GB Operational Concept
Standalone Driver Advisory System (S-DAS)

Issue 1.0
12 March 2012

Content approved by:
Tom Lee
Head of New Systems

© RAIL SAFETY AND STANDARDS BOARD LTD.
2012 ALL RIGHTS RESERVED This publication
may be reproduced free of charge for research,
private study or for internal
circulation within an organisation. This is subject to it
being reproduced and referenced
accurately and not being used in a misleading
context. The material must be acknowledged as
the copyright of Rail Safety and Standards Board
and the title of the publication specified
accordingly. For any other use of the material please
apply to <name of person/department responsible
with contact details

Published by

RSSB
Block 2 Angel Square
1 Torrens Street
London EC1V 1NY

© Copyright 2012
Rail Safety and Standards Board Limited

Reference: NS-FUTRO_OC-9001
GB Operational Concept
Standalone Driver Advisory System (S-DAS)

Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction</td>
<td>4</td>
</tr>
<tr>
<td>1.2</td>
<td>Background</td>
<td>4</td>
</tr>
<tr>
<td>1.3</td>
<td>Purpose</td>
<td>4</td>
</tr>
<tr>
<td>1.4</td>
<td>Document Scope</td>
<td>5</td>
</tr>
<tr>
<td>1.5</td>
<td>Scope exclusions</td>
<td>6</td>
</tr>
<tr>
<td>1.6</td>
<td>References</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Assumptions</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>Operation of S-DAS</td>
<td>8</td>
</tr>
<tr>
<td>3.1</td>
<td>Operations Principles</td>
<td>8</td>
</tr>
<tr>
<td>3.2</td>
<td>System Design Principles</td>
<td>8</td>
</tr>
<tr>
<td>3.3</td>
<td>Energy Efficient Speed Profile Calculation</td>
<td>10</td>
</tr>
<tr>
<td>3.4</td>
<td>Information Displayed</td>
<td>10</td>
</tr>
<tr>
<td>3.5</td>
<td>Customising S-DAS</td>
<td>18</td>
</tr>
<tr>
<td>3.6</td>
<td>Driving With S-DAS</td>
<td>21</td>
</tr>
<tr>
<td>3.7</td>
<td>Train Preparation</td>
<td>25</td>
</tr>
<tr>
<td>3.8</td>
<td>System Maintenance</td>
<td>25</td>
</tr>
<tr>
<td>3.9</td>
<td>S-DAS Driving Guidance and Training</td>
<td>26</td>
</tr>
<tr>
<td>3.10</td>
<td>RU Roles and Responsibilities</td>
<td>26</td>
</tr>
<tr>
<td>3.11</td>
<td>IM Responsibilities</td>
<td>28</td>
</tr>
<tr>
<td>4</td>
<td>Open Points</td>
<td>30</td>
</tr>
<tr>
<td>4.1</td>
<td>Overview</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td>Definitions</td>
<td>34</td>
</tr>
<tr>
<td>6</td>
<td>Abbreviations</td>
<td>36</td>
</tr>
</tbody>
</table>

Appendix A | Example System Architecture | 38 |
| A.1 | Overview | 38 |
| A.2 | S-DAS Onboard Sub-System | 40 |
| A.3 | S-DAS Trackside Sub-System | 40 |
| A.4 | S-DAS Data | 41 |
| A.5 | Data Responsibilities | 48 |
| A.6 | S-DAS Operating States | 49 |
| Appendix B | Safety Assessment of S-DAS hazards | 51 |
| Appendix C | From S-DAS to C-DAS | 66 |
| C.1 | Introduction | 66 |
| C.2 | Current state | 66 |
| C.3 | Development strategy | 66 |
| C.4 | Assumptions | 66 |
| C.5 | Migration strategy | 67 |
| C.6 | Reference | 69 |
GB Operational Concept
Standalone Driver Advisory System (S-DAS)

Issue status

<table>
<thead>
<tr>
<th>Version</th>
<th>Status</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>Draft document created</td>
<td>29 September 2011</td>
</tr>
<tr>
<td>0.2</td>
<td>Draft document</td>
<td>29 September 2011</td>
</tr>
<tr>
<td>0.3</td>
<td>Draft document</td>
<td>30 September 2011</td>
</tr>
<tr>
<td>0.4</td>
<td>Draft document</td>
<td>03 October 2011</td>
</tr>
<tr>
<td>0.5</td>
<td>Draft document</td>
<td>04 October 2011</td>
</tr>
<tr>
<td>0.6</td>
<td>Draft document for initial internal (RSSB) peer review</td>
<td>05 October 2011</td>
</tr>
<tr>
<td>0.7</td>
<td>Draft document addressing comments from initial internal (RSSB) peer review</td>
<td>11 October 2011</td>
</tr>
<tr>
<td>0.8</td>
<td>Draft document for final internal (RSSB) peer review</td>
<td>14 October 2011</td>
</tr>
<tr>
<td>0.9</td>
<td>Draft document addressing comments from final internal (RSSB) peer review</td>
<td>19 October 2011</td>
</tr>
<tr>
<td>0.10</td>
<td>Draft document addressing comments from external (Network Rail) review</td>
<td>17 November 2011</td>
</tr>
<tr>
<td>0.11</td>
<td>Addressing further comments from Network Rail and First Group.</td>
<td>21 December 2011</td>
</tr>
<tr>
<td>0.12</td>
<td>Draft document addressing comments from RSSB TOM and V/TC&amp;C SIC</td>
<td>31 January 2012</td>
</tr>
<tr>
<td>0.13</td>
<td>Draft document with addition of Appendix C</td>
<td>27 February 2012</td>
</tr>
<tr>
<td>0.14</td>
<td>Draft document addressing comments on Appendix C and comments from FSR.</td>
<td>9 March 2012</td>
</tr>
<tr>
<td>1.0</td>
<td>Issue 1</td>
<td>12 March 2012</td>
</tr>
</tbody>
</table>

General information

Each infrastructure manager or railway undertaking is reminded of the need to consider its own responsibilities to ensure health and safety at work and its own duties under health and safety legislation. The Rail Safety and Standards Board (RSSB) does not warrant that compliance with all or any documents published by RSSB is sufficient in itself to ensure safe systems of work or operation or to satisfy such responsibilities or duties.

RSSB members wishing to use the information contained in this document as the basis for further work are strongly advised to contact RSSB for current information on status, further guidance and the possibility of additional support.

Uncontrolled copies of this document may be obtained from the Head of New Systems, RSSB, Block 2 Angel Square, 1 Torrens Street, London EC1V 1NY.
GB Operational Concept
Standalone Driver Advisory System (S-DAS)

1 Introduction
1.1 This document has been produced by RSSB to specify the operational concept for a Standalone Driver Advisory System (S-DAS) for the Vehicle/Train Control and Communications System Interface Committee (V/TC&C SIC).

1.2 Background
1.2.1 The creation of an operational concept document is part of the Great Britain (GB) rail industry’s plan for the future implementation of a Driver Advisory System (DAS). The development of the operational concept for DAS will eventually consider two DAS variants, Standalone and Connected:

a) Standalone DAS (S-DAS) provides train drivers with an advisory train speed (limited by the linespeed profile and maximum train speed) that is informed by the real time measured progress of an individual train against predefined (static) route geography and schedule data.

b) Connected DAS (C-DAS) provides train drivers with an advisory train speed (limited by the linespeed profile and maximum train speed) that is informed by the real-time, dynamic update of schedule information via a telecommunications link to a control centre that is monitoring the location and speed of many trains in an area.

1.2.2 The implementation of any DAS is intended to deliver benefits in the quality, cost and efficiency of train operation. The benefits resulting from the implementation of S-DAS are expected to include:

a) Traction energy cost savings.

b) Reduction in carbon emissions.

c) Improved train regulation.

d) Possible safety improvements due to:

i) Trains being regulated to a working timetable resulting in fewer restrictive signals being encountered.

ii) Lower sectional running and station approach speeds.

e) Reduced brake and track wear and associated maintenance costs.

1.3 Purpose
1.3.1 The purpose of this document is to inform the development of functional and non-functional requirements and operational guidance for an S-DAS implementation. The document will assist stakeholders in developing an understanding of how S-DAS will affect them by:

a) Providing a common vision of S-DAS operation in GB for passenger and freight operation.

b) Providing a high level definition of the system boundary and interfaces including system users and other affected roles.
c) Providing a broad, high level description of how the system will operate in association with existing signalling infrastructure and operational rules and processes on all types of routes, with their different service patterns and types of traffic.

d) Providing a description of the information required by drivers and other users of the system to provide the required functionality.

e) Providing a preliminary identification of the system data requirements to support the display of the required S-DAS information to drivers.

f) Providing a preliminary safety analysis of S-DAS operation.

g) Explaining the functionality of S-DAS from the perspective of an operational user.

h) Providing information relevant to (but not limited to) the following:

i) Infrastructure Manager (IM).

ii) Railway Undertakings (RU).

iii) RSSB.

iv) Association of Train Operating Companies (ATOC).

v) Freight Operating Companies (FOC).

vi) Maintenance organisations for traction and rolling stock and infrastructure.

vii) System/equipment suppliers.

viii) Department for Transport (DIT).

ix) Office of Rail Regulation (ORR).

1.3.2 The document is additionally intended to support the development of the Connected DAS operational concept described in [RD1].

1.3.3 Although the content of the document is not itself mandatory, it can be used to determine what could be mandatory in Railway Group Standards and other specifications. The word ‘MUST’ indicates the potential for a future requirement.

1.3.4 A number of open points have been identified during the development of this document that require additional work to resolve. The open points, and associated working assumptions are documented in section 4.

1.3.5 An initial safety review of the S-DAS system has been included in Appendix B. This was carried out using safety assessments performed as part of the T724 research project [RD2] which were assessed for relevance to S-DAS.

1.4 Document Scope

1.4.1 The scope of this document is the operation of S-DAS within the context of the GB mainline railway.
1.4.2 Notwithstanding the statement in 1.3.3 above, the document reflects, in respect of driver display and interactions, experience gained by a particular operator. As such the statements in some sections of this document may be unduly prescriptive. A comment to that effect appears at the start of each of these sections.

1.4.3 The document also includes (Appendix C) material aimed at de-risking the process of migration from S-DAS to C-DAS.

1.5 Scope exclusions

1.5.1 The following are excluded from the scope of this document:

a) The design of the working time table.

b) The definition of the onboard algorithms for the determination of the advisory information.

c) The format of data and the means of exchange between involved parties.

d) The migration path from Standalone to Connected DAS.

e) The DMI design.

1.6 References


2 Assumptions

2.1 The architecture of an S-DAS implementation includes an onboard and trackside sub-system, and a means for information to be passed between these sub-systems. There is no interface to trackside or onboard signalling or train regulation systems. An example S-DAS system architecture is provided in Appendix A.

2.2 For S-DAS, real time data processing is done by the S-DAS onboard sub-system. This means that there is no dependence on trackside systems for real time data processing.

2.3 An S-DAS interface is provided in the driving cab to display information to the driver.

2.4 Interfaces between the S-DAS and other onboard systems are kept to the minimum required for correct S-DAS operation, to reduce system complexity and implementation cost.

2.5 The S-DAS speed measurement system provides a speed estimate of comparable accuracy to that expected of a train speedometer.

2.6 The advisory information is presented as advice of the speed to drive at, or to coast, or that the train is in a TSR area.

2.7 Drivers drive to the highest possible (or permissible) safe speed unless advised otherwise. S-DAS therefore only displays advisory speed information that is lower, and not equal to, permissible or maximum train speeds.

2.8 Advisory information does not affect sectional running times sufficiently to affect level crossing warning times (working assumption for Open Point 1 in section 4).

2.9 Signallers are made aware where trains have an operational S-DAS. ARS will not be changed (working assumption for Open Point 2 in section 4).

2.10 ESR information does not form part of the S-DAS customisation data (working assumption for Open Point 3 in section 4).

2.11 There is no requirement for S-DAS to display current train speed (working assumption for Open Point 4 in section 4).

2.12 The facility to display scheduled departure time and associated countdown timers is provided but the usage must be configurable (working assumption for Open Point 5 in section 4).

2.13 There is a strong industry desire that the technical solution should be low cost (working assumption for Open Point 6 in section 4).
3 Operation of S-DAS

3.1 Operations Principles

3.1.1 Information provided to drivers by S-DAS is wholly advisory and must be considered technically and operationally as non-safety related. The status of the S-DAS advice must be clearly defined and communicated to drivers.

3.1.2 The advisory information displayed by the S-DAS must not lead to increased driver workload or cause distraction from other driving activities. The S-DAS must not impact negatively on safety.

