall support the automatic suppression of displayed information on detection of a situation where it could be incorrect or unhelpful.

**CSSR-333**

**Status:** Normative

**Rationale:** To avoid situations or conditions where the potential for conflict between advisory information and safety critical information is high or where C-DAS might be likely to detract from driver performance.

**HF Measure:** Yes
Safety Measures: C-H1, C-H2, C-H4, C-H5, C-H10, C-H15, C-H17a, C-H25, C-H30, C-H102, C-H122

Guidance: Situations where automatic suppression might be required include, but are not limited to:

a. C-DAS does not have access to all the data it requires for correct operation, including current train location and speed.
b. C-DAS detects an inconsistency between the route or schedule data available to a train and the train’s actual location.
c. The train is in a pre-defined ‘auto-suppress’ area.
d. On receipt of an input which indicates that an on-train protection or warning system is providing a brake intervention or indicating a need to reduce speed.

Guidance: Pre-defined auto-suppress areas could include station or other complex areas, permissive platforms or permissive freight lines.

Guidance: The RU should determine conditions for the automatic suppression of advisory information using a suitable risk based approach. For position based suppression, any known positional uncertainty inherent in how train location is determined should be considered. This avoids the C-DAS auto-suppressing on the grounds that the train is no longer following the planned route unless the discrepancy between estimated position and the planned route exceeds the inherent error in the position estimation. It may be necessary for C-DAS not to suppress the display until it can obtain an independent indication that the train’s location is inconsistent with the schedule, routing or linespeed data available to it.

Guidance: Consideration should be given to providing an indication to the driver that suppression is active, and possibly also the reason for the suppression.

The C-DAS RU Subsystem shall provide the capability for suppression to affect the display of advisory or non-advisory information differently depending on the suppression reason.

CSSR-341

Status: Application-Specific

Rationale: It may be suitable to maintain the display of specific information as it is still useful to the driver, whilst suppressing other information which could be incorrect or unhelpful.

HF Measure: Yes

Safety Measures: C-H1, C-H2, C-H4, C-H13, C-H14, C-H15, C-H17, C-H25

Guidance: The following table indicates how the display might reflect the various suppression conditions.

<table>
<thead>
<tr>
<th>System Status</th>
<th>Advisory Information</th>
<th>Non-Advisory Information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Journey Segment Information</td>
<td>Countdown timers</td>
</tr>
<tr>
<td>Display not suppressed, system not disabled</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Automatic Suppression (Inconsistency between route or schedule data and trains actual location)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automatic Suppression (all)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
If automatic suppression is supported, the C-DAS RU Subsystem shall automatically unsuppress the display of advice speed when no auto-suppress conditions apply.

**CSSR-337**

<table>
<thead>
<tr>
<th>Status:</th>
<th>Normative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale:</td>
<td>So that the advisory information is made available to the driver when no auto-suppress conditions are applied.</td>
</tr>
<tr>
<td>Guidance:</td>
<td>To avoid transient display changes due to automatic suppression and un-suppression which could distract the driver from the main driving tasks, consideration should be given to configuring a minimum time between display suppression and unsuppression.</td>
</tr>
</tbody>
</table>

The C-DAS RU Subsystem shall allow the display of advisory and non-advisory information to be manually suppressed and unsuppressed.

**CSSR-339**

<table>
<thead>
<tr>
<th>Status:</th>
<th>Normative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale:</td>
<td>To allow the RU to decide whether to offer drivers an alternative to ignoring advisory information which they consider misleading or distracting.</td>
</tr>
<tr>
<td>HF Measure:</td>
<td>Yes</td>
</tr>
<tr>
<td>Safety Measures:</td>
<td>C-H1, C-H2, C-H4, C-H13, C-H14, C-H15, C-H17, C-H25, C-H102, H103, C-H104</td>
</tr>
<tr>
<td>Guidance:</td>
<td>The design of the manual suppression should consider the accessibility and ease of activation of the controls.</td>
</tr>
<tr>
<td>Guidance:</td>
<td>Consideration should be given to the interaction between automatic and manual suppression and unsuppression, for example if an automatic suppression is active, should manual unsuppression override it and vice versa.</td>
</tr>
<tr>
<td>Guidance:</td>
<td>Consideration should be given to providing an indication to the driver that suppression is active, and possibly also the reason for the suppression.</td>
</tr>
</tbody>
</table>
3.6.3 Driver input (other than set-up)

Other than during set-up, the C-DAS RU Subsystem shall update the display without driver involvement.

**CSSR-595**

- **Status:** Normative
- **Rationale:** To minimise driver distraction
- **HF Measure:** Yes
- **Guidance:** Without driver involvement includes no requirement for a driver acknowledgement of data updates.

The C-DAS RU Subsystem shall provide the capability for the driver to enter or select the current running line.

**CSSR-347**

- **Status:** Application-Specific
- **Rationale:** To trigger the C-DAS to stop providing advisory and other information for a line on which the train is not operating and, if the data is available, to provide updated advisory and other information for the actual line.
- **Guidance:** This would be used when there has been a change to running line which has not been notified to the C-DAS or which it has not automatically detected, and the C-DAS is therefore providing advice for a different line from the one on which the train is operating.
- **Guidance:** The current running line could be manually entered by the driver or selected from a menu of running lines near the train position.

The C-DAS RU Subsystem shall have the capability to allow the driver to enter or select a delay attribution code.

**CSSR-348**

- **Status:** Application-specific
- **Rationale:** Feedback from the RUs is that this can be more convenient for the driver than having to provide information manually after the journey.
- **Guidance:** It is expected that the driver will be permitted by operational procedure to input such data only when the train is at a standstill.
- **Guidance:** It is expected that structured input will be used wherever possible.

3.6.4 Degraded operations and Disable

The C-DAS RU Subsystem shall provide a means for the driver to infer whether the display has ‘frozen’.

**CSSR-350**

- **Status:** Normative
- **Rationale:** So that the driver is not misled by advisory information when the display cannot be updated.
- **Safety Measures:** C-H7, C-H30
- **Guidance:** This does not necessitate the provision of a specific indication for this purpose if it is considered acceptable for this to be inferred from another indication or information display, for example the change in the seconds count in the display of current time.
The C-DAS RU Subsystem shall provide a means for the driver to disable operations on the C-DAS Onboard.

**Status:** Normative

**Rationale:** To provide the driver with the means to switch off the C-DAS Onboard when its use is not required or could lead to incorrect advisory or non-advisory information being displayed.

**Guidance:** This might be used for operational reasons (e.g. entry into an area with degraded infrastructure or subject to a possession), or if the driver detects that the C-DAS Onboard has acquired incorrect data or is faulty.

**Guidance:** It may be useful for the driver to be able to determine whether C-DAS operation has been disabled.

**Guidance:** No advice or other information should be displayed by the C-DAS onboard once the C-DAS has been disabled. Any requirement for the continued display of information with C-DAS disabled should consider the reasons why disabling might be necessary.

Once on-train operation of the C-DAS RU Subsystem has been disabled a full set-up of the C-DAS onboard shall be required before on-train operation may resume.

**Status:** Normative

**Rationale:** So that Disable serves as a complete 'reset' of the C-DAS Onboard to avoid the re-use of setup information that may no longer be applicable.

**HF Measure:** Yes

**Safety Measures:** C-H8, C-H9, C-H10, C-H11, C-H31

### 3.6.5 DMI design

The C-DAS RU Subsystem shall have the capability to adjust display brightness settings of the Onboard display.

**Status:** Normative

**Rationale:** To ensure the driver is not distracted by the brightness of the C-DAS onboard display being inappropriate to the local operating environment.

**Guidance:** The display brightness adjustment facility may be automatic, may require driver intervention, or be a combination of the two.

**Guidance:** An automatic adjustment facility could automatically switch between pre-defined night and day brightness settings, or support a range of brightness settings between a pre-defined minimum and maximum brightness depending on detected ambient light levels. Consideration could also be given for further manual "tuning" of display brightness from the automatically selected brightness level to suit the individual driver in a range of visibility conditions.

**Guidance:** Where display brightness adjustment is automatic, display brightness changes due to detected low ambient light conditions should occur quickly enough that drivers are not distracted by an over-bright display (for example when entering a tunnel), but avoid
adjusting the brightness for short duration changes in ambient light (for example due to passing under a bridge).

Guidance: Where brightness levels can be adjusted manually, consideration should be given to whether the driver can reduce the brightness of the display to a level where the information presented is not visible. Reducing the brightness of the display to this extent has been utilised on some DAS implementations as a means to manually suppress the display.

3.7 Reporting

The C-DAS RU Subsystem shall send Train Registration data to the C-DAS IM Subsystem at on-train set-up.

CSSR-367

Status: Normative
Rationale: To provide initial C-DAS Onboard Set-up and Train Specific Data to Traffic Management for use in regulation activities.
Guidance: Train Registration data includes Set-up data and Train Specific Data.

The C-DAS RU Subsystem shall send revised Train Registration data to the C-DAS IM Subsystem when any change to these values occurs en route.

CSSR-368

Status: Normative
Rationale: To provide current C-DAS Onboard Set-up and Train Specific Data to Traffic Management for use in regulation activities.
Guidance: Train Registration data includes set-up data and Train Specific Data.

The C-DAS RU Subsystem shall have the capability to provide the C-DAS IM Subsystem with train location, speed and datum time for each of the trains on which it is operating.

CSSR-370

Status: Normative
Rationale: To provide this information to benefit the operation of other systems.
Guidance: The datum time must be in the time reference frame used by the C-DAS RU subsystem.

The C-DAS RU Subsystem shall send the C-DAS IM Subsystem the predicted time at which a train will reach a Timing Point if the C-DAS Onboard detects that the train will not be able to achieve the time specified in its current schedule.

CSSR-371

Status: Normative
Rationale: To provide early indication that a train is not going to meet a target location at the specified time.
Guidance: The prediction should be a ‘best case’ estimate, based on the assumption that the train will not encounter restrictive aspects.

The C-DAS RU Subsystem shall provide to the C-DAS IM Trackside Subsystem the current operating state of each C-DAS Onboard.

CSSR-372

Status: Normative
Rationale: To provide the state of the C-DAS Onboard to enable a person or system to act accordingly (e.g. to make a manual intervention in the train schedules).

Guidance: Operating states will include:
- C-DAS fitted and working
- C-DAS fitted but not communicating
- S-DAS/N-DAS fitted
- S-DAS/N-DAS not working

Where the capability to allow the driver to enter or select a delay attribution code is provided, the C-DAS RU Subsystem shall provide the C-DAS IM Subsystem with any available delay attribution information relating to individual trains.

Status: Normative
Rationale: The provision of delay attribution information contributes to network performance and delay attribution analysis.

The C-DAS RU Subsystem shall include provision to enable remote monitoring or recording of DMI output.

Status: Preferred
Rationale: To support driver training and instructor monitoring of driving performance with C-DAS during training and service conditions.

### 3.8 Messaging and Telecommunications

The C-DAS RU Subsystem shall be able to exchange data with Traffic Management whenever new data becomes available.

Status: Normative
Rationale: To support train regulation activities.
Guidance: This will be subject to availability of the underlying communications capability.
Guidance: Achieving this for a TM area will require mobile communications between trackside and onboard elements that support the system latency requirements. This would likely require the use of packet switching. The use of GSM-R is not preferred.

The C-DAS on each train shall initiate communications with the C-DAS RU Trackside in order to perform C-DAS set-up.

Status: Normative
Rationale: Because the train knows the (fixed) communications address of the RU Trackside.
Guidance: It is anticipated that the Onboard will use a fixed communications address or a communications address acquired at start-up in order to communicate with the appropriate C-DAS RU Trackside.
Followling any loss of communications between the C-DAS Onboard and the C-DAS RU Trackside, the C-DAS Onboard shall attempt to restore communications with the C-DAS RU Trackside.

**CSSR-381**

- **Status:** Normative
- **Rationale:** Because the C-DAS Onboard knows the communications address of the C-DAS RU Trackside.

The C-DAS RU subsystem shall preserve message ordering.

**CSSR-382**

- **Status:** Normative
- **Rationale:** To ensure that each C-DAS subsystem processes related data messages in the order in which they were generated
- **Guidance:** The C-DAS RU subsystem must forward messages in the order in which it receives them.

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

**CSSR-383**

- **Status:** Normative
- **Rationale:** To avoid delays in making data available to user subsystems and systems.

The C-DAS RU subsystem shall have the capability to receive messages at any time.

**CSSR-384**

- **Status:** Normative
- **Rationale:** To avoid delays in making data available to user subsystems and systems.

The C-DAS RU subsystem shall transmit and receive the data messages which comply with the IM-RU Interface Specification [RD11].

**CSSR-385**

- **Status:** Normative
- **Rationale:** To support the standardised interface, and hence enable development of C-DAS products which is independent of development of Network Rail systems.

The C-DAS RU subsystem shall construct and de-construct the data messages specified in the IM-RU Interface Specification [RD11].

**CSSR-386**

- **Status:** Normative
- **Rationale:** To support the standardised interface, while also allowing C-DAS product suppliers to maintain proprietary data formats for internal processing.
- **Guidance:** The formats of the other data messages involved are: supplier-specific format for messages to/from trains, and as specified in [RD18] for messages to/from LINX and Traffic Management.

The C-DAS RU Trackside shall deliver to each affected C-DAS Onboard the relevant data content of messages it receives from the C-DAS IM Trackside.