3.1.3 The S-DAS must only present advice to the driver when it is beneficial to follow the advice.

GN1 If S-DAS information is presented when no performance benefit can be gained, drivers may lose trust in the system and not use it in the future. Additionally, if S-DAS information is presented when no benefit can be gained it may present an unnecessary distraction to the driver.

3.1.4 Following the advisory information must not lead to drivers having to brake excessively on the approach to station stops or speed decreases.

GN2 While this is partly addressed by driver training and the understanding that the information provided by standalone S-DAS is advisory only, the algorithms and train data employed by the S-DAS system must be designed to minimise the risk of excessive braking being required.

3.1.5 Advisory speed and distance information must be displayed in the same units employed by the in-cab speed display.

GN3 On ETCS fitted trains where speed information could be displayed in either Miles/Hour (mph) or Kilometres/Hour (km/h), depending on the ETCS operating level, the advisory speed units will need to be switched accordingly.

3.1.6 The S-DAS driver interface must not replicate information that the driver is already provided with (e.g. current train speed).

GN4 If duplicate information was to be provided it could conflict with other sources of the same information which may pose a distraction to the driver.

3.2 System Design Principles

3.2.1 The S-DAS onboard sub-system should for preference be capable of dependably resolving train position between adjacent tracks (separated by the ‘six-foot’).

GN5 If this capability is provided the system will be able to determine autonomously when a train is no longer following the path allowed for a particular journey. Otherwise, the driver will be responsible for determining when the train is re-routed if the re-routing is onto an adjacent track.

3.2.2 S-DAS must calculate and display information to the driver in sufficient time for the driver to react safely and efficiently to changes.

3.2.3 The information displayed by the S-DAS must be designed so that it is readable, intuitive and is presented in a timely manner.
3.2.4 The design of the S-DAS display must be developed in accordance with human factors best practice and in consultation with drivers.

3.2.5 The location of the S-DAS user interface in the train cab must be developed in accordance with human factors best practice and in consultation with drivers.

3.2.6 The S-DAS user interface must be designed to minimise manual data input to reduce the likelihood of input errors.

3.2.7 Any data preparation processes generating information for S-DAS operation must employ a level of checking appropriate to the required integrity of the data.

3.2.8 Where the manual input of data is required, the process for manual entry must be such that the risk of incorrect data being utilised by the system is minimised to an acceptable level.

**GN6**

*There are a number of strategies that could be employed to reduce the risk of incorrectly entering data, including:*

* a) Present data items for selection from a predefined list rather than requiring data to be manually typed in.

* b) Range and value checking on entered data.

* c) Once data has been entered requiring the user to check and confirm that the entered data is correct.*

3.2.9 The RU should consider the level of potential integration between the S-DAS onboard sub-system and other onboard systems.

**GN7**

*The level of potential integration between S-DAS and other onboard systems may vary according to whether the S-DAS equipment is to be retrofitted to existing stock or fitted to new stock. There may be trade-offs required between the lower costs of an entirely independent application, and benefits resulting from sharing services, data or equipment with other existing or future applications: e.g. positioning equipment, GNSS or communications antennas, time source, DMI, TMS etc.*

3.2.10 The RU should consider whether to provide an interface between the S-DAS and the existing onboard data recording equipment. If an interface is not implemented, a means must be provided for information recorded on separate systems to be synchronised.

3.2.11 S-DAS must support the remote installation of upgrades to the onboard S-DAS software.

3.2.12 S-DAS must support the remote update of configurable parameters.

3.2.13 There must be no control interface between S-DAS and the onboard braking and traction systems.

3.2.14 The S-DAS time source must provide time information within the tolerances required for effective DAS operation.

3.2.15 The default language for any information displayed to the driver must be English. The RU should consider whether other language options may be made available for selection, but the display language must return to default when the system is powered up.
3.3 Energy Efficient Speed Profile Calculation

3.3.1 The S-DAS must calculate accurate advisory information that provides the optimum energy efficiency for a specific train whilst meeting the schedule specified in the working time table.

GN8 Research project T724 [RD2] states that to provide optimum energy efficiency the advisory information presented to the driver should be calculated so that it:

   a) Limits the maximum speed.
   b) Minimises braking.
   c) Uses the traction system (including regenerative braking) in its most efficient power setting.

3.3.2 The energy efficient speed profile must take account of:

   a) Scheduled departure and arrival times at timing points and station stops.
   b) Actual train characteristics, for example traction and braking profiles, rolling resistance, weight, length and maximum train speed.
   c) Temporary speed restrictions (TSR).
   d) Route geography.

3.3.3 The S-DAS data processing algorithms must be configured to the particular type of route, service pattern and traffic type (passenger, freight etc.).

3.3.4 The S-DAS data processing algorithms must be capable of being configured to meet changing operational requirements.

3.4 Information Displayed

NOTE: This section of the document has been informed by the experience gained by a particular operator when implementing an S-DAS system. As such some of the statements in the section may be unduly prescriptive.

3.4.1 Advisory Information

3.4.1.1 The S-DAS user interface must be capable of displaying the following types of advisory information to the driver at the same time:

   a) Current.
   b) Approaching.

GN9 The purpose of providing current advisory information is so that the driver has the benefit of knowing what the S-DAS is proposing at the current location of the train.

GN10 The purpose of providing approaching advisory information is so that the driver has the benefit of preparing for any future change in advisory information.

3.4.1.2 The current advisory information displayed to the driver must be at most one of the following:

   a) The current advisory speed.
b) Notification that the train is within a TSR area.

c) Notification that the train is within a Coasting area.

3.4.1.3 The approaching advisory information displayed to the driver must be at most one of the following:

a) The new advisory speed that is approaching.

b) Notification that the start of a TSR area is approaching.

3.4.1.3c) Notification that the start of a Coasting area is approaching.

GN11 Various advisory information display options were trialled by First Group to determine the driver preferences. The options trialled were:

a) A graphical representation of the required driving profile i.e. presented instructions for when the driver should brake, maintain speed or accelerate.

b) A time based display of early or late running.

c) Text based advice of the speed to drive at, or to coast.

The results of the trial (which was on non-ETCS fitted trains) indicated that a text based speed value option (option c above) was overwhelmingly the preferred option. The other two options were found to be difficult to interpret, distracting, and increased driver workload.

GN12 It may be clearer to the driver to display the different variations in advice information in different formats. For example, each of the advisory information ‘types’ listed above could be displayed in a unique colour. The RU should consider whether to use different formats for each variation and this should be assessed in accordance with human factors best practice and in consultation with drivers.

3.4.1.4 The S-DAS must only display advisory speed information (current or approaching) that has been calculated as lower than the minimum of the linespeed profile and the maximum train speed.

GN13 This prevents the display of mandatory speed information to the driver by an advisory system.

3.4.1.5 The rate of change of displayed advisory speed information must be controlled such that driver’s workload is not increased and the driver is not distracted.

GN14 Possible means of achieving this include:

a) Incremental limits to be imposed for the display of advisory speed e.g. the speed is displayed in 5 mph or 5 kph increments only (8mph/kph hysteresis).

b) Time limits to be imposed between advisory speed value changes.

3.4.1.6 The S-DAS must not display TSR speed values, only that the train is within or approaching a TSR area.
Although the TSR speed value is used by the S-DAS algorithms to determine the advisory information, the TSR speed value is not displayed to prevent drivers becoming reliant on S-DAS for mandatory speed information. The advisory information only advises of an approaching TSR area and when the train is within a TSR area.

3.4.1.7 The S-DAS must indicate when coasting is advised.

3.4.1.8 The S-DAS must only display approaching information if a change in advisory information occurs within a distance or time defined by a configurable ‘look-ahead’ parameter.

The ‘look-ahead’ parameter determines how far ahead, in distance or time from the current train position, the S-DAS is permitted to display approaching advisory information.

It is important to set the ‘look ahead’ parameters so that approaching advisory information is only displayed to the driver when it is useful to do so. For example, it may not be desirable to provide information to the driver of a change in speed which occurs ten miles ahead. The ‘look ahead’ parameter may be route or location specific.

3.4.1.9 A countdown display to the location of a change in advisory information must be provided so that the driver can adequately determine when or where the actual change in advice starts.

The countdown display may indicate a time or distance until the change in advisory information, or a simply progress bar, the value or length of which steadily decreases at discrete intervals as the train approaches the change location. For example the countdown display could show a time to a change location starting with 1 minute (‘look ahead’ parameter) decreasing to 30s then 20s, 10s down to 1s. The form of the countdown timer should be assessed in accordance with human factors best practice and consultation with drivers.

3.4.2 Journey Segment Information

3.4.2.1 The S-DAS must be capable of displaying the following journey segment related information:

a) The name of the next station stop or timing point.

b) The scheduled arrival time at the next station stop or timing point.

c) The estimated time of arrival at the next station stop or timing point.

3.4.2.2 The S-DAS must be capable of displaying the scheduled time of departure from stations, and a countdown indication to the scheduled time of departure when a train is at a stand in a departure station.

3.4.2.3 The S-DAS must display the current time.

3.4.3 Train Consist Information

3.4.3.1 The S-DAS must display train consist information that is useful to the driver in operating the train.

Train consist information forms part of the S-DAS setup information described in section 3.5.3 of this document. Certain elements of the train consist information could be used by drivers to support the operation of the train, for example:
GB Operational Concept
Standalone Driver Advisory System (S-DAS)

a) On passenger trains, S-DAS could display the current train formation to drivers, e.g. 4 car or 12 car, to assist the driver in identifying a platform stop location.

b) On freight trains, S-DAS could display train length, train mass or maximum train speed to drivers.

GN20 The RU should determine what information is useful and how best to provide this information.

3.4.4 System Information

3.4.4.1 A means must be provided to allow the driver to determine whether the user interface display has ‘frozen’.

GN21 This could take the form of a system health indication on the S-DAS user interface that flashes or changes colour at a defined rate. The method employed should consider the potential for driver distraction.

3.4.4.2 The S-DAS must be configured so that it can provide feedback to drivers on their driving efficiency after the journey.

GN22 The RU should determine how best to provide this information, for example, driving efficiency factor measured as a percentage or an indication of energy usage for the journey in the appropriate units (kilowatts per hour, litres per mile etc.).

3.4.5 Information Display Conditions

3.4.5.1 Advisory and journey segment information must only be displayed if the customisation data for an entire journey segment is available onboard.

GN23 Customisation data required for a journey segment includes the departure and arrival times at the journey segment start and end points (stations or timing points) and all necessary route geography data applicable to the journey segment.

3.4.5.2 The display of advisory and journey segment information must be automatically suppressed when S-DAS detects that the train’s actual position is not consistent with the specified journey.

GN24 This ensures that the driver will not be presented with advisory or journey segment information for an incorrect route which could lead to trains being advised to drive slower than required to meet the timetable, or being advised to drive at a speed higher than the line can support. This also prevents advisory information being presented if the train’s position cannot be determined. Journey data may continue to be recorded if the information display is automatically suppressed to allow the RU to assess the impact of the suppression.

3.4.5.3 Any known positional uncertainty inherent in the means S-DAS uses to determine train position must not lead to the incorrect automatic suppression of the S-DAS advisory information.

GN25 The means that S-DAS uses to determine train position may have inherent positional uncertainty. The design of the automatic suppression algorithm should consider these uncertainties but not apply them too restrictively and assume that the train is off route when this cannot dependably be determined.
3.4.5.4 The display of advisory information must be automatically suppressed if the system detects that the driving is not consistent with the current advisory profile. The condition used to detect this situation must be configurable, and will likely be dependent on some combination of time, distance, speed and heading.

GN26 The driving may not be consistent with the current advisory profile due to the driver responding to restrictive signal aspects that the S-DAS system is unaware of.

3.4.5.5 The display of advisory information must be automatically unsuppressed if, following automatic suppression (see clause 3.4.5.4), the system detects that the driving is within a predefined tolerance of the current advisory profile and no other suppression condition is applicable.

3.4.5.6 Suppression areas must be pre-configured to avoid advisory information distracting the driver in complex areas where there is likely to be high workload and where there is little benefit in providing advisory information.

GN27 Suppression areas could include the approach to, within, and departing from stations or other complex areas.

3.4.5.7 The display of current advisory information must be suppressed while the train is within a pre-configured suppression area.

GN28 Approaching advisory information may be retained so that the driver is aware of what the advisory information will be when the train leaves the suppression area.

3.4.5.8 On leaving a pre-configured suppression area, S-DAS must automatically unsuppress the display of advisory information.

3.4.5.9 The S-DAS driver interface must not display advisory or journey segment information if S-DAS has been manually suppressed.