**CSSR-387**
Status: Normative
Rationale: To pass on to the relevant C-DAS Onboard all data received from the C-DAS IM Subsystem.

The C-DAS RU Trackside shall deliver to the C-DAS IM Trackside the relevant data content of messages received from any C-DAS Onboard.

CSSR-388

Status: Normative
Rationale: To pass on to the C-DAS IM Subsystem all data received from the C-DAS Onboard.

The C-DAS RU subsystem shall time stamp each message it constructs.

CSSR-391

Status: Normative
Rationale: So that the receiver of the message can determine whether the data contained in the message is time-expired.
Guidance: This requirement applies to messages passed (in either direction) between the C-DAS RU Subsystem and C-DAS IM Subsystem, as specified in the IM-RU Interface Specification [RD11].

The C-DAS RU subsystem shall include the Unique Train Identifier in each message sent to or from a C-DAS Onboard.

CSSR-392

Status: Normative
Rationale: To ensure that data is routed to and received by the correct C-DAS Onboard.
Guidance: The Unique Train Identifier is provided to C-DAS as part of the schedule data during set-up.

The C-DAS RU subsystem shall confirm receipt of messages from the C-DAS IM subsystem as specified in the C-DAS IM-RU Interface Specification [RD11].

CSSR-393

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.

The C-DAS shall utilise a guaranteed message delivery system between the C-DAS RU and IM Subsystems.

CSSR-394

Status: Normative
Rationale: To ensure that no messages are lost in transit between the C-DAS RU and IM Subsystems.

3.9 Time synchronisation

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

CSSR-398
Status: Normative
Rationale: To be consistent with Network Rail’s Traffic Management system
Safety Measures: C-H21

The C-DAS RU Subsystem shall use local time based on UTC for the display of time information.

CSSR-514

Status: Normative
Rationale: UTC is an accurate universally accepted reference for time and allows C-DAS to maintain time in a manner consistent with Traffic Management.

3.10 Faults and Failures

The C-DAS RU Subsystem shall provide the driver with a means to initiate a test that the equipment is working correctly.

CSSR-400

Status: Preferred
Rationale: So that the driver can check the equipment is functioning correctly, and respond accordingly.

Guidance: If the C-DAS is not working correctly the driver should disable C-DAS and inform the RU’s operations control.

The C-DAS RU Subsystem shall if possible log in the journey record of an individual train any faults it detects in its own operation.

CSSR-401

Status: Normative
Rationale: To support corrective maintenance and failure analysis.

The C-DAS RU Subsystem shall disable on-train operations if it detects a fault from which it cannot recover.

CSSR-404

Status: Normative
Rationale: So that the C-DAS does not continue to operate with a known functional issue.

The C-DAS RU 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.

CSSR-436

Status: Preferred
Rationale: To support maintainability of the system and contribute to achieving availability targets.

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

CSSR-437

Status: Preferred
Rationale: To support the maintenance organisation in the provision of effective and efficient maintenance, and reduce staff exposure to the railway.

3.11 Logging (journey records)

The C-DAS RU Subsystem shall maintain the journey record of an individual train at all times when it (the C-DAS) is operational on the train.

**CSSR-406**

<table>
<thead>
<tr>
<th>Status:</th>
<th>Normative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale:</td>
<td>So that the record for the complete journey is available to support any necessary incident analysis.</td>
</tr>
<tr>
<td>Guidance:</td>
<td>It is anticipated that journey records may be requested by the Infrastructure manager occasionally on an ad hoc basis to support network performance analysis and timetable improvement programmes.</td>
</tr>
<tr>
<td>Guidance:</td>
<td>The maintenance of journey records should be independent of onboard suppression.</td>
</tr>
</tbody>
</table>

The C-DAS RU Subsystem shall include in the journey record of an individual train all changes in Train Registration data.

**CSSR-407**

<table>
<thead>
<tr>
<th>Status:</th>
<th>Normative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale:</td>
<td>To ensure that there is an accurate and up to date log of changes in the inputs to C-DAS.</td>
</tr>
<tr>
<td>Guidance:</td>
<td>Train Registration data includes set-up data and Train Specific Data.</td>
</tr>
</tbody>
</table>

The C-DAS RU Subsystem shall include in the journey record of an individual train any driver input that impacts on C-DAS operation.

**CSSR-408**

<table>
<thead>
<tr>
<th>Status:</th>
<th>Normative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale:</td>
<td>To ensure that there is an accurate and up to date log of changes in the inputs to C-DAS.</td>
</tr>
<tr>
<td>Guidance:</td>
<td>An example of this driver input is the entry of the current running line if supported.</td>
</tr>
</tbody>
</table>

The C-DAS RU Subsystem shall include in the journey record of an individual train any C-DAS related controls entered by the driver.

**CSSR-409**

<table>
<thead>
<tr>
<th>Status:</th>
<th>Preferred</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale:</td>
<td>To ensure that there is an accurate and up to date log of changes in the inputs to C-DAS.</td>
</tr>
<tr>
<td>Guidance:</td>
<td>Examples of these controls include the operation of the manual suppression or disable control, if provided.</td>
</tr>
</tbody>
</table>

The C-DAS RU Subsystem shall include in the journey record of an individual train any messages sent or received between it and any on-train or off-train subsystem.

**CSSR-410**

<table>
<thead>
<tr>
<th>Status:</th>
<th>Preferred</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale:</td>
<td>To ensure that there is an accurate and up to date log of changes in the inputs and outputs of the C-DAS subsystems.</td>
</tr>
</tbody>
</table>
The C-DAS RU Subsystem shall include in the journey record of an individual train any changes in its own operational state.

**CSSR-411**

<table>
<thead>
<tr>
<th>Status</th>
<th>Normative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale</td>
<td>So that there is a record of the C-DAS functional behaviour.</td>
</tr>
<tr>
<td>Guidance</td>
<td>Changes in operational state includes for example the suppression and unsuppression of advisory information and, where this is achieved automatically, the reason for it.</td>
</tr>
</tbody>
</table>

The C-DAS RU Subsystem shall include in the journey record of an individual train the train location, actual speed and advisory information, including the applicable units, at an interval to be agreed with the RU.

**CSSR-412**

<table>
<thead>
<tr>
<th>Status</th>
<th>Normative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale</td>
<td>To support any necessary incident or network performance analysis.</td>
</tr>
</tbody>
</table>

The C-DAS RU Subsystem shall include in the journey record of an individual train: location and time at each Timing Point and in addition at any unscheduled stop and start.

**CSSR-413**

<table>
<thead>
<tr>
<th>Status</th>
<th>Normative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale</td>
<td>To support any necessary incident or network performance analysis.</td>
</tr>
</tbody>
</table>

The C-DAS RU Subsystem shall include in the journey record of an individual train the time corresponding to each data record.

**CSSR-414**

<table>
<thead>
<tr>
<th>Status</th>
<th>Normative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale</td>
<td>This is needed for post-journey analysis, and for comparison with data from other sources.</td>
</tr>
<tr>
<td>Guidance</td>
<td>The recorded time should be the time that the event was detected rather than the time that the data record was recorded.</td>
</tr>
</tbody>
</table>

The C-DAS RU Subsystem shall include in the journey record of an individual train any abnormal circumstances that it detects.

**CSSR-415**

<table>
<thead>
<tr>
<th>Status</th>
<th>Normative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale</td>
<td>So that there is a record of the abnormalities in the C-DAS functional behaviour.</td>
</tr>
<tr>
<td>Guidance</td>
<td>These might include any of:</td>
</tr>
<tr>
<td></td>
<td>a. Missing Infrastructure Geography, Permissible Speeds or schedule data</td>
</tr>
<tr>
<td></td>
<td>b. Non-current version of Infrastructure Geography or Permissible Speeds</td>
</tr>
<tr>
<td></td>
<td>c. An inconsistency between the route or schedule data available to a train and the train’s actual location</td>
</tr>
<tr>
<td></td>
<td>d. Loss or resumption of communications between the C-DAS Onboard and C-DAS RU Trackside</td>
</tr>
<tr>
<td></td>
<td>e. Loss or resumption of ability to determine train location</td>
</tr>
<tr>
<td></td>
<td>f. Loss or lack of communications with on-train systems for the provision of set-up data, if detected.</td>
</tr>
</tbody>
</table>
The C-DAS RU Subsystem shall be supported by tools to analyse journey logs.

<table>
<thead>
<tr>
<th>Status:</th>
<th>Normative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale:</td>
<td>To support the efficient analysis of journey records.</td>
</tr>
</tbody>
</table>

The C-DAS RU Subsystem shall provide a facility to download journey records from an individual train remotely.

<table>
<thead>
<tr>
<th>Status:</th>
<th>Preferred</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale:</td>
<td>It would be operationally inconvenient to have to access the train to retrieve journey records.</td>
</tr>
</tbody>
</table>
4  Subsystem Requirements – Non-Functional

4.1  Safety

The C-DAS RU Subsystem shall not be able to control on-train braking or traction.

<table>
<thead>
<tr>
<th>Status:</th>
<th>Normative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale:</td>
<td>C-DAS is an advisory system only.</td>
</tr>
</tbody>
</table>

CSSR-419

The C-DAS RU Subsystem shall not impact on the operation of safety critical systems.

<table>
<thead>
<tr>
<th>Status:</th>
<th>Normative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale:</td>
<td>To ensure the safety integrity of other systems is maintained.</td>
</tr>
</tbody>
</table>

CSSR-420

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

<table>
<thead>
<tr>
<th>Status:</th>
<th>Normative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale:</td>
<td>Determined by safety analysis (see [RD16]).</td>
</tr>
</tbody>
</table>

CSSR-424

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

<table>
<thead>
<tr>
<th>Status:</th>
<th>Normative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale:</td>
<td>A C-DAS failure must not create safety issues in a system.</td>
</tr>
<tr>
<td>Guidance:</td>
<td>Satisfying this requirement will require particular care if the C-DAS shares equipment with a safety system, e.g. ETCS DMI.</td>
</tr>
</tbody>
</table>

CSSR-425

4.2  Security

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

<table>
<thead>
<tr>
<th>Status:</th>
<th>Normative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale:</td>
<td>To protect the availability, integrity and confidentiality of the system.</td>
</tr>
<tr>
<td>Guidance:</td>
<td>This applies to both the trackside and onboard elements.</td>
</tr>
</tbody>
</table>

CSSR-428

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

<table>
<thead>
<tr>
<th>Status:</th>
<th>Normative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale:</td>
<td>To prevent unauthorised physical access, damage or interference to and information.</td>
</tr>
<tr>
<td>Guidance:</td>
<td>This applies to both the trackside and onboard elements.</td>
</tr>
</tbody>
</table>

CSSR-429
The C-DAS RU Subsystem shall be secure against the risk presented by personnel.

**Status:** Normative

**Rationale:** To minimise the likelihood of malicious activity or human error that may harm the operational railway.

**Guidance:**

4.3 RAM

The C-DAS RU Subsystem reliability targets are TBD.

**Status:** Normative

**Rationale:** To meet the required performance targets for the subsystem.

**Guidance:** Reliability targets will be derived from overall system availability requirements set by Digital Railway – Open Point CDX.01 refers. Until Digital Railway targets are available it is recommended that the reliability targets specified in the RAM plans supplied as part of the RU Subsystem deliverables should be used.

The C-DAS RU Subsystem availability targets are TBD.

**Status:** Normative

**Rationale:** To meet the required performance targets for the subsystem.

**Guidance:** Availability targets will be derived from overall system availability requirements set by Digital Railway – Open Point CDX.01 refers. Until Digital Railway targets are available it is recommended that the availability targets specified in the RAM plans supplied as part of the RU Subsystem deliverables should be used. Digital Railway availability targets will also drive Start-up requirements for the C-DAS IM subsystem.

The C-DAS RU Subsystem maintainability targets are TBD.

**Status:** Normative

**Rationale:** To meet the required performance targets for the subsystem.

**Guidance:** Maintainability targets will be derived from overall system availability requirements set by Digital Railway – Open Point CDX.01 refers. Until Digital Railway targets are available it is recommended that the maintainability targets specified in the RAM plans supplied as part of the RU Subsystem deliverables should be used.

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

**Status:** Normative

**Rationale:** To support effective and efficient maintenance.

**Guidance:** This includes but is not limited to:
- The use of Line Replaceable Units
- No or limited requirement to configure replaceable components
- No or limited preventative maintenance
- No requirement for bespoke tools for routine maintenance
The C-DAS RU Subsystem shall provide a secure facility to allow on-train software changes to be installed remotely.

**CSSR-796**

**Status:** Preferred  
**Rationale:** To facilitate maintenance of on-train software.

### 4.4 Performance

#### 4.4.1 C-DAS service response times

The C-DAS RU Subsystem C-DAS shall achieve expected one-way latencies of 6 seconds (80%) and 29 seconds (95%) for delivering data updates from C-DAS.

**CSSR-440**

**Status:** Normative  
**Rationale:** To achieve operationally acceptable response times  
**Guidance:** System response times covering Traffic Management and C-DAS will be set by Digital Railway (see Open Point CDX.02) and will be partitioned to give allocations to each of the system elements involved. In the meanwhile, the requirements shown in Table 4-1 below are proposed for message flows initiated by C-DAS. These 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.