3.4.5.10 The S-DAS driver interface must not display advisory, journey segment, or train consist information if S-DAS has been manually disabled.

3.4.5.11 Table 1 below summarises the information display conditions by information type.

<table>
<thead>
<tr>
<th>Information</th>
<th>Specific Information</th>
<th>When displayed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setup Information</td>
<td>N/A</td>
<td>Displayed as part of the setup process performed by the driver (see section 3.5.3 of this document)</td>
</tr>
<tr>
<td>Journey Segment and Train Consist Information</td>
<td>Generic</td>
<td>Displayed when all of the following conditions are met:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Customisation data is available for the journey segment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The S-DAS onboard sub-system is not manually disabled.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The display of advisory information is not suppressed (manual or automatic) i.e.:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o The train’s current position is consistent with</td>
</tr>
</tbody>
</table>
## GB Operational Concept
### Standalone Driver Advisory System (S-DAS)

<table>
<thead>
<tr>
<th>Information</th>
<th>Specific Information</th>
<th>When displayed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Departure information (scheduled departure time and countdown)</td>
<td>Specific conditions for the display of departure information are:</td>
<td>the route geography data for the journey. (Exception – if the display of advisory information is suppressed, train consist information is still displayed.)</td>
</tr>
<tr>
<td></td>
<td>• The train is stationary within a station stop area for which departure information is available.</td>
<td></td>
</tr>
<tr>
<td>Current Advisory Information</td>
<td>Generic</td>
<td>Specific conditions for the display of current advisory information are:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Customisation data is available for the journey segment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The S-DAS onboard sub-system is not manually disabled.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The display of advisory information is not suppressed (manual or automatic), i.e.:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o The train’s current position is consistent with the route geography data for the journey.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Driving is consistent with the advisory profile.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Train is not in an advisory information suppression area.</td>
</tr>
<tr>
<td>Speed</td>
<td>Specific conditions for the display of current advisory speed information are:</td>
<td>the current advisory information is a speed i.e. not TSR or Coast.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The advisory speed is calculated as lower than the minimum of the linespeed profile and the maximum train speed.</td>
</tr>
<tr>
<td>TSR</td>
<td>Specific conditions for the display of current advisory TSR information are:</td>
<td>the current advisory information is a TSR i.e. not a speed or Coast.</td>
</tr>
<tr>
<td>Coast</td>
<td>Specific conditions for the display of current advisory Coast information are:</td>
<td>the current advisory information is Coast i.e. not a speed or TSR.</td>
</tr>
<tr>
<td>Generic</td>
<td>Generic conditions for the display of approaching advisory information are:</td>
<td>Customisation data is available for the journey segment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The S-DAS onboard sub-system is not manually disabled.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The display of advisory information is not suppressed (manual or automatic), i.e.:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o The train’s current position is consistent with the route geography data for the journey.</td>
</tr>
</tbody>
</table>
GB Operational Concept
Standalone Driver Advisory System (S-DAS)

<table>
<thead>
<tr>
<th>Information</th>
<th>Specific Information</th>
<th>When displayed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>○ Driving is consistent with the advisory profile.</td>
</tr>
<tr>
<td>Speed</td>
<td>Specific conditions for the display of approaching advisory speed information are:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The train is within the predefined look-ahead parameter of a change in advisory information.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The approaching advisory information is an advisory speed.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The approaching advisory speed is calculated as lower than the minimum of the linespeed profile and the maximum train speed.</td>
<td></td>
</tr>
<tr>
<td>TSR</td>
<td>Specific conditions for the display of approaching TSR information are:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The train is within the predefined look-ahead parameter of a change in advisory information.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The approaching advisory information is TSR.</td>
<td></td>
</tr>
<tr>
<td>Coast</td>
<td>Specific conditions for the display of approaching Coast information are</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The train is within the predefined look-ahead parameter of a change in advisory information.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The approaching advisory information is Coast.</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: S-DAS Information Display Conditions Summary
3.4.5.12 Table 2 below summarises the information to be displayed in the various system states. A tick indicates that the information type can be displayed subject to other conditions (listed in Table 1 above) being met.

<table>
<thead>
<tr>
<th>System Status</th>
<th>Display Information Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Current Advisory Information</td>
</tr>
<tr>
<td>Display not suppressed, system not disabled</td>
<td>✓</td>
</tr>
<tr>
<td>Automatic Suppression (Off Route, see clause 3.4.5.2)</td>
<td></td>
</tr>
<tr>
<td>Automatic Suppression (Inconsistent Driving, see clause 3.4.5.4)</td>
<td></td>
</tr>
<tr>
<td>Automatic Suppression (Suppression Area, see clause 3.4.5.6)</td>
<td></td>
</tr>
<tr>
<td>Manual Suppression (see section 3.6.5)</td>
<td></td>
</tr>
<tr>
<td>Manual Disable (see section 3.6.5)</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Information Displayed vs. System States
3.5 Customising S-DAS

3.5.1 Overview

3.5.1.1 The S-DAS onboard sub-system must be customised with the data necessary to allow the information described in section 3.4 of this document to be calculated for a particular journey and displayed to the driver.

The data required to customise the S-DAS onboard sub-system for a particular journey can be divided into four components:

a) Infrastructure related data, which includes:
   i) Route geography data – track centrelines, curvature, altitude, linespeed, PSR, station locations.
   ii) Electrical energy consumption limitations due to energy tariffs (by time of day, geographic location etc.)

b) Operating data, which includes:
   i) Working timetable data (departure and arrival times at station stops and timing points).
   ii) Temporary speed restrictions (TSRs).

c) Train related data, which includes:
   i) Acceleration and braking capabilities.
   ii) Power consumption characteristics (e.g. traction and hotel power consumption, efficiency etc).
   iii) Maximum train speed.
   iv) Train weight.
   v) Train length.

d) Setup Information (See section 3.5.3 of this document).

3.5.1.2 The customisation data for the journey to be undertaken must be onboard prior to the journey beginning.

3.5.1.3 For effective S-DAS operations, the customisation data to be used by the S-DAS onboard sub-system must be current.

3.5.2 Customisation Data Flow

3.5.2.1 Relevant customisation data must be transferred to the S-DAS onboard sub-system.

3.5.2.2 Setup information must be entered at the beginning of a journey (See section 3.5.3).

3.5.2.3 The S-DAS onboard sub-system must record details of each S-DAS journey.
GB Operational Concept
Standalone Driver Advisory System (S-DAS)

3.5.2.4 Journey data records must be available for transfer or download by the RU during or on completion of a journey.

3.5.3 Set up Information

3.5.3.1 Before the start of a particular journey, S-DAS must be primed with the data relevant to the particular journey being undertaken.

3.5.3.2 The S-DAS must have the means to identify the driver using a unique Driver ID.

3.5.3.3 The S-DAS must have the means to identify the journey using a TRN.

3.5.3.4 TRNs are used to differentiate between train services, giving each train its own identity, which can be used for train planning, regulation or communication purposes. For S-DAS, the TRN allows for the determination of the relevant customisation information (route geography, working timetable, TSR etc.) to be utilised by S-DAS for a particular journey. Consideration should be given to providing a means for the TRN to be obtained from another onboard system.

3.5.3.5 In GB a TRN currently consists of a 4-character alphanumeric (for example, 1L26), which contains three items of information:

   a) Class of train.
b) Destination, stopping pattern or other form of service differentiation.

c) Train/route number.

3.5.3.4 S-DAS must initially support GB alphanumeric TRNs.

3.5.3.5 S-DAS must support a migration to eight digit TRNs.

3.5.3.6 S-DAS must provide the means for driver to manually enter the TRN by either:

a) Selecting a TRN from a chronological list of possible TRNs which correspond with the known train location and time, or

b) Manually typing the TRN.

GN39 Selecting the TRN from a list reduces the opportunity for error that would be incurred if the TRN were to be entered manually and allows for discrimination between duplicate TRNs.

3.5.3.7 The S-DAS must provide the means for the driver to confirm that the system has identified the correct journey from the TRN provided.

GN40 This could be achieved by displaying the journey start and end point, and departure time information determined from the entered TRN and requiring that the driver confirm it is correct.

3.5.3.8 A means must be provided for S-DAS to determine the actual train consist.

GN41 If the train consist data does not accurately represent the train to be operated, the advisory information provided to the driver may not be optimised which will have a performance impact. This information could be entered or selected manually by the driver, or provided by other onboard systems.

GN42 Train consist information includes acceleration capability, train length, weight and maximum speed. For passenger trains it could also include the identification of isolated or unavailable traction engines because this impacts on train acceleration capability. Additionally, train faults that lower the maximum speed of a train, for example broken windows or raised emergency bypass switches, could also be identified to ensure that advisory information does not exceed the maximum speed of the train.

GN43 For freight trains, train consist information, identified by a TRN, is available via TOPS and is presented to the driver in the form of a train consist sheet [RD3]. Train consist information could therefore (preferably) be downloaded by the S-DAS onboard sub-system directly from TOPS if the necessary interface was available, or the driver could enter the relevant information from the train consist sheet manually.

GN44 ETCS onboard equipment requires train consist information to be entered for correct ETCS system operation. Where the ETCS train consist data overlaps with the needs of S-DAS, consideration should be given to providing a means for common data to be shared between the two systems.
GB Operational Concept
Standalone Driver Advisory System (S-DAS)

To reduce the risk of incorrect train consist information being entered manually, drivers should where possible be presented with pre-defined lists from which the relevant train consist information is selected. Manual entry of train consist information should be avoided where possible, but where it is necessary appropriate means should be employed to reduce the risk of error as described in section 3.2.7 and GN6 of this document.

3.5.3.9 The S-DAS must provide the means for the driver to check and confirm that the train consist information is correct.

3.5.3.10 Where manual entry or selection of setup information is required, S-DAS must support the correction of errors without the whole setup process having to be repeated.

3.5.3.11 Setup information from a completed journey must not be retained by the S-DAS onboard sub-system and presented to the driver at the start of the next journey.

3.5.4 Journey Records

3.5.4.1 The S-DAS must record the driving profile for each journey so that the effectiveness of the S-DAS, and network and driver performance can be measured.

3.5.4.2 The S-DAS must provide the means for journey records to be downloaded or transferred from the S-DAS onboard sub-system.

3.6 Driving With S-DAS

NOTE: This section of the document has been informed by the experience gained by a particular operator when implementing an S-DAS system. As such some of the statements in the section may be unduly prescriptive.

3.6.1 Overview

3.6.1.1 It is important to recognise that S-DAS provides advisory information to the driver which is intended to support existing decision making processes. The driver must treat the information provided by the S-DAS as advisory only and continue to drive in accordance with current rules, route knowledge, operational notices and policies.

3.6.1.2 S-DAS must provide advisory information that supports drivers in meeting the following driving goals identified by Research Project T724 [RD2]:

a) Maintain the schedule of the service (“as far possible, [ensure that] the trains runs to time and any avoidable delay is prevented”; p.9, [RD4]).

b) Apply additional driving guidance in best practice (such as professional driving) and RU specific initiatives (section 5.3.1 of [RD2] “Ecodriving”: Improving energy efficiency of service delivery).

3.6.1.3 The driver’s ability to achieve the (highest priority) goal of maintaining safety (identified by Research Project T724 [RD2], “safety duties take priority over all other duties”; p.9, [RD4]), must not be diminished by the implementation of S-DAS.
3.6.2 S-DAS Driver Controls and Indications

3.6.2.1 The driver must only operate/interact with S-DAS when it is safe to do so.

**GN46** In order to avoid driver distraction, S-DAS could be configured to make sure that certain functions are available for use only when the train is at a stand. This could be effected either by S-DAS equipment configuration or by the development of operator procedures.

3.6.2.2 The driver must be provided with a control to manually suppress the display of S-DAS information.

**GN47** Situations that require the display of S-DAS information to be manually suppressed are described in section 3.6.5. Display information that is suppressed is defined in Table 2. Journey data may continue to be recorded if the information display is suppressed, to allow the RU to assess the impact of the suppression.

3.6.2.3 The driver must be able to determine via the user interface that the display of S-DAS information is being suppressed (following manual or automatic suppression, see section 3.4.5 of this document).

**GN48** This could take the form of messages describing the location of the train within a defined suppression area (for example, ‘Approaching Station’, ‘Stopped in Station’), or advising that the train is off route or that S-DAS has been manually suppressed.

3.6.2.4 The driver must be provided with a control to unsuppress the display of S-DAS information.

3.6.2.5 The manual unsuppress control must only function if the display of advisory information is manually suppressed and no automatic suppression conditions apply.

3.6.2.6 The driver must be provided with a control to manually disable S-DAS.

**GN49** Situations that require S-DAS to be manually disabled are described in section 3.6.5. No S-DAS information is displayed if S-DAS has been manually disabled, nor is journey data recorded.

3.6.2.7 The driver must be provided with an indication that S-DAS has been manually disabled.

3.6.2.8 The driver must be provided with a control to re-enable S-DAS.

3.6.2.9 The driver must be provided with an indication if the setup process is unsuccessful, i.e. if the customisation data applicable to the journey defined by the TRN is not available.

3.6.2.10 The S-DAS user interface must be capable of switching between predefined night and day default brightness settings.

**GN50** This switching could be provided automatically or by manual intervention from the driver.
GB Operational Concept
Standalone Driver Advisory System (S-DAS)

3.6.2.11 The driver must be provided with a control to manually adjust the brightness of the S-DAS display from the night/day default settings within a predefined minimum and maximum brightness range.

3.6.2.12 It must not be possible for the driver to reduce the brightness such that displayed information is not visible.

3.6.2.13 Automatic switching, if provided, must not reduce the brightness such that displayed information is not visible.

3.6.2.14 Automatic switching, if provided, must be controlled so that the switch between night and day settings is not triggered by short duration events, for example the train passing under a bridge.

GN51 This could be controlled by the definition of a minimum reaction time for the day/night switching function.

3.6.2.15 The driver must be provided with the means to enter a new Driver ID without having to re-enter all the setup information at driver changeover.

GN52 In the event that the train consist has changed during the driver changeover, or the driver handover is taking place at the start of a new journey with a new TRN, the relevant setup information will need to be amended.

GN53 If the removal of the master key results in a loss of power to the S-DAS onboard sub-system, setup information may need to be re-entered or confirmed when the onboard sub-system is re-powered. RUs should consider the impact of this on driver handover times.

3.6.2.16 The driver must be provided with the means to amend train consist information without having to re-enter all the setup information.

GN54 The facility to amend train consist data during a journey is essential in order to facilitate train operation at locations where changes are planned or anticipated. Changes to train consist may result from coupling or uncoupling or freight trains loading or unloading during a journey.

3.6.2.17 The driver must be provided with the means to amend TRN data without having to re-enter all the setup information.

3.6.2.18 The driver must be provided with the means to amend station stop information i.e. include additional station stops, or remove redundant station stops if notification is received from station staff or the signaller via special-stop or not-to-call orders.

GN55 If an additional stop is required to be made, S-DAS could provide a higher advisory speed than would normally be the case in the affected journey segments to ensure the timetable can still be met. Conversely, if a station stop is no longer required, drivers could be advised to drive more slowly in affected journey segments to achieve better energy savings. Amending the station stop information also ensures that the displayed journey segment information is accurate.

3.6.2.19 If the RU intends to utilise S-DAS journey records as part of network performance monitoring processes, then:
a) The driver must be provided with the means to manually select or input explanatory information that describes why the S-DAS advisory information was not followed during a journey.

b) The explanatory information must be recorded in the journey records.

GN56 The user interface should provide a predefined list of explanatory information from which the driver can select. The RU should determine the requirements for the explanatory information that drivers can access, but as a minimum it must be self-explanatory and easy to discriminate. Explanatory information could be directly associated with existing delay attribution codes allowing the journey record to additionally support the delay attribution process.

GN57 Examples of explanatory information include:

a) Restrictive signals.

b) Infrastructure faults.

c) Low adhesion.

d) Poor weather.

e) Train fault.

f) Request stops.

3.6.3 Onboard Safety Systems

3.6.3.1 S-DAS must not affect the driver’s use of existing onboard safety systems (DRA, DSD, DVD, AWS etc.) in accordance with existing rules and procedures.

3.6.4 Temporary and Emergency Speed Restrictions

3.6.4.1 S-DAS must take account of TSRs when calculating recommended speeds.

3.6.4.2 With relation to the use of ESR information by S-DAS, see open point 3 in section 4.

3.6.5 Out of Course Operations

3.6.5.1 The driver must be able to manually suppress the display of advisory and journey information if the train has been re-routed and the S-DAS system continues to display advisory or journey information associated with the original route (see section 3.4.5 of this document).

GN58 Manual suppression of out-of-context information when the train has been rerouted ensures that the driver will not be presented with advisory information for the incorrect route which could lead to trains being advised to drive slower than required to meet the timetable, or being advised to drive at a speed higher than the line can support.

GN59 If the train positioning system is not capable of discriminating between parallel lines, the driver should manually suppress S-DAS if, for example routed from the fast to the slow line. This will require the driver to know which line the S-DAS information is actually based on.
3.6.5.2 The driver must be able to manually disable the S-DAS for moves into, within and out of possessions and worksites.

3.6.5.3 The driver must be able to manually disable the S-DAS in the event that the operation of S-DAS becomes degraded.

**GN60** This includes any planned outages to amend or upgrade S-DAS equipment where this will result in a reduction of service during the changeover, or the driver becoming aware of an S-DAS failure, for example 'screen freeze', incorrect advisory information being displayed with the train still on route etc.

3.6.5.4 The S-DAS should either be manually disabled or the display suppressed if the driver is informed of the need to operate over degraded signalling infrastructure. This includes examination of the line, temporary block working, single line working, and wrong direction movements. The RU must consider which of the two options is preferable, i.e. disabling S-DAS or suppressing the display.

**GN61** If the display is suppressed but the S-DAS is not manually disabled, journey records related to the degraded operation will be available for future analysis to determine the impact on network performance.

3.6.5.5 The S-DAS should either be manually disabled or the display suppressed in the event of abnormal working. Examples would include moving the train following a train failure, or the reduction of infrastructure availability due to a bridge strike or broken rail. The RU must consider which of the two options is preferable, i.e. disabling S-DAS or suppressing the display.

**GN62** If the display is suppressed but the S-DAS is not manually disabled, journey records related to the abnormal working operation will be available for future analysis to determine the impact on network performance.

### 3.7 Train Preparation

3.7.1 It must be possible to incorporate any additional train preparation tasks associated with the S-DAS onboard equipment; whilst limiting the overall impact on workload and timings through the efficient sequencing of train preparation activities.

**GN63** The introduction of S-DAS will increase the amount of onboard equipment. This equipment may require additional activities to be undertaken during train preparation. Examples of additional train preparation activities may include S-DAS customisation and visual inspection of internally and externally fitted S-DAS equipment.

**GN64** RUs should include consideration of defective S-DAS in their respective defective on-train equipment contingency plans.

### 3.8 System Maintenance

3.8.1 The location of S-DAS onboard sub-system components must allow for easy access for all required maintenance activities.

3.8.2 The RU must consider the impact of an S-DAS implementation on existing Vehicle Maintenance Instructions (VMI) and Vehicle Maintenance Overhaul Instructions (VMOI) and revise them as necessary.
3.9 **S-DAS Driving Guidance and Training**

**NOTE:** This section of the document has been informed by the experience gained by a particular operator when implementing an S-DAS system. As such some of the statements in the section may be unduly prescriptive.

3.9.1 The RU must develop driving guidance and training that adequately develops the drivers’ competency and skills on the usage of S-DAS.

**GN65** The RU is responsible for the training of staff who are directly involved with the use, maintenance and preparation of trains which are fitted with S-DAS.

**GN66** The following are factors that should be covered in the guidance and training:

a) Train preparation activities and any amendments to existing train preparation task sequencing as a result of the introduction of S-DAS.

b) S-DAS customisation and setup.

c) Driver handover procedures.

d) Information display and controls.

e) The status of the S-DAS advisory information.

f) When to use S-DAS.

g) Where S-DAS works.

h) When to manually suppress/unsuppress the S-DAS display.

i) When to manually disable/re-enable S-DAS.

j) S-DAS fault reporting.

k) System maintenance tasks.

3.9.2 The RU must decide the policy for S-DAS usage by its drivers.

**GN67** Information provided to drivers by S-DAS is considered to be wholly advisory, but if not following this information could have negative consequences for drivers, then the status of the information will need to be defined by the RU in consultation with driver managers and drivers.

3.10 **RU Roles and Responsibilities**

3.10.1 **Customisation Data Responsibilities**

3.10.1.1 The RU must prepare and maintain all train related customisation data (see section 3.5.1 of this document).

**GN68** This responsibility may be fulfilled by existing RU train planning functions using existing train planning software.

**GN69** The RU should provide IM Operations Planning with the train related customisation data to allow the performance of S-DAS fitted trains to be modelled for the identification of network performance improvements.

3.10.1.2 The RU must manage the transfer of infrastructure related customisation data between the IM and RU.
3.10.1.3 The RU must ensure that all the customisation data required for S-DAS operation is correctly prepared and formatted.

The preparation and formatting of S-DAS data may include:

a) Constructing gradients from altitude data

b) Overlaying TSR speeds onto the profiles supplied as part of the route geography etc.

3.10.1.4 The RU must ensure that all S-DAS data preparation and formatting processes employ a level of checking appropriate to the required integrity of the data.

3.10.1.5 The RU must ensure that all the customisation data required for S-DAS operation is current, and is transferred to the S-DAS onboard sub-system.

3.10.1.6 The process for correctly preparing, formatting and transferring customisation data to the S-DAS onboard sub-system must limit the amount of manual data entry. Where data is manually entered a checking process appropriate to the required integrity of the data must be employed to ensure the data is entered correctly.

3.10.1.7 The RU must update S-DAS customisation information in sufficient time to prevent implemented infrastructure or train information changes impacting on S-DAS operation.

3.10.1.8 The RU must have contingency arrangements in place if the S-DAS customisation information is not current.

3.10.1.9 The RU must develop processes and procedures necessary for the retrieval, analysis and distribution of S-DAS journey records.

3.10.1.10 The RU must manage the S-DAS onboard sub-system software configuration.

3.10.1.11 The RU must develop and manage processes and procedures for the maintenance and upkeep of the S-DAS onboard sub-system equipment and interfaces, and any trackside equipment required to support S-DAS operations in accordance with defined processes and procedures, to meet system-wide availability targets.

3.10.2 RU Operations Control

3.10.2.1 RU Operations Control must ensure that Signallers are made aware when S-DAS becomes operational on a fleet or is taken out of operation.

3.10.3 Driver

3.10.3.1 The driver is the only direct user of the S-DAS information, and must:

a) Complete system set up prior to journey start.
b) Monitor and control S-DAS during the journey and follow the advisory information when s/he judges that it is practical and appropriate to do so.

c) Amend or update setup information as required during the journey.

3.10.4 Driver Manager

3.10.4.1 The Driver Manager must manage S-DAS driver competency and arrange for drivers to be trained and/or briefed in the use of S-DAS.

GN72 Regardless of training and instructions regarding the status of advisory information in cab, it is considered possible that drivers may become increasingly reliant on the information provided, diluting their application of route knowledge and adherence to lineside indications and signage and external instructions. It may be appropriate for drivers to be encouraged to occasionally drive with S-DAS manually disabled or suppressed in order to retain their ‘non-DAS’ operational knowledge.

3.10.4.2 The Driver Manager must advise drivers if customisation data is not current so that the appropriate contingency arrangements can be implemented.

3.10.5 Train Maintainer

3.10.5.1 The train maintainer must perform S-DAS onboard sub-system maintenance as required by maintenance processes.

3.10.6 Train Preparer

3.10.6.1 The train preparer must complete any train preparation activities associated with the S-DAS onboard sub-system.

GN73 This could be carried out by dedicated train preparation staff or drivers.

3.11 IM Responsibilities

3.11.1 Customisation Data Responsibilities

3.11.1.1 The IM must provide the required infrastructure customisation data (see section 3.5.1 of this document) to the RU in an agreed format via an agreed interface. The format, units and resolution required for specific data parameters defined in the infrastructure data must also be agreed.

3.11.1.2 The IM must provide infrastructure customisation data updates to the RU in sufficient time to prevent implemented infrastructure changes impacting on S-DAS operation. These updates must be in an agreed format via an agreed interface.

3.11.1.3 The IM must make available to the RU in electronic form the published working timetable, updates to the working timetable, and weekly operating notices.

3.11.1.4 To minimise error, any data preparation processes required for the provision of infrastructure customisation data or data updates must employ a level of checking appropriate to the required integrity of the data.
GB Operational Concept
Standalone Driver Advisory System (S-DAS)

3.11.2 IM Data Preparer

The role of IM data preparer is responsible for collating, checking, and maintaining infrastructure customisation data and delivering it to the RU. This role is not necessarily fulfilled by one person, more likely a team of independent preparers and checkers.

3.11.3 IM Operations Planning

The implementation of S-DAS is not expected to affect the role of Operations Planning significantly. However operational modelling may benefit from using the RU generated train customisation data used for S-DAS, and feedback from journey records analysis may be used to amend incorrect or non-achievable timetable data.