<table>
<thead>
<tr>
<th>Time Segment</th>
<th>Expected (seconds)</th>
<th>Max (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-DAS Onboard dispatch of data and transmission to RU Trackside</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>C-DAS RU Trackside processing</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>C-DAS RU Trackside message transmission to C-DAS IM Trackside</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>TOTAL (1-way)</strong></td>
<td>&lt;6 (80%)</td>
<td>29 (95%)</td>
</tr>
</tbody>
</table>

Table 4-1: Time partitioning for cross-system latencies initiated from C-DAS RU Subsystem

The C-DAS RU Subsystem shall achieve expected one-way latencies of 7 seconds (80%) and 35 seconds (95%) for delivering updated Schedule or Speed Restriction data to a C-DAS Onboard and it being utilised in the advisory calculations and any necessary amendments to advisory information displayed to the driver.

**CSSR-440a**

**Status:** Normative  
**Rationale:** To achieve operationally acceptable response times  
**Guidance:** System response times covering Traffic Management and C-DAS will be set by Digital Railway (see Open Point CDX.02) and partitioned to give allocations to each of the system elements involved. In the
meanwhile, the requirements shown in Table 4-2 below are proposed for message flows associated with data updates to C-DAS from Traffic Management. These 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.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Expected (seconds)</th>
<th>Max (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-DAS RU Trackside processing and transmission to C-DAS Onboard</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>C-DAS Onboard processing</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>TOTAL (1-way)</td>
<td>&lt;7 (80%)</td>
<td>35 (95%)</td>
</tr>
</tbody>
</table>

Table 4-2: Time partitioning for cross-system latencies for data updates to C-DAS

The maximum time for C-DAS Onboard from power up to readiness for on-train C-DAS Set-up (driver interaction) shall be no more than 2 minutes.

CSSR-442

Status: Normative
Rationale: To achieve an operationally acceptable start-up time
Guidance: This requirement is based on requirements for comparable on-train systems.

Guidance: The time specified includes validation checks of data stored on-train.

The maximum time for on-train C-DAS Set-up on a train which is not ETCS-fitted shall be 30 seconds.

CSSR-519

Status: Normative
Rationale: To achieve an operationally acceptable on-train start-up time.
Guidance: This time is in addition to any time required for driver interaction for start-up of other on-train systems. It is measured from the point at which the C-DAS Onboard is first ready for interaction with the driver, and includes any data acquisition and verification required before the C-DAS Onboard is ready to provide advisory information.

Guidance: This requirement is based on 5 seconds elapsed for each driver input screen and a maximum of 6 screens.

4.4.2 C-DAS Location and Speed Requirements

The location estimation system used by the C-DAS RU Subsystem shall have a nominal accuracy of ±25m.

CSSR-526

Status: Normative
**Rationale:** So that the C-DAS Onboard can correctly identify the linespeed for the train's actual location along the track.

**Guidance:** C-DAS uses location and speed estimates for four purposes

a. To give a correct estimate of the train’s current location and speed on which to base its calculated speed profile and consequently its advice speeds;

b. To control location-related suppression and unsuppression of display advice;

c. To display the correct route look-ahead information to the driver;

d. To report location correctly to external systems.

**Guidance:** A location accuracy of ±25m along track is adequate for all these purposes and will be achieved in most circumstances with a COTS (consumer grade) GPS device. Such devices give a nominal location accuracy of 10m and in practice generally achieve 5m. This does not provide sufficient accuracy to distinguish between the running line and an adjacent track; thus, when automatic track discrimination is needed another technique must be used instead of GPS or to supplement it. In a Traffic Management area current and planned running lines are required to be provided as part of the train schedule. Elsewhere when automatic track discrimination is needed another technique must be used instead of GPS or to supplement it; such techniques might include: Forward Facing CCTV (FFCTV), trackside infrastructure (Eurobalises or other RFID tags), or other on-train equipment capable of recognising trackside features.

**Guidance:** GPS also gives a speed accuracy of better than ±2km/h which is sufficient for C-DAS.

**Guidance:** A significant limitation of GPS is that it provides location and speed estimates only where there is clear line-of-sight to a sufficient number of satellites. Where this condition cannot be met over a significant portion of the route, any GPS-based location-estimation equipment used by the C-DAS Onboard should include an infill technique (see Class B Locator as described in [RD6] section G5.3). The appropriate solution should bear in mind the characteristics of the route, and be agreed between the RU and the C-DAS product supplier.

### 4.5 Design and Development

The installation data required for onboard C-DAS operation shall be available to the C-DAS onboard system before it is required for use.

**Status:** Normative

**Rationale:** To reduce the time needed for set-up at journey start and to support the continued provision of onboard C-DAS functionality in the event of a loss of communication with the C-DAS RU trackside.

**Guidance:** The size of individual installation datasets, the infrequency with which their contents change, and the computational requirements for any pre-processing that may be required may be such that it will be appropriate for the foreseeable future to process and deliver this data to C-DAS onboards off-line and for it to be stored persistently in preference to making run-time demands on processing power and communications bandwidth).
The C-DAS RU Subsystem shall be designed and implemented to be compliant with all the relevant safety standards

Status: Normative
Rationale: To meet the requirements for the acceptance and approval of safety-related electronic systems in the railway signalling field.
Guidance: Standards include: BS E50129 - Railway applications — Communication, signalling and processing systems — Safety related electronic systems for signalling; BS E50128 - Railway applications — Communication, signalling and processing systems — Software for railway control and protection systems; BS EN50159: Railway applications - Communication, signalling and processing systems - Safety-related communication in transmission systems.

The C-DAS on-train display shall be designed to be easily customised, in respect of content, layout and format.

Status: Normative
Rationale: To facilitate the introduction of changes to the display where required.
Guidance: For example as a result of implementing the same C-DAS Onboard on different rolling stock, or for different service types, or for when rolling stock is transferred from one RU to another RU.
Guidance: Display items that may be required to be easily customised include, but are not limited to:
   a. Display brightness configurations (maximum, minimum and default night and day display brightness levels; automatic brightness switching constraints etc.)
   b. The content, format and display conditions for the advisory information, for example look-ahead parameters, display refresh conditions, minimum advice speed, etc.
   c. Which information is displayed and when, for example journey segment / route look-ahead information, departure countdown timers etc.
   d. Specific display formats (colour, font, on-screen location etc.) for the various information types displayed.
   e. The content, format and display conditions for customisation data
   f. Information related to the definition of suppression areas.
   g. Content and format of data selection menus.

The C-DAS RU Subsystem algorithms shall be designed to be easily configurable to meet changing operational circumstances.

Status: Normative
Rationale: To facilitate the introduction of changes to the algorithms where required, for example as a result of rolling stock being re-allocated to different lines with different service needs.

The C-DAS RU 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.

Status: Normative
Rationale: To support effective operation throughout the system life.