3.11.4 Signaller or Automatic Route Setting (ARS) System

3.11.4.1 The IM must determine the policy for train signalling and regulation control in areas where S-DAS trains operate.

Neither the signaller nor ARS system is directly involved with S-DAS. However S-DAS should reduce train speeds to prevent early arrivals, which might require the signaller or ARS systems to amend any assumed behaviours or rules used for determining the means in which trains are regulated. See open point 2 in section 4.
4 Open Points

4.1 Overview

4.1.1 Table 3 below lists a number of open points and associated working assumptions. Where possible, a justification for the working assumption has also been included. These open points will be considered in the next stage of development, in addition to undertaking a more detailed safety assessment of this operational concept.

The working assumptions are additionally documented in section 2, Assumptions. References to clauses affected by the open point and working assumption are also listed, and where considered necessary, clauses in the document may also include cross-references to associated open points.
<table>
<thead>
<tr>
<th>Open point identity</th>
<th>Open point</th>
<th>Working Assumption</th>
<th>Justification</th>
<th>Affected Clauses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The advisory speed information presented to drivers could alter sectional running times sufficiently that level crossing warning times are affected resulting in increased risk of crossing misuse. Additional work needs to determine the impact of S-DAS on level crossing warning times and suitable controls and mitigations.</td>
<td>Advisory information will not affect sectional running times sufficiently to affect level crossing warning times.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>What changes need to be made to train signalling and regulation where trains are operated with S-DAS?</td>
<td>Signallers are made aware where trains have an operational S-DAS. ARS will not be changed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>If ESR information is not considered in the advisory calculations, drivers</td>
<td>ESR information does not form part of the S-DAS</td>
<td>The use of ESR data in the calculation of the advisory information by the S-DAS onboard sub-system has not</td>
<td>3.3.2, 3.4.1.2, 3.4.1.3,</td>
</tr>
</tbody>
</table>
## GB Operational Concept
### Standalone Driver Advisory System (S-DAS)

<table>
<thead>
<tr>
<th>Open point identity</th>
<th>Open point</th>
<th>Working Assumption</th>
<th>Justification</th>
<th>Affected Clauses</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>The S-DAS user interface could support the driver activated display of current train speed to facilitate continued train operations in the event of a speedometer or other speed information source (e.g. ETCS DMI) failure. The RU should consider the provision of this functionality and the use of the S-DAS user interface as a source of current train speed information. The assessment should consider all relevant operational, functional and non-functional requirements.</td>
<td>There is no requirement for S-DAS to display current train speed.</td>
<td>No such requirement identified during research project T724, or as part of the First Group trials.</td>
<td>3.1.6, 3.4, 3.4.5, Table 1</td>
</tr>
<tr>
<td>5</td>
<td>The display of scheduled departure time and countdown timers may</td>
<td>The facility to display Scheduled departure time and</td>
<td>3.4.2.2</td>
<td></td>
</tr>
</tbody>
</table>

The facility to display
Scheduled departure time and

customisation data.

been considered in this document as no evidence of a recognized process for the dissemination of ESR information between the IM and the RU could be found (apparently the publication of ESR information in late notice cases has been discontinued).
GB Operational Concept  
Standalone Driver Advisory System (S-DAS)

<table>
<thead>
<tr>
<th>Open point identity</th>
<th>Open point</th>
<th>Working Assumption</th>
<th>Justification</th>
<th>Affected Clauses</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>cause distraction to the driver and result in the train departing from a station when it is not safe to do so. Risks associated with the use of S-DAS displayed scheduled departure time and associated countdown timers by drivers need to be assessed.</td>
<td>associated countdown timers is provided but the usage must be configurable.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>An appropriate Safety Integrity Level (SIL) rating must be incorporated within the system design to recognise the potential consequences of drivers being provided with the incorrect advisory information.</td>
<td>There is a strong industry desire that the technical solution should be low cost.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Open Points and Working Assumptions
5 Definitions

Abnormal Working
Extreme loading on a part of the railway system. For example, this may be the result of extended delays on one part of the service impinging on another.

An unforeseen or unplanned event, which does not have life threatening or extreme loss implication, including faults and failures external to S-DAS equipment.

Advisory
Recommended but not compulsory.

Coasting (or the advisory information COAST)
The driver does not need to apply traction to meet the WTT requirements, but can still apply traction if necessary. The driver must still brake to follow any restrictive aspects.

Connected DAS
Connected DAS 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, dynamic update of schedule information via a telecommunications link to a control centre that is monitoring the location and speed of multiple trains in an area.

ETCS Fitted Trains
A vehicle which has been fitted with Onboard ETCS Equipment.

ETCS Operating Level
The level of ETCS functionality within ERTMS.

European Train Control System (ETCS)
Interoperable system to provide train protection and in cab signalling.

GB Mainline Railway
GB Mainline Railway has the meaning given to it in the Railways and Other Guided Transport Systems (Safety) Regulations 2006.

Train Reporting Number
A number used by railway staff in Great Britain to identify a particular train service. Also referred to as a headcode.

Journey
A term used to define the scheduled movement of a train between a start and a finish point. For example, journey between London Euston and Glasgow Central.

Journey Segment
A segment of the full journey between adjacent timing points.

Linespeed Profile
The speed profile (Linespeed and Permanent Speed Restrictions) to be followed by a particular train as defined in the Sectional Appendix.
GB Operational Concept
Standalone Driver Advisory System (S-DAS)

Route Geography
Route Geography includes both infrastructure asset data (track, points, bridges, stations etc) and permissible speeds. For S-DAS the route geography data is constructed for and associated with a particular journey considering the expected routing of the train required to complete the journey.

Standalone DAS
Standalone DAS 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 an individual train against predefined (static) route geography and schedule data.

Working Timetable
A detailed record of train movements to the nearest 30 seconds. The WTT is retained by Network Rail within the Train Service Database (TSDB), which drives major systems responsible for running the railway.
## Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARS</td>
<td>Automatic Route Setting</td>
</tr>
<tr>
<td>ATOC</td>
<td>Association of Train Operating Companies</td>
</tr>
<tr>
<td>ATP</td>
<td>Automatic Train Protection</td>
</tr>
<tr>
<td>AWS</td>
<td>Automatic Warning System</td>
</tr>
<tr>
<td>C-DAS</td>
<td>Connected Driver Advisory System</td>
</tr>
<tr>
<td>DAS</td>
<td>Driver Advisory System</td>
</tr>
<tr>
<td>DIT</td>
<td>Department for Transport</td>
</tr>
<tr>
<td>DRA</td>
<td>Driver's Reminder Appliance</td>
</tr>
<tr>
<td>DSD</td>
<td>Driver's Safety Device</td>
</tr>
<tr>
<td>DVD</td>
<td>Driver's Vigilance Device</td>
</tr>
<tr>
<td>ESR</td>
<td>Emergency Speed Restriction</td>
</tr>
<tr>
<td>ERTMS</td>
<td>European Rail Traffic Management System</td>
</tr>
<tr>
<td>ETCS</td>
<td>European Train Control System</td>
</tr>
<tr>
<td>FOC</td>
<td>Freight Operating Company/Companies</td>
</tr>
<tr>
<td>GB</td>
<td>Great Britain</td>
</tr>
<tr>
<td>GN</td>
<td>Guidance Note</td>
</tr>
<tr>
<td>GRIP</td>
<td>Governance for Railway Investment Projects</td>
</tr>
<tr>
<td>GNSS</td>
<td>Global Navigation Satellite System</td>
</tr>
<tr>
<td>IM</td>
<td>Infrastructure Manager</td>
</tr>
<tr>
<td>Km/h</td>
<td>Kilometers per hour</td>
</tr>
<tr>
<td>Mph</td>
<td>Miles per hour</td>
</tr>
<tr>
<td>ORR</td>
<td>Office of Rail Regulation</td>
</tr>
<tr>
<td>RSSB</td>
<td>Rail Safety and Standards Board</td>
</tr>
<tr>
<td>RU</td>
<td>Railway Undertaking</td>
</tr>
<tr>
<td>S-DAS</td>
<td>Standalone Driver Advisory System</td>
</tr>
<tr>
<td>TPWS</td>
<td>Train Protection and Warning System</td>
</tr>
</tbody>
</table>
GB Operational Concept
Standalone Driver Advisory System (S-DAS)

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSDB</td>
<td>Train Service Database</td>
</tr>
<tr>
<td>TSR</td>
<td>Temporary Speed Restriction</td>
</tr>
<tr>
<td>V/TC&amp;C SIC</td>
<td>Vehicle/Train Control and Communications System Interface Committee</td>
</tr>
<tr>
<td>WON</td>
<td>Weekly Operating Notice</td>
</tr>
<tr>
<td>WTT</td>
<td>Working Timetable</td>
</tr>
</tbody>
</table>
Appendix A  Example System Architecture

A.1  Overview

A.1.1 Figure A.1 and the following sections present an overview of an example S-DAS architecture. Organisational boundaries and interfaces, data flows, and system/user interactions are also described.

A.1.2 The S-DAS example architecture consists of an onboard sub-system, and a trackside sub-system connected by a communications link. In this example architecture the communications link between the onboard and trackside sub-systems is a wireless mobile link to reduce the dependence on physical interfaces, including plugs, cables and sockets, and the associated failure modes, and the need to provide these physical interfaces at all locations where journeys could start and end.

A.1.3 In this example it has been assumed that:
   a) The RU restricts access to S-DAS to competent drivers only. This is managed by the system checking the driver ID entered during setup against a list of S-DAS competent users. The list of competent users is managed by the RU and downloaded to the S-DAS onboard sub-system.
   b) The RU uses S-DAS journey records as part of the driver competency management process (see section 3.6.2.19 of this document).
   c) The full set of static infrastructure data and transient operating data (see Table A.1) are transmitted to the S-DAS onboard data store and are not merged at the trackside.

A.1.4 In Figure A.1:
   a) System architecture elements are shown as red boxes.
   b) The flow of data between the S-DAS trackside and onboard sub-systems is indicated by orange lines.
   c) The transfer of data between the IM and the RU is indicated by green arrows.
   d) S-DAS onboard sub-system elements and interactions are shown within a blue border.
   e) The RU trackside sub-system elements, data processes and data elements are shown within a dark green border.
   f) The IM trackside data processes and data elements are shown within a black border.
   g) Process and sub-system interactions are shown as black lines.
   h) User interactions with processes or sub-systems are shown as black dashed lines.
GB Operational Concept
Standalone Driver Advisory System (S-DAS)

Figure A.1: Example System Architecture
A.2 **S-DAS Onboard Sub-System**

A.2.1 The S-DAS onboard sub-system is a computer based system which monitors progress of the train against the planned timetable and provides advisory information to the driver.

A.2.2 The S-DAS onboard sub-system is composed of the following:

a) An onboard communications link component.

b) A Global Navigation Satellite System (GNSS) receiver to provide:
   i) Train location.
   ii) Train speed.
   iii) Time.

c) A user interface.

d) A processing unit.

e) Interfaces to other onboard systems.

A.2.3 The onboard communications link component allows for the initiation, maintenance, and termination of a communications link with the trackside sub-system for the purposes of data exchange.

A.2.4 The train location, speed measurement, and clock functions are provided by an onboard GNSS receiver. This system provides real-time train speed and location, and time information within the tolerances required for effective S-DAS operation.

A.2.5 The user interface provides the interface for all user interactions with the S-DAS onboard sub-system, with the exception of manual S-DAS onboard sub-system isolation and/or power isolation interfaces.

A.2.6 The processing unit controls and oversees all aspects of onboard S-DAS operation:

   a) Initiation, management and termination of a communications link with trackside.

   b) Stores and manages changes to data received from the trackside sub-system and from driver input, and determines the relevant working data (see section A.4 of this document for data descriptions).

   c) Processes all user inputs from the user interface.

   d) Processes inputs from other onboard sub-systems.

   e) Calculates the advisory information displayed via the user interface using predefined algorithms, onboard ‘working’ data and real-time train location, speed and time data.

   f) Manages system status and operational states.

A.3 **S-DAS Trackside Sub-System**

A.3.1 The S-DAS trackside sub-system is composed of the following:

   * Trackside communications link component.

   * Trackside data store.
GB Operational Concept
Standalone Driver Advisory System (S-DAS)

A.3.2 The trackside communications link component allows for the initiation, maintenance and termination of a link with the S-DAS onboard sub-system for the purposes of data exchange.

A.3.3 The S-DAS trackside sub-system can manually establish a connection with the S-DAS onboard sub-system at any time for the purposes of journey data interrogation only. The benefits this trackside interrogation provides should be considered against the possible security risks that may arise from unsolicited trackside access to the S-DAS onboard sub-system.

A.3.4 The trackside data store is a managed store of customisation data required for S-DAS operation. A description of the data held with the trackside data store is provided in section A.4.

A.4 S-DAS Data

A.4.1 With reference to the example architecture shown in Figure A.1, Table A.1 defines the following:

a) The different data sets that are required or generated by this S-DAS onboard sub-system for each journey.

b) A description of what information the data sets might contain.

c) Where the information is sourced from and how the information is made available to the S-DAS onboard sub-system.

d) How the data sets are used.

A.4.2 There are eight data types associated with this example S-DAS architecture:

a) Infrastructure

b) Operating

c) Train

d) User

e) TRN

f) Stopping Pattern

g) Journey Record

A.4.3 The data types are associated with a data description as follows:

a) Static – data that is not changed or amended on a regular basis.

b) Transient – data that is changed or amended on a regular basis.

c) Working – The data set utilized by the S-DAS onboard sub-system for a particular journey.

d) Dynamic – advisory or system status information presented by the onboard DAS system to users via the user interface.

e) Log – recorded operational data associated with a particular journey and a particular driver that is made available for post-journey analysis.

A.4.4 The association of data type and data description is not logical.
# GB Operational Concept
## Standalone Driver Advisory System (S-DAS)

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Includes</th>
<th>Source and Interface to Onboard</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure</td>
<td>Static</td>
<td>Route geography of all routes that the trains may travel over, including</td>
<td>Prepared by the IM and delivered to the RU.</td>
<td>Used by the S-DAS onboard sub-system to:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Altitude</td>
<td>Imported into the trackside data store by RU Operations Control.</td>
<td>- Determine, in conjunction with the TRN entered by the driver, the relevant route geography information for the Infrastructure Working data.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Curvature</td>
<td>Updated on the S-DAS onboard sub-system via the communications link at the start of every journey.</td>
<td>- Determine when a train has left the planned route in order to cease display of advisory information.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Linespeed</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Permissible speed restrictions</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Station stop locations including all stations that a train is scheduled to stop at during a journey as well as any stations that could also be included as Special Stops during the journey.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Timing point locations.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Electrical energy consumption limitations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating</td>
<td>Transient</td>
<td>Working timetable and Timetable updates.</td>
<td>Prepared by the IM and delivered to the RU.</td>
<td>Used by the S-DAS onboard sub-system to:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Temporary speed restriction</td>
<td>Formatted and imported into the trackside data store by RU Operations</td>
<td>- Present a list of possible TRNs to the driver for selection, based on current time and location, to define the Transient Working data.</td>
</tr>
</tbody>
</table>
## GB Operational Concept
### Standalone Driver Advisory System (S-DAS)

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Source and Interface to Onboard</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>details as per the WON.</td>
<td>Control.</td>
<td>TRN data.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Updated on the S-DAS onboard sub-system via the communications link at the start of every journey.</td>
<td>• Present a list of all stations on the line for driver selection in the event of Not-to-Call or Special Stop orders being received, or stops being requested, to include in the Infrastructure Working data.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Determine, in conjunction with the TRN and the Transient Timetable data entered by the driver, the relevant timetable information for the Infrastructure Working data.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Determine when advisory and approaching advisory information is displayed.</td>
</tr>
<tr>
<td>Train</td>
<td>Static</td>
<td>Predefined train consists and associated characteristics, including:</td>
<td>Used by the S-DAS onboard sub-system to:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Traction capabilities (including combinations of available traction motors etc.).</td>
<td>• Present a list of possible train consists and traction capabilities to the driver for selection in order to determine the Transient Train data.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Train length.</td>
<td>• Determine, in conjunction with the Transient Train data entered by the driver, the applicable Train Working data.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Maximum speed (including in S-DAS relevant degraded</td>
<td></td>
</tr>
</tbody>
</table>

Prepared and imported into the trackside data store by RU Operations Control. Updated on the S-DAS onboard sub-system via the communications link at the start of every journey.
### GB Operational Concept
**Standalone Driver Advisory System (S-DAS)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Includes</th>
<th>Source and Interface to Onboard</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>situations).&lt;br&gt;• Mass/length distribution&lt;br&gt;• Power consumption characteristics</td>
<td>Prepared and imported into the trackside data store by RU Operations Control.&lt;br&gt;Updated on the S-DAS onboard sub-system via the communications link at the start of every journey.</td>
<td>Used by the S-DAS onboard sub-system to check that a driver, identified by a Driver ID, is S-DAS competent and can be provided with advisory information (See A.1.3).</td>
</tr>
<tr>
<td>User</td>
<td>Static</td>
<td>Competent user identities. Associated Driver ID.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>User</td>
<td>Transient</td>
<td>Driver ID. Manually entered by the driver.</td>
<td>Used by the S-DAS onboard sub-system to:&lt;br&gt;• Record the identity of the driver responsible for a particular journey or journey segment in the journey data.&lt;br&gt;• Check that a driver, identified by a Driver ID, is S-DAS competent and can be provided with advisory information (See A.1.3).</td>
<td></td>
</tr>
<tr>
<td>TRN</td>
<td>Transient</td>
<td>TRN. Manually selected or entered by the driver.</td>
<td>Used by the S-DAS onboard sub-system to:&lt;br&gt;• Determine the correct route geography, timetable and TSR information to be used for the Infrastructure Working data.</td>
<td></td>
</tr>
</tbody>
</table>
### GB Operational Concept
#### Standalone Driver Advisory System (S-DAS)

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Includes</th>
<th>Source and Interface to Onboard</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Train</td>
<td>Transient</td>
<td>Actual train consist and associated information.</td>
<td>Manually selected or entered by the driver.</td>
<td>Used by the S-DAS onboard sub-system to:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Determine, in conjunction with the Static Train data the applicable Train Working data.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Update the Train Working Data for a journey already being undertaken (if the train consist changes during the course of the journey).</td>
</tr>
<tr>
<td>Stopping</td>
<td>Transient</td>
<td>Non-scheduled station stops (Special stop orders).</td>
<td>Manually selected or entered by the driver.</td>
<td>Used by the S-DAS onboard sub-system to:</td>
</tr>
<tr>
<td>Pattern</td>
<td></td>
<td>Scheduled stops that should not be made (Not-to-call orders).</td>
<td></td>
<td>- Determine, in conjunction with the Static Infrastructure and Transient Infrastructure data, the Infrastructure Working data.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Request stops.</td>
<td></td>
<td>- Update the Working Infrastructure Data for a journey already being undertaken (if the driver is provided with Not-to-call or Special Stop orders in the course of the journey).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Allow for any request stops made to be logged in the journey record.</td>
</tr>
<tr>
<td>Operating</td>
<td>Working</td>
<td>The working operating data includes, for the particular journey identified by the TRN:</td>
<td>Calculated by the onboard processing unit for the particular journey identified by the TRN.</td>
<td>Used by the processing unit to determine the advisory and journey information presented to the driver during the journey.</td>
</tr>
</tbody>
</table>
## GB Operational Concept

### Standalone Driver Advisory System (S-DAS)

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Includes</th>
<th>Source and Interface to Onboard</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Train</td>
<td>Working</td>
<td>The working train data includes, for the particular journey:</td>
<td>Calculated by the onboard processing unit for the particular journey based on driver selections.</td>
<td>Used by the processing unit to calculate the advisory information presented to the driver during the journey.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Relevant static infrastructure data.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Relevant transient operating data.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Transient timetable data.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Journey Record</td>
<td>Log</td>
<td>Operational information pertaining to a particular journey and/or a particular driver, including:</td>
<td>Generated by the onboard in real time and delivered to the trackside data store at the end of the journey, or when requested.</td>
<td>Used by the RU and/or IM to:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- All driver interactions (data entry and selections at Setup, driver changeover, entered explanatory information etc.) with the S-DAS onboard sub-system.</td>
<td></td>
<td>- Evaluate the impact of the S-DAS both on driver performance and on energy consumption.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Analyse and evaluate the impact of the S-DAS on network performance.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Monitor usage of S-DAS and energy performance for driver incentive purposes.</td>
</tr>
</tbody>
</table>
## GB Operational Concept
### Standalone Driver Advisory System (S-DAS)

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Includes</th>
<th>Source and Interface to Onboard</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>● Journey details (date, start and end stations etc.).</td>
<td></td>
<td>● Assess driver competency in S-DAS use.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Displayed S-DAS information.</td>
<td></td>
<td>● Identify timetable “choke points” or faults.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Actual train speed.</td>
<td></td>
<td>● Identify errors in S-DAS data.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Scheduled and actual arrival and departure times at station and timing point.</td>
<td></td>
<td>● Assist in delay attribution.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Energy usage.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table A.1** S-DAS Data Sets
GB Operational Concept
Standalone Driver Advisory System (S-DAS)

A.5 Data Responsibilities
A.5.1 Infrastructure Manager Responsibilities
A.5.1.1 The IM is responsible for providing the required Static Infrastructure data to the RU in an agreed format via an agreed interface.
A.5.1.2 The IM is responsible for providing Static Infrastructure data updates to the RU in sufficient time to prevent implemented infrastructure changes impacting on S-DAS operation. These updates should be in an agreed format via an agreed interface.
A.5.1.3 The IM remains responsible for the publication of the working timetable, updates to the working timetable, and weekly operating notices.

A.5.2 Railway Undertaking Responsibilities
A.5.2.1 The RU is responsible for preparing and maintaining the Static Train data.
A.5.2.2 The RU is responsible for preparing and maintaining the Static User data.
A.5.2.3 The RU is responsible for preparing and maintaining the Transient Operating data. This data is compiled from:
   a) The working timetable.
   b) Working timetable updates.
   c) Weekly operating notices.
A.5.2.4 The RU is responsible for importing data into, and maintaining the data within, the trackside data store.
A.5.2.5 The RU is responsible for importing or implementing data updates within the trackside data store in sufficient time to prevent implemented infrastructure changes impacting on S-DAS operation.
A.5.2.6 The RU is responsible for the management and, where required, dissemination of S-DAS journey records to other interested parties in an agreed format via an agreed interface.

A.5.3 Driver Responsibilities
A.5.3.1 The driver is responsible for entering Transient User, TRN, Train and Stopping Pattern data via the user interface before the start of a journey.
A.5.3.2 The driver is responsible for amending the Transient Train data if the train consist changes during a journey.
A.5.3.3 The driver is responsible for amending the Transient User data at driver handover.
A.5.3.4 The driver is responsible for amending the Transient Stopping Pattern data as required during a journey.
A.5.3.5 The driver is responsible for entering any necessary explanatory information if the advisory information provided by S-DAS cannot be followed so that this can be recorded in the journey record.
A.6 S-DAS Operating States

A.6.1 The S-DAS operating states for the example architecture are characterised in Figure A.2 below.

Figure A.2: Example S-DAS Operating States
Starting from the state \(<S\text{-DAS Powered} = \text{False}>\) (coloured red in Figure A.2), the following numbered transitions are applicable:

1) The switching of cab master key switch to the ‘on’ position results in the S-DAS onboard sub-system switching on and the automatic completion of a system self test and the S-DAS registration process. The S-DAS registration process entails the update of any customisation data from the trackside data store.

2) If the system self test fails \(<S\text{-DAS Status} = \text{Not Healthy}>\) or the S-DAS registration fails \(<S\text{-DAS Registered} = \text{False}>\), S-DAS is unavailable for the journey and the driver is informed.

3) If the self test is passed and S-DAS registration is successfully completed, S-DAS becomes available and the driver is required to input the setup information:
   a) Driver ID.
   b) TRN.
   c) Train consist.

4) If a system failure occurs \(<S\text{-DAS Status} = \text{Not Healthy}>\) or the driver setup is not completed successfully \(<S\text{-DAS Driver Setup} = \text{False}>\) e.g. if the Driver ID is not recognised or no customisation data is available for the selected TRN, S-DAS is unavailable for the journey and the driver is informed.

5) After successful completion of driver setup S-DAS becomes active and displays advisory and journey information to the driver (see 3.4.5). S-DAS remains in this state if the display of advisory information is manually or automatically suppressed.

6) At any time in the journey, the S-DAS system powers down if the Cab master key switch is moved to the off position. If this is done from the states \(<S\text{-DAS Active} = \text{True}>\) or \(<S\text{-DAS Available} = \text{False}>\) after \(<S\text{-DAS Active} = \text{true}>\) the S-DAS onboard sub-system establishes a communications link with the trackside data store and transfers the journey record.

7) At any time during the journey the driver can manually disable the S-DAS. The driver is provided with information that S-DAS is disabled. S-DAS remains unavailable until re-enabled.