Guidance: This includes compliance with BS EN50129 - Railway applications — Communication, signalling and processing systems — Safety related electronic systems for signalling; BS EN50128 - Railway applications — Communication, signalling and processing systems — Software for railway control and protection systems; BS EN50159: Railway applications - Communication, signalling and processing systems - Safety-related communication in transmission systems; BS EN 50155 Railway Applications – Electronic Equipment used on rolling stock.

The C-DAS RU Subsystem shall be designed to minimise and simplify data input on the driver interface.

CSSR-449

Status: Normative
Rationale: To minimise the impact of C-DAS on driver workload and reduce to an acceptable level the likelihood of input errors.

HF Measure: Yes
Safety Measures: C-H19, C-H20
Guidance: Techniques that may be used include:
   a. The use of menu selection or other automatic means in preference to manual entry
   b. Range and value checking on entered data
   c. Requiring the user to confirm that the entered data is correct.

The design and the in-cab location of the C-DAS display shall be agreed between the C-DAS product supplier and the RU, and in accordance with human factors good practice.

CSSR-450

Status: Normative
Rationale: To ensure agreement from all stakeholders.

HF Measure: Yes
Guidance: The C-DAS may share its DMI with other on-train systems, subject to the constraints identified in Rail Standards documents and taking into account the recommendations of [RD10] and the resolution of Open Point CD2.01.

Guidance: It is recommended that drivers are consulted on the design and in-cab location of the C-DAS display. Consideration should also be given to consulting with ROSCOs and vehicle manufacturers.

Guidance: Human Factors analysis should be carried out.

Any data preparation processes generating data for C-DAS operation shall employ a level of checking appropriate to the accuracy and correctness of the data that is required to support safe and efficient C-DAS operations.

CSSR-453

Status: Normative
Rationale: To minimise the occurrence of hazards resulting from data errors.
Safety Measures: C-H3, C-H12, C-H17, C-H19, C-H20

The level of integration between the C-DAS Onboard and other on-train systems shall be agreed in consultation with ROSCOs and vehicle manufacturers.

CSSR-603

Status: Normative
Rationale: To ensure that the C-DAS implementation meets the needs of all stakeholders.

Guidance: The C-DAS Onboard for a new build train should generally comply with the guidance given in [RD6] and [RD7] in respect of its ability to share with other on-train applications the services provided by common SatNav-based Locator and telecoms equipment. For a retrofit application, compliance should be waived only with the agreement of the ROSCO and vehicle owner.

### 4.6 Ergonomics

The design and positioning of the C-DAS Onboard display shall comply with the relevant Ergonomics and Human Factors standards and best practice.

<table>
<thead>
<tr>
<th>Status:</th>
<th>Normative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale:</td>
<td>To align with HF best practice, so that:</td>
</tr>
<tr>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>--</td>
<td>the information it displays is clear and intuitive,</td>
</tr>
<tr>
<td>--</td>
<td>the display does not lead to unacceptable workload demands on drivers,</td>
</tr>
<tr>
<td>--</td>
<td>the display does not cause unacceptable distraction from other driving activities that might impact negatively on safety</td>
</tr>
<tr>
<td>--</td>
<td>the controls are readily accessible and easy to use.</td>
</tr>
<tr>
<td>HF Measure:</td>
<td>Yes</td>
</tr>
<tr>
<td>Safety Measures:</td>
<td>C-H31</td>
</tr>
<tr>
<td>Guidance:</td>
<td>The amount of information displayed may be limited by the size and positioning of the C-DAS DMI in the cab.</td>
</tr>
</tbody>
</table>

The C-DAS RU Subsystem shall not affect the driver’s use of existing onboard safety systems in accordance with existing rules and procedures.

<table>
<thead>
<tr>
<th>Status:</th>
<th>Normative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale:</td>
<td>The C-DAS should not import safety risk into the operational duties of the driver.</td>
</tr>
<tr>
<td>HF Measure:</td>
<td>Yes</td>
</tr>
<tr>
<td>Guidance:</td>
<td>Existing onboard safety systems includes DRA, DSD, Vigilance, AWS, TPWS, ETCS etc.</td>
</tr>
</tbody>
</table>

### 4.7 EMC

The C-DAS Subsystem shall be compliant with all relevant EMC standards.

<table>
<thead>
<tr>
<th>Status:</th>
<th>Normative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale:</td>
<td>The C-DAS and its constituent subsystems is required to operate correctly in the railway environment without undesired affects from within and outside that environment, or affecting the correct operation of other systems.</td>
</tr>
<tr>
<td>Guidance:</td>
<td>Standards include: BS EN50121 Railway applications - Electromagnetic Compatibility.</td>
</tr>
</tbody>
</table>
4.8 Environmental

The C-DAS Subsystem shall comply with all relevant environmental standards.

<table>
<thead>
<tr>
<th>Status:</th>
<th>Normative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale:</td>
<td>The C-DAS Subsystem must be able to operate correctly in its intended environment</td>
</tr>
<tr>
<td>Guidance:</td>
<td>Standards include BS EN50125 Railway applications — Environmental conditions for equipment.</td>
</tr>
</tbody>
</table>
5 Glossary

5.1 Abbreviations

ATO  Automatic Train Operation
ATP  Automatic Train Protection
AWS  Automatic Warning System
C-DAS Connected Driver Advisory System
CCS  Command Control and Signalling
CIF  Common Interface File
COTS Commercial Off The Shelf
DAS  Driver Advisory System
DMI  Driver Machine Interface
DRA  Driver’s Reminder Appliance
DSD  Driver’s Safety Device
EoA  End of Authority
ERTMS European Rail Traffic Management System
ETCS European Train Control System
ESR  Emergency Speed Restriction
GNSS Global Navigation Satellite System
GPS  Global Positioning System
IM   Infrastructure Manager
LINX Layered Interface Exchange
N-DAS Networked DAS
NRT  Network Rail Telecoms
PRM  People with Reduced Mobility
PSR  Permanent Speed Restriction
QoS  Quality of Service
RAMS Reliability, Availability, Maintainability and Safety
RFID Radio Frequency Identifier
ROC  Rail Operating Centre
RU   Railway Undertaking
S-DAS Standalone Driver Advisory System
SSP  Static Speed Profile
STM  Specific Transmission Module
STP  Short Term Planning
TAF  Telematics Applications for Freight
TAP  Telematics Applications for Passenger
TM   Traffic Management
TPWS Train Protection & Warning System
TRN  Train Running Number
5.2 Terminology

Applicable Timetable
The Working Timetable for a set of services overlaid by Short Term Planning updates, as agreed between the IM and RU as the basis of operations for the following day.

Application data
Part of Customisation data (qv).

Blanket speed restriction
A speed restriction which is not published, but is notified to drivers by Operations Control via the signaller or by other means. Lineside signage is not provided, and stop and caution procedures do not apply. A single speed value applies, and the restriction may apply only to selected train types (i.e. not to all train types). Assumptions and requirements for ESRs given in this document should be considered to apply also for blanket speed restrictions except where otherwise stated.

Common Interface File
A file whose format is described in [RD8], used for conveying train schedules and schedule revisions from Network Rail’s Integrated Train Planning Service to its customers.

Connected DAS
A system which provides train drivers with an advisory train speed (within and up to the linespeed profile and maximum train speed) that is informed by the real-time, measured progress of the individual train against (static) Infrastructure Geography with (dynamic) linespeed and schedule data.

Current Schedule
The currently planned sequence of named locations, corresponding times and path for a single train service, as per the Planned Schedule together with any Schedule Updates. The time specified will be arrivals and departures for scheduled stops, and passing times for non-stopping locations.

Customisation Data
The data which determines the detailed operation of the C-DAS. It comprises:

- Application data – Infrastructure Geography, Static Speed Profiles, TSRs and ESRs, Schedule
- Set-up data – Driver ID, Train Running Number (TRN), Train Specific Data

Data partitioning
A scheme to allow trains to carry Infrastructure Geography and Static Speed Profile datasets only for a relevant subset of the rail network. (These datasets change relatively rarely, and the aim is to provide trains with the Application data required for their routes (see definition of Customisation Data above), but without requiring them to be updated when there are changes only to parts of the national data which are irrelevant to their operations.)

Disable
Action by which the DAS Onboard is closed down, either by the driver or automatically, in the event of a system failure, display frozen or as instructed by the RU / IM.
Emergency Speed Restriction  
A speed restriction which is not published but which is indicated to the driver by lineside signage, and notified to drivers by stop and caution procedure when the signage is not yet in place. The speed value may vary by direction of travel. Speed values apply as per TSRs. Changes to published TSRs are treated as ESRs. Assumptions and requirements for ESRs given in this document should be considered to apply also for blanket speed restrictions except where otherwise stated.

Infrastructure Geography (data)  
The data which describes the topography and topology of the network infrastructure. It comprises three parts:

a.  Track Geography  
   Track centre line, altitude, curvature

b.  Rail Network Model(s)  
   Connectivity and Navigability

c.  Track features  
   Asset data (points, stations, tunnels, location markers e.g. mileposts, line identities etc.) and other parameters (e.g. C-DAS display units and ETCS National Values)

It also includes linkages (mapping) between (b) and (a), and between Timing Point locations and Track Geography / Track features, and a means – based on track link id – to support mapping between routing data, track geography and network models.

Initial Schedule  
The schedule obtained by a train as part of C-DAS set-up. An Initial Schedule obtained from Traffic Management will be the Planned Schedule (qv) with any amendments generated by Traffic Management has generated; otherwise it will be just The Planned Schedule.

Journey  
The scheduled movement of a train between two named points, e.g. journey between London Euston and Glasgow Central.

Journey Segment  
The part of a journey that lies between two adjacent Timing Points.

Layered Interface Exchange (LINX)  
The data integration platform being developed as part of the Network Rail Traffic Management system.

Line segment  
The sequence of track links between two adjacent Timing Point Locations on the train journey.

Linespeed  
The Static Speed Profile modified by any applicable Temporary, Emergency and Blanket Speed Restrictions for a particular direction of travel and train type.

Linespeed Profile  
The sequence of linespeeds to be observed by a particular train along its journey or part of journey.

Multiple unit train set  
A permanently or semi-permanently coupled set of rail vehicles (i.e. a unit), which can be operated independently as a train, or which, when coupled to one or more similar units, can operate collectively as a train driven from the cab of the leading unit.

Network Model  
A description of the track layout which specifies how it may be traversed, i.e. permissible sequences of track links.

Networked DAS  
A system which provides train drivers with an advisory train speed (within and up to the linespeed profile and maximum train speed) that is informed by the measured progress of the individual train against (static) Infrastructure Geography with schedule and linespeed data which may be updated dynamically by an RU facility.
Non-Traffic Management area
An area which is not controlled by a Traffic Management system. Such areas may support N-DAS operation, i.e. limited data exchange between C-DAS fitted trains in the area and an RU’s facility.

Permanent Speed Restriction
A speed restriction which is published in the Sectional Appendix and is reflected in the Permissible Speeds (qv). PSRs are indicated to the driver by lineside signage and, where the reduction in speed exceeds applicable criteria, warning signage with a permanent AWS magnet may be provided on the approach.

Permissible Speed
The speed published in the Sectional Appendix. This is the speed at which the train may operate over a particular stretch of infrastructure, and reflects infrastructure constraints, direction and the train type. The concept of Permissible Speeds is replaced in ETCS by Static Speed Profiles (qv).

Plan
The collective schedule for multiple trains.

Planned Schedule
The part of the Applicable Timetable that applies to a single train service; this would generally align to the published timetable modified by any STPs. Where a service has been introduced or amended by VSTP, the Planned Schedule is the schedule defined or amended in the VSTP.

Planning Data
Any plan or schedule.

Registration Data
The data passed by C-DAS to identify a particular train and service. It comprises Set-up data and Train Specific Data.

Routing
The route and track on which the train operates.

Schedule (1)
As Current Schedule (qv).

Schedule (2)
Any of Planned Schedule, Initial Schedule or Current Schedule (qv).

Schedule Timing Tolerance
A time window during which a train may arrive, depart or pass a given Timing Point Location without affecting the behaviour of other trains.

Schedule Updates
Any changes made to the Planned Schedule for a particular service, so as to regulate trains and /or to recover from perturbations.

Segment Profile
A data packet used for ATO (see [RD4])

Set-up
The driver-controlled sequence by which the on-train DAS subsystem is prepared for operation. This may be either Full Set-up which is generally performed when the driver first activates the cab, or Partial Set-up which must be performed whenever any of the Set-up data (qv) is changed.

Set-up data
Part of Customisation data (qv).

Speed restrictions
Infrastructure-related limitations on the maximum speed a train may travel. Speed restrictions apply to a given area or length of track and may vary with the direction of travel and the train type. A speed restriction will be one of:

- Permanent speed restriction (qv)
- Temporary speed restriction (qv)
- Emergency speed restriction (qv)
- Blanket speed restriction (qv).

Standalone DAS
An on-train system which provides train drivers with an advisory train speed (within and up to the linespeed profile and maximum...
train speeds) that is informed by the real time measured progress of an individual train against pre-defined (static) Infrastructure Geography, linespeed and schedule data.

Static Speed Profile
This is the speed profile at which the train may operate over a particular stretch of infrastructure, and reflects infrastructure constraints, direction and the ETCS train categories. Static Speed Profiles are the ETCS equivalent of Permissible Speeds (qv).