8) If a system failure occurs at any time \(<S\text{-DAS Status} = \text{Not Healthy}>\) S-DAS becomes unavailable for the remainder of the journey and the driver is informed.

9) If \(<S\text{-DAS Status} = \text{Healthy}>\), the driver may re-enable S-DAS when it is appropriate to do so.
GB Operational Concept
Standalone Driver Advisory System (S-DAS)

Appendix B  Safety Assessment of S-DAS hazards

A detailed safety assessment of this operational concept has not been carried out. However, hazard workshops conducted under project T724, see [RD2], identified a set of hazards associated with the operation of driver advisory systems. The research was not specific to a particular architecture therefore the hazards cover a wider range of issues, some of which fall within the scope of this operational concept. The most significant difference is that the assessment included hazards from systems where dynamic signaling information is used as an input to enable the system to calculate appropriate advisory speeds. The hazards identified by T724 have been reviewed, and those considered applicable to S-DAS are included in Table B.1 below. The hazard numbering from the original research project hazard listing has been retained.

The hazards together with the possible controls contained in this operational concept are presented in Table B.1. Where required, changes have been made to the comments column. The ‘Possible Controls’ column has been introduced to demonstrate where requirements listed in this document address identified hazards. A formal safety assessment is still required to determine if the controls are complete and reduce the risk As Low as Reasonably Practicable (ALARP).

Next steps for safety management

Aside from the operational benefits afforded by standalone DAS, it will be necessary to demonstrate that the system does not impact the safe operations of the railway by providing incorrect, conflicting, distracting or confusing information to the driver. The steps to achieve this are:

1. To undertake a review of the hazards presented in Table B.1 to ensure all significant hazards are identified.
2. To determine the causes, controls and escalations for each hazard based on the proposed architecture.
3. To risk-rank the hazards to identify those that increase the existing level of risk, and the approximate extent of the increase.
4. To quantify the safety benefits of the system through reducing the number red signals approached and reducing station approach speeds.
5. To assess the overall effect on safety by comparing (3) and (4).
6. To identify any additional controls required to reduce risk compliant with the principle of reducing risk ALARP.
7. To review (6) in the context of all other costs and benefits to make a decision on the overall viability of the system.

Note that the viability of the system may well depend on the routes and mix of train types that use routes and therefore it is likely that any assessment needs to be made on a route basis, rather than a national assessment as the costs, benefits and risks will be location specific.
<table>
<thead>
<tr>
<th>Ref.</th>
<th>Hazard</th>
<th>Cause</th>
<th>Consequence type</th>
<th>Comment</th>
<th>Possible Controls</th>
</tr>
</thead>
</table>
| H3   | This train or another train delayed at the junction. | Train behaviour differs from that assumed by S-DAS - e.g. adhesion conditions vary or power outputs differ. | Safety and Operability. | Operational benefits of system are lost; more energy use, capacity loss, brake energy increased. 
Recovery time is used up. | 3.4.5.4 
Open point 2 |
| H5   | Bad train regulation negates the operation of the system. | Signallers don't understand the system. 
Signallers constrained by too much uncertainty in day to day operation. | Operability. | Algorithms don't have chance to work. 
Loss of benefits of system. | 3.11.4 
Open point 2 |
| H6   | System can't adequately predict departure times from platform. | Dwell times in platforms are more unpredictable than those at junctions. | Operability only. | Increased or no advisory speed lowers system benefits. 
Recovery time is used up (assumed departure time lowers advisory speed in previous sections). | Open point 2 |
### GB Operational Concept

**Standalone Driver Advisory System (S-DAS)**

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Hazard</th>
<th>Cause</th>
<th>Consequence type</th>
<th>Comment</th>
<th>Possible Controls [Clause/GN No.]</th>
</tr>
</thead>
<tbody>
<tr>
<td>H7</td>
<td>Dwell time at station extended.</td>
<td>Poor design of system.</td>
<td>Safety and Operability.</td>
<td>Increased or no advisory speed lowers system benefits. Recovery time is used up (assumed departure time lowers advisory speed in previous sections).</td>
<td>3.11.1.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.11.1.3 (If the change to the dwell time is permanent)</td>
</tr>
<tr>
<td>H8</td>
<td>Train speed lower than required.</td>
<td>Wrong 'message' generated.</td>
<td>Safety and Operability.</td>
<td>Late arrival at junction or station. Train suffers delay and delays following trains. Possibility of increased number of restrictive signals for following and other trains.</td>
<td>2.5 (Assumption)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Driver misinterprets 'message'.</td>
<td></td>
<td></td>
<td>3.2.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.2.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.4.5.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.5.3.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.9</td>
</tr>
<tr>
<td>H9</td>
<td>Extended time of passage affects infrastructure e.g. level crossing warning times.</td>
<td>Wrong 'message' generated.</td>
<td>Safety and Operability.</td>
<td>Increased risk of level crossing misuse.</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Driver misinterprets</td>
<td></td>
<td></td>
<td>3.2.7</td>
</tr>
</tbody>
</table>
## GB Operational Concept
### Standalone Driver Advisory System (S-DAS)

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Hazard</th>
<th>Cause</th>
<th>Consequence</th>
<th>Comment</th>
<th>Possible Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>'message'.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| H11  | Speed in excess of permitted. | Wrong advisory information generated.  
Driver misinterprets advisory information.  
Driver follows advisory information instead of TSR or ESR. | Safety and Operability. | Could result in a derailment. | 3.2.7  
3.2.8  
GN11  
3.4.1.4  
3.4.1.6  
3.4.5.1  
3.5.3.8  
3.6.4  
3.6.5.1 |
<table>
<thead>
<tr>
<th>Ref.</th>
<th>Hazard</th>
<th>Cause</th>
<th>Consequence type</th>
<th>Comment</th>
<th>Possible Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H14 Train delay leads to driver being criticised or admonished.</td>
<td>System consistently requires lower than necessary speed.</td>
<td>Operability only</td>
<td>-</td>
<td>3.5.4 3.6.2.19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Driver managers don't understand what the system is doing and that</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>the delays are necessary.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>H15 System distracts driver while he is undertaking another duty which</td>
<td>Poor DMI display. Messages changing too rapidly. Messages over-</td>
<td>Safety and</td>
<td>-</td>
<td>3.1.2 3.2.4 3.2.5</td>
</tr>
<tr>
<td></td>
<td>affects the speed.</td>
<td>complex.</td>
<td>operability.</td>
<td></td>
<td>3.4.5.6 3.4.5.7</td>
</tr>
<tr>
<td></td>
<td>H16 Driver brakes rather than</td>
<td>Intermittent DMI display.</td>
<td>Safety and</td>
<td>Could lead to a person falling due</td>
<td>3.1.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>operability.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ref.</td>
<td>Hazard</td>
<td>Cause</td>
<td>Consequence type</td>
<td>Comment</td>
<td>Possible Controls</td>
</tr>
<tr>
<td>------</td>
<td>--------</td>
<td>-------</td>
<td>------------------</td>
<td>---------</td>
<td>------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>to excessive braking.</td>
<td></td>
<td>3.4.1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>operability.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Messages produced at too frequent an interval. Coasting message produced too late to allow target speed to be achieved by coasting.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>System gives driver a higher speed than required, overriding driver's normal action.</td>
<td>Safety and operability.</td>
<td>3.4.1.4 3.6.1.1 3.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Dependence on train detection.</td>
<td>Safety and operability.</td>
<td>3.2.1 3.4.5.2 3.4.5.3 3.6.5.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Failure or inaccuracy of measurement or</td>
<td>Safety and</td>
<td>3.2.1</td>
</tr>
<tr>
<td>H19</td>
<td>Train position defined too coarsely.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H20</td>
<td>Loss of or erroneous train position</td>
<td></td>
<td></td>
<td>-</td>
<td>3.2.1</td>
</tr>
</tbody>
</table>
## GB Operational Concept
### Standalone Driver Advisory System (S-DAS)

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Hazard</th>
<th>Cause</th>
<th>Consequence type</th>
<th>Comment</th>
<th>Possible Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>H21</td>
<td>Variation between system and actual train parameters.</td>
<td>Wind, adhesion, ice, variable brake performance. Low braking rates of light engines.</td>
<td>Safety and Operability.</td>
<td>-</td>
<td>3.2.7, 3.2.8, 3.5.3.8, 3.5.3.9</td>
</tr>
<tr>
<td>H23</td>
<td>System provides incorrect message to freight train driver.</td>
<td>Freight train handling is potentially more complex than for passenger trains.</td>
<td>Safety and Operability.</td>
<td>Overspeeding could lead to collision or derailment. Underspeeding could impact on efficient train regulation. Loss of benefits of system.</td>
<td>3.3.3, 3.5.3.8, 3.5.3.9</td>
</tr>
<tr>
<td>H24</td>
<td>Data for freight train wrong.</td>
<td>Freight trains will need more precise data, e.g.</td>
<td>Safety and Operability.</td>
<td>Overspeeding could lead to collision or derailment.</td>
<td>3.2.7</td>
</tr>
<tr>
<td>Ref.</td>
<td>Hazard</td>
<td>Cause</td>
<td>Consequence type</td>
<td>Comment</td>
<td>Possible Controls</td>
</tr>
<tr>
<td>------</td>
<td>--------</td>
<td>-------</td>
<td>------------------</td>
<td>---------</td>
<td>-------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>consist.</td>
<td></td>
<td></td>
<td>3.2.8 3.5.3.8 3.10.1.1</td>
</tr>
<tr>
<td>H25</td>
<td>No timetable information available</td>
<td>Untimetabled train.</td>
<td>Operability only</td>
<td>Loss of benefits of system.</td>
<td>3.4.5 3.6.5.1</td>
</tr>
<tr>
<td>H26</td>
<td>Inaccuracy of time or speed measurement.</td>
<td>Speedometer error. Clock error.</td>
<td>Safety and Operability.</td>
<td>Overspeeding could lead to collision or derailment. Underspeeding could impact on efficient train regulation.</td>
<td>2.5 (Assumption) 3.2.14</td>
</tr>
<tr>
<td>H28</td>
<td>Driver fails to carry out another duty.</td>
<td>Message arrives at same time as another action required. Example other tasks are DSD not cancelled, leading to emergency braking. Driver does not check doors safely</td>
<td>Safety and Operability.</td>
<td>-.</td>
<td>3.1.2 3.2.4 3.2.5 3.4.5.7</td>
</tr>
</tbody>
</table>
## GB Operational Concept

### Standalone Driver Advisory System (S-DAS)

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Hazard</th>
<th>Cause</th>
<th>Consequence type</th>
<th>Comment</th>
<th>Possible Controls [Clause/GN No.]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>closed.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| H29  | Driver fails to act on 'message' | Distraction by other duties. | Operability only. | Loss of benefits of system. | 3.1.1  
3.6.2.19  
3.9 |
| H30  | Driver ignores messages. | Message format is not acceptable to the driver. Lack of training. No buy-in. | Operability only. | Loss of benefits of system. | 3.1.1  
3.9 |
| H31  | Driver uncertain as to whether to follow 'message' or external signals. | Wrong message generated.  
Poor driver training. | Safety and Operability. | Driver potentially ignores signals. TPWS trips. SPADs. | 3.1.1  
3.6.2.19  
3.9 |
<p>| H32  | System does not cope with failure of signalling or train detection systems. | Inherent with S-DAS. | Safety and Operability. | Loss of benefits of system. | 3.6.5.4 |</p>
<table>
<thead>
<tr>
<th>Ref.</th>
<th>Hazard</th>
<th>Cause</th>
<th>Consequence type</th>
<th>Comment</th>
<th>Possible Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>H33</td>
<td>No method of dealing with failures of the system itself.</td>
<td>Poor design</td>
<td>Operability only</td>
<td>Loss of benefits of system.</td>
<td>3.6.5.3</td>
</tr>
<tr>
<td>H34</td>
<td>Failure of system integration with existing systems on existing trains.</td>
<td>Expense due to redesigning Train Management System. Obsolescence of equipment.</td>
<td>Operability only.</td>
<td>Loss of benefits of system.</td>
<td>3.2.9 3.10.1.11</td>
</tr>
<tr>
<td>H35</td>
<td>Conflict with other safety systems.</td>
<td>Poor design leads to simultaneous demands or conflicting messages (e.g. similar warning tone frequencies, lamp colours) - Driver confused and fails to act.</td>
<td>Safety and Operability.</td>
<td>-</td>
<td>3.1.2 3.2.3 3.2.4 3.2.5 3.4.5.6 3.4.5.7</td>
</tr>
<tr>
<td>H36</td>
<td>Data incorrectly loaded or incomplete.</td>
<td>Many.</td>
<td>Safety and Operability.</td>
<td>Overspeeding could lead to collision or derailment.</td>
<td>3.2.6</td>
</tr>
</tbody>
</table>
## GB Operational Concept
### Standalone Driver Advisory System (S-DAS)

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Hazard</th>
<th>Cause</th>
<th>Consequence type</th>
<th>Comment</th>
<th>Possible Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Underspeeding could impact on efficient train regulation.</td>
<td>3.2.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.4.5.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.4.5.11</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.11.1.2</td>
</tr>
<tr>
<td>H37</td>
<td>Data not current</td>
<td>Many.</td>
<td>Safety and Operability.</td>
<td>Overspeeding could lead to collision or derailment.</td>
<td>3.10.1.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.10.1.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.11.1.2</td>
</tr>
<tr>
<td>H38</td>
<td>Data not correct</td>
<td>Many.</td>
<td>Safety and Operability.</td>
<td>Overspeeding could lead to collision or derailment.</td>
<td>3.2.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.11.1.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.10.1.6</td>
</tr>
<tr>
<td>H39</td>
<td>Data not updated.</td>
<td>No system in place, Confusion over responsibility.</td>
<td>Safety and Operability</td>
<td>Overspeeding could lead to collision or derailment.</td>
<td>3.10.1.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.10.1.7</td>
</tr>
</tbody>
</table>
# GB Operational Concept

## Standalone Driver Advisory System (S-DAS)

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Hazard</th>
<th>Cause</th>
<th>Consequence type</th>
<th>Comment</th>
<th>Possible Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[Clause/GN No.]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| H40  | Data inconsistent with other sources of driver data. | Poor process control. | Safety and Operability. | Driver does not follow more restrictive information leading to overspeeding with the potential for a collision or derailment. | 2.5  
3.1.6  
3.2.10  
Open point 4 |
| H41  | Emergency speed restrictions will not necessarily be visible to the system. | Limitations of S-DAS. | Safety and Operability. | If the driver follows the S-DAS information rather than the lineside instruction, there is the potential to overspeed. | 3.6.4 |
| H42  | System cannot cope with 'real time' changes to the timetable. | Lack of integration with the timetable generation process. Manual timetable modification. System has a poor | Operability only. | Inherent to S-DAS. | 3.6.2.18  
3.10.1.3  
3.10.1.7  
3.11.1.3 |
<table>
<thead>
<tr>
<th>Ref.</th>
<th>Hazard</th>
<th>Cause</th>
<th>Consequence type</th>
<th>Comment</th>
<th>Possible Controls [Clause/GN No.]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>response time.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H44</td>
<td>Driver does not know that the system has failed.</td>
<td>No method of warning provided.</td>
<td>Operability only.</td>
<td>-</td>
<td>3.4.4.1</td>
</tr>
<tr>
<td>H46</td>
<td>Speed control commands are given too late.</td>
<td>System is slow in operation.</td>
<td>Safety and Operability.</td>
<td>Passenger falls due to excessive braking.</td>
<td>3.1.1 3.2.3</td>
</tr>
<tr>
<td>H47</td>
<td>Dilution of driver knowledge.</td>
<td>Over-reliance on system.</td>
<td>Safety and Operability.</td>
<td>Increased probability of driver error - SPAD, collision &amp; derailment.</td>
<td>3.10.4.1</td>
</tr>
<tr>
<td>H48</td>
<td>User interface fails.</td>
<td>Poor design.</td>
<td>Safety and Operability</td>
<td>This is an operability issue unless the screen freezes and provides a continuous high or low speed.</td>
<td>3.4.4.1 3.6.5.3</td>
</tr>
<tr>
<td>H49</td>
<td>Inappropriate information given for service being considered.</td>
<td>Poor design.</td>
<td>Safety and Operability</td>
<td>-</td>
<td>3.5.3.6 3.5.3.7</td>
</tr>
<tr>
<td>Ref.</td>
<td>Hazard</td>
<td>Cause</td>
<td>Consequence type</td>
<td>Comment</td>
<td>Possible Controls</td>
</tr>
<tr>
<td>------</td>
<td>--------</td>
<td>-------</td>
<td>------------------</td>
<td>---------</td>
<td>-------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[Clause/GN No.]</td>
</tr>
<tr>
<td>H51</td>
<td>Messages arrive at DMI at too low a frequency.</td>
<td>System limitations.</td>
<td>Operability only.</td>
<td>Loss of benefits of the system.</td>
<td>3.5.3.8, 3.5.3.9, 3.11.1.4</td>
</tr>
<tr>
<td>H52</td>
<td>Messages arrive at DMI at too great a frequency</td>
<td>Poor design.</td>
<td>Safety and Operability.</td>
<td>Driver distraction and increased workload.</td>
<td>3.4.1.5</td>
</tr>
<tr>
<td>H53</td>
<td>Driver cannot easily access messages from DMI.</td>
<td>DMI badly designed.</td>
<td>Operability only.</td>
<td>Driver annoyance and confusion - loss of confidence. Loss of benefits of the system.</td>
<td>3.2.3, 3.2.4, 3.2.5</td>
</tr>
<tr>
<td>H56</td>
<td>Driver advice is incorrect because train has been re-routed from planned path (e.g. fast line, slow</td>
<td>Re-routing decision by signaler.</td>
<td>Safety and Operability.</td>
<td>Loss of benefits of the system. Speed advice may be too high for</td>
<td>3.4.5.2, 3.4.5.2</td>
</tr>
</tbody>
</table>
### GB Operational Concept

#### Standalone Driver Advisory System (S-DAS)

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Hazard</th>
<th>Cause</th>
<th>Consequence type</th>
<th>Comment</th>
<th>Possible Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>line).</td>
<td></td>
<td></td>
<td>alternative route.</td>
<td>3.6.5.1</td>
</tr>
<tr>
<td>H58</td>
<td>Control centre makes inaccurate predictions of future train movements.</td>
<td>Actual train performance differs from that assumed in control centre journey time predictions.</td>
<td>Safety and Operability.</td>
<td>Loss of benefits of the system. Impact on train regulation.</td>
<td>Open point 2</td>
</tr>
</tbody>
</table>

**Table B.1** S-DAS Preliminary Hazards and Controls
Appendix C  From S-DAS to C-DAS

This appendix summarises the DAS Project’s proposed strategy for development of Connected DAS (C-DAS) and the migration from S-DAS to C-DAS, and outlines the expected similarities and differences between S-DAS and C-DAS.

C.1  Introduction

Two variants of Driver Advisory Systems (DAS) namely Standalone and Connected are identified in section 1.2.1 above:

- Standalone DAS (S-DAS) provides train drivers with an advisory train speed (limited by the linespeed profile and maximum train speed) that is informed by the real time measured progress of an individual train against predefined (static) route geography and schedule data. Its primary use is to optimise energy usage.
- Connected DAS (C-DAS) provides train drivers with an advisory train speed (limited by the linespeed profile and maximum train speed) that is informed by the real-time, dynamic update of schedule information via a telecommunications link to a control centre that is monitoring the location and speed of many trains in an area. It can be used to optimise energy, capacity or network performance.

The implementation of any DAS is intended to deliver benefits in the quality, cost and efficiency of train operation.

The primary benefits resulting from the implementation of S-DAS are expected to be:

a) Traction energy cost savings and an associated reduction in carbon emissions
b) Improved train regulation under unperturbed conditions

The additional benefits resulting from the implementation of C-DAS are expected to be:

- c) Network capacity improvements
d) Improved train regulation under perturbed conditions.

C.2  Current state

S-DAS products were originally developed for the long-haul freight market in the USA and Australia, and have more recently been adapted for use on passenger fleets. A number of products are currently operational in the UK and worldwide.

C-DAS products are beginning to emerge, but there are few examples of operational use.

C.3  Development strategy

The DAS project’s development strategy for C-DAS is based on the premise that C-DAS products will for the most part be evolutions of S-DAS products, upgraded to interface with emerging Traffic Management systems.

C.4  Assumptions

1. The C-DAS includes an on-train subsystem, an off-train (infrastructure) subsystem and communications between them.
2. The C-DAS operates in the context of a Traffic Management system which has the capability to revise the schedules of trains in the area it controls.
3. The C-DAS may be used to optimise any of network capacity, performance or energy.
4. Responsibility for the following lies outside the scope of the C-DAS:
GB Operational Concept
Standalone Driver Advisory System (S-DAS)

- Calculating revised train schedules
- Monitoring train locations (other than self-monitoring by the on-train C-DAS subsystem)
- Route setting
- Monitoring signalling states

5. Driver training for C-DAS (as for S-DAS) ensures that drivers follow DAS recommendations only where they do not conflict with safety considerations or driver judgement.

6. The on-train C-DAS subsystem will operate as an S-DAS if it is unable to receive updates from the off-train subsystem.

C.5 Migration strategy
While details of future C-DAS cannot be predicted at this stage, the following general statements indicate the expected relationship between C-DAS and the characteristics of an S-DAS which is consistent with the body of the current document.

C.5.1 On-train subsystem
1. DMI
DMI functionality for C-DAS will not differ in major respects from S-DAS, though C-DAS may require a small number of further controls and indications.

DMI design principles will be the same for S-DAS and C-DAS, and will reflect feedback from practical experience of using DAS in operational service.

On ETCS-fitted trains, DMI design will reflect the outcome of research project T906: ERTMS/ETCS driver machine interface options for future train cab design, as a result of which C-DAS may share the ETCS DMI. In addition C-DAS startup data (driver, operational train number, consist) may be derived from ETCS startup data rather than being entered or confirmed on a separate screen.

2. Data
For S-DAS, the form and content of the route geography and timetable data and the protocol used to download it to a train is supplier-specific. Similarly, train parameters are made available for network performance analysis via a supplier-specific interface.

In addition, for S-DAS any necessary pre-processing of route geography and timetable data (for example, to overlay TSRs onto linespeed data) is performed offline prior to downloading to the train, and any changes to the on-train data are achieved by over-writing the previously loaded data. For C-DAS, where dynamic updates are expected, the on-train C-DAS will require the capability to manage partial and / or segmented updates to route geography and timetable data.

The DAS project will shortly start to develop an interface specification for C-DAS data passed between trains and trackside, which is expected to become a Railway Group Standard. This is shown as Airgap interface in Figure C-1 below. The publication of this interface will allow product suppliers to upgrade their S-DAS to prepare for migration to C-DAS.

3. ESRs
ESR information is not made available to S-DAS. Subject to further analysis, ESR information will not in general be used by C-DAS, though with a possible exception for calculating the recommended speed profiles for ETCS-fitted trains running on ETCS Level 2 or Level 3 infrastructure.
4. Train location

As for S-DAS, C-DAS will generally use an on-train GPS-based device to monitor its location and speed against the profile recommended by the DAS. However C-DAS may require a device with better capabilities (e.g. to operate in obstructed environments, and to discriminate between adjacent tracks) than is needed by an S-DAS.

For retro-fit, whether or S-DAS or C-DAS it may be acceptable to use a dedicated GPS-based device, even where it requires a separate antenna on the train roof. However for new build it will be preferred for the C-DAS to use a GPS-based device shared by other on-train applications.

C.5.2 Off-train subsystem

1. Scope

The off-train C-DAS subsystem provides an interface between the Traffic Management system and the trains which it manages. Its scope is therefore:

- Management of telecommunications links between ground and trains;
- Management of data transfers between Traffic Management and trains, to include message construction and deconstruction, and routing;
- Mediating updates to schedule and route geography data between Traffic Management system and on-train C-DAS;
- C-DAS fault handling.

2. Data

For S-DAS, route geography and timetable data are supplied by Network Rail as specified in [AD1]. For C-DAS this data will be provided from NR’s Traffic Management system via an interface which has not yet been defined; the interface is expected to be similar to [AD1], but some degree of difference is inevitable. The off-train C-DAS will then process this data for transmission to the on-train C-DAS subsystem; the processing will be constrained by the interfaces with the Traffic Management system and with the on-train C-DAS subsystem (the airgap interface) – see Figure C-1.

![Figure C-1 – C-DAS and its interfaces](image-url)
GB Operational Concept
Standalone Driver Advisory System (S-DAS)

C.5.3 Communications across the airgap interface
1. Communications interface
   For retro-fit, whether for S-DAS or C-DAS it may be acceptable to use a dedicated communications interface, even where it requires a separate antenna on the train roof. However for new build it will be preferred for the C-DAS to use a communications gateway shared by other on-train applications.

C.6 Reference
[AD1] DAS Project: Interim Data Description for Driver Advisory Systems, Network Rail Reference CCMS:62518798