Suppress
Action by which the DAS on-train display is disabled in whole or in part. This is either done by the driver manually or automatically in circumstances defined by the RU.

Temporary Speed Restriction
A speed restriction which is published in the weekly operating notice. The speed value may vary by direction of travel. One speed value may apply for all types of train, or two differential speeds may apply to different types of train, colloquially termed as passenger and freight. TSRs are indicated to the driver by lineside signage and, in most cases, warning boards and permanent AWS magnets. A TSR may undergo a non-published change if its geographical limits are reduced; such changes are reflected in changes to the lineside signage and will be made available to C-DAS in Traffic Management areas.

Timing Point
A named location on the railway and the time associated with it on a train’s schedule. A Timing Point may correspond to an arrival time, departure time or passing time.

Timing Point Location
A named location for which a time is specified on the train’s schedule.

Track link
An individual length of track which cannot include points, a junction, or the end of a loop except as an end-point.

Traffic Management area
An area of the rail network controlled by a Traffic Management system. Such areas will be capable of supporting full C-DAS operation, i.e. systematic data exchange in near-real time between C-DAS-fitted trains in the area and a Traffic Management system.

Train Consist and Capability Data
A table of train data, containing ‘preset’ values including physical train characteristics, braking, traction and resistance parameters for a number of consists, to be used in C-DAS speed profile calculations. The use of ‘presets’ is recommended for multiple unit train sets as an efficient and effective means of data entry and may also be applicable for frequently used consists of variable formation trains.

Train Running Number
The identity of the train service. GB Rail currently uses a 4-character headcode, but may be expected to migrate to an identifier which is unique across the network, and not repeated within a 24-hour period.

Train Specific Data
Parameters which determine the behaviour of a particular train, including train length, mass, maximum speed, braking parameters, traction parameters, resistance coefficients.

Unique Train Identifier
An identifier which identifies a particular service uniquely across the GB rail network on a particular day.

Unsuppress
Action by which the DAS on-train display is re-enabled. This is either done by the driver manually or automatically in circumstances defined by the RU.
Variable formation train

A variable formation train is one for which a 'preset' has not been defined e.g. freight train, loco-hauled passenger train, or unusual combinations of units.
Appendix A  C-DAS Overview

A.1 Problem statement

The role of a Driver Advisory System is to provide information that helps the driver of each train to deliver the service specified by the Traffic Management control function in a manner which optimises the use of key resources across an area and set of trains, typically some combination of performance, capacity and energy.

Network Rail plans to facilitate the deployment of Driver Advisory Systems to operate in conjunction with the Traffic Management systems which are being developed as part of the implementation of the Digital Railway programme.

It is a key requirement for the client of this project and the end-users of the proposed Driver Advisory System that it shall improve recovery from perturbation as well as supporting scheduled operation.

A.2 Solution outline

To meet these requirements the Driver Advisory System will include a ground subsystem and an on-train subsystem. The ground subsystem receives target timing information for each train, calculated by Traffic Management’s operational forecast and planning function based on the train’s current location and the current traffic control priorities. The targets, reflecting the capabilities of the train (mass, braking characteristics etc.) and the constraints imposed by the route (permissible speeds, gradients, speed restrictions etc.), are transmitted to the train. The on-train subsystem calculates the appropriate speed profile for that train, continuously monitors the train’s location relative to its targets, displays advisory information to the driver and also informs the ground subsystem of the train’s progress to pass on to Traffic Management so that targets may be updated as appropriate. A closed-loop Driver Advisory System of this kind is known as a Connected Driver Advisory System (C-DAS)

A high level of the system architecture for the proposed Connected Driver Advisory System is shown in Figure 1.

![Figure A-1: Connected Driver Advisory System overview](image-url)
Appendix B  C-DAS Context Architecture

![C-DAS Context Architecture Diagram]

**Figure B-1: C-DAS Architecture Context**
Appendix C  **Train Specific data**

The term ‘Train Specific Data’ denotes the combination of Train Consist data and Train Capability Data.

<table>
<thead>
<tr>
<th>Item</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Train length</td>
<td></td>
</tr>
<tr>
<td>Train mass</td>
<td></td>
</tr>
<tr>
<td>Train mass/length pairs</td>
<td>As an alternative to single mass and length for whole train</td>
</tr>
<tr>
<td>Maximum speed of train</td>
<td>Maximum speed of train as consisted.</td>
</tr>
<tr>
<td>Train types</td>
<td>The conventional (i.e. non-ETCS) train types (aka train speed categories) to which the train belongs</td>
</tr>
<tr>
<td>Maximum braking effort</td>
<td></td>
</tr>
<tr>
<td>Brake settings table</td>
<td>Brake step &amp; corresponding proportion of Maximum Braking Effort</td>
</tr>
<tr>
<td>Brake step for 'normal' braking</td>
<td>In line with RU’s driving policy</td>
</tr>
<tr>
<td>Brake timing parameters</td>
<td>Brake delay and brake build-up times</td>
</tr>
<tr>
<td>Traction cutoff time</td>
<td></td>
</tr>
<tr>
<td>Maximum power</td>
<td></td>
</tr>
<tr>
<td>Maximum tractive effort</td>
<td></td>
</tr>
<tr>
<td>Tractive effort table</td>
<td>Speed band &amp; corresponding proportion of Maximum Tractive Effort</td>
</tr>
<tr>
<td>Power settings table</td>
<td>Power setting (notch) &amp; corresponding proportion of Maximum Tractive Effort</td>
</tr>
<tr>
<td>Coefficients of resistance</td>
<td>A, B, C (Davis coefficients)</td>
</tr>
<tr>
<td>Resistance table</td>
<td>Speed band &amp; corresponding Resistance</td>
</tr>
<tr>
<td>Rotating mass</td>
<td></td>
</tr>
<tr>
<td>Fuel consumption</td>
<td>A table of speed bands and corresponding values for each power mode</td>
</tr>
<tr>
<td>Hotel power</td>
<td></td>
</tr>
<tr>
<td>Presence or otherwise of regenerative brakes</td>
<td></td>
</tr>
<tr>
<td>Presence or otherwise of tilt system</td>
<td></td>
</tr>
<tr>
<td>Presence or otherwise of regenerative brakes</td>
<td></td>
</tr>
<tr>
<td>Regenerative efficiency</td>
<td>Applicable only to train with a regenerative brake capability</td>
</tr>
<tr>
<td>Current brake state</td>
<td>Normal or degraded</td>
</tr>
<tr>
<td>Current traction capability</td>
<td>Proportion of the nominal (maximum)</td>
</tr>
<tr>
<td>Current operational state of doors</td>
<td>Normal or degraded - Passenger trains only</td>
</tr>
<tr>
<td>Current consisted orientation</td>
<td>Normal or reverse - Passenger trains only</td>
</tr>
</tbody>
</table>