

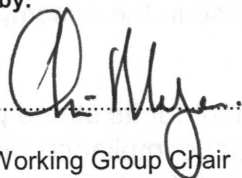
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Date:	1 June 2008
Compliance date:	1 September 2008

Level 3

Automatic Route Setting Specification

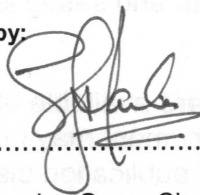
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Published and Issued by Network Rail, 40 Melton Street, London NW1 2EE.



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Ref:	NR/L3/SIG/10120
Issue:	1
Date:	1 June 2008
Compliance date:	1 September 2008

Issue record

Issue	Date	Comments
1	01/6/2008	Initial issue

Compliance

This Network Rail standard is mandatory and shall be complied with by Network Rail and its contractors if applicable from 1 September 2008.

When this standard is implemented, it is permissible for all projects that have formally completed GRIP Stage 4 to continue to comply with the Issue of any relevant Network Rail Standards current when GRIP Stage 4 was reached and not to comply with requirements contained herein, unless the designated Standard Owner has stipulated otherwise in the accompanying Briefing Note.

Reference documentation

See section 3.

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1 Purpose

This document contains the system requirements for Automated Route Setting Systems (ARS) for use in conjunction with control systems that are of sufficient size to require an ARS function.

This document does not describe the operation of the control system and shall be viewed as a product specification for use when designing an ARS system for incorporation within a control system.

2 Scope

This specification has been produced for implementation at new control centre schemes and may be considered for retrospective fitment at existing control centres that have a requirement for an automated route setting system.

3 Reference Documentation

NR/SP/SIG/10071	Acceptance of Signalling Equipment Issue 2 December 2004
NR/SP/SIG/10067	Requirement Specification for VDU based Systems, August 2003
GK/RT0209	Testing and commissioning of signalling and operational telecommunications systems, Issue 1, Network Rail, December 2000
GK/RT0210	Asset Management for the Safety of Signalling and Operational Telecommunication Systems and Equipment, Issue 1, Network Rail, December 2000.
BS EN 50121-1	Electro-Magnetic Compatibility (EMC) – Part 1, General, CENELEC, September 2001
BS EN 50121-4	Electro-Magnetic Compatibility (EMC) – Part 4, Signalling, Communications, CENELEC, September 2000.
BS EN 50125-3	Railway Applications: Environmental Conditions for Signalling and Telecommunications, CENELEC, January 2003
BS EN 50126	Railway Applications – Specification of Demonstration of Reliability, Availability, Maintainability and Safety, CENELEC, September 1999.
BS EN 50128	Communication, signalling and processing systems – Software for Railway Control & Protection Systems, CENELEC, March 2001
BS EN 50129	Communication, signalling and processing systems – Safety Related Electronic Systems for Signalling, CENELEC, Feb 2003
BS EN 60529	Degrees of Protection Provided by Enclosures (IP Code), British Standards Institute, 1992
BS EN 60721-3-1	Classification of environmental conditions. Classification of groups of environmental parameters and their severities – Storage. 1997
BS EN 60721-3-2	Classification of environmental conditions. Classification of

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	groups of environmental parameters and their severities – Transportation. 1997
BS ISO 10007	Quality management systems. Guidelines for configuration management
NR/SP/ERG/24020	Incorporating Ergonomics within Engineering Design Projects: Requirements
RT/E/G/00028	Incorporating Ergonomics within Engineering Design Projects
RT/E/P/11304	Requirement for Data Logging Systems used to monitor signalling installations
RT/E/P/11305	The provision of Data Logging Systems used to monitor signalling installations

4 Definitions

ARTmean ART max

Mean and Maximum Active Repair Times; the mean and the maximum times from personnel commencing repair work to its satisfactory conclusion and the restoration to service of the repaired item.

Configuration Parameters

The ARS makes decisions based on core algorithms for specific operating circumstances, these algorithms refer to variables held as data known as the configuration parameters stored in configuration files.

Data Preparer

The person or organisation responsible for preparation of Geographic Data.

Equipment Design Authority

The body responsible for the production and maintenance of the System equipment design.

Geographic Data

Data used to configure a programmable electronic system for a particular site.

Line Replaceable Unit

A system module or component that can be replaced by a competent maintenance technician.

Maintainer

For the purposes of this Specification, defined as the organisation responsible for maintenance of the System.

Operations Analyst

An person competent to interact with the Operator's Workbench and authorised to validate new or modified parameter files.

Operations Specialist

An experienced operator competent to interact with the ARS system and authorised to edit the system parameters.

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Perturbation Plans

A set of predefined rules for modification to the timetable to deal with a change to the normal pattern of working

Safety Integrity

The likelihood of a safety-related system achieving its required safety features under all the stated conditions within a stated operational environment and within a stated period of time. Safety Integrity encompasses both random failure integrity and systematic failure integrity.

Safety Integrity Level

One of four possible discrete levels for specifying the safety integrity requirements of the safety functions to be allocated to the safety related systems. Safety Integrity Level 4 has the highest level of safety integrity and Safety Integrity Level 1, the lowest.

Special Timing Pattern

A special timetable with a pre-defined route and stopping pattern for a train.

Signaller

The person responsible for the operation of the signalling system, to safely control the passage and regulation of trains.

Technician

A maintainer with specific responsibility for carrying out maintenance of the system.

Tidal Flow

The biased direction of trains on bi-directional lines at certain times of day.

Timetable Data

The Network Rail timetable database (TSDB) contains details of every train path with data including for example, a unique train number, the TD code, start, intermediate and end times, line codes, platform codes and next train working codes.

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Abbreviations

AC	Alternating Current
ACF	ARS Configuration File
ACI	Automatic Code Insertion
ARS	Automated Route Setting
CBI	Computer Based Interlocking
CD	Compact Disk
CD-ROM	Compact Disk – Read-only Memory
CIF	Common Interface File
CRC	Cyclic Redundancy Check
CSV	Comma Separated Value
EMC	Electro-Magnetic Compatibility
ESR	Emergency Speed Restriction
FTN	Fixed Telecoms Network
GUI	Graphical User Interface
hh:mm:ss	Hour Minute Second format
ISDN	Integrated Services Digital Network
IXL	Interlocking
mph	Miles Per Hour
NPI	New Product Initiative
PP	Perturbation Plan
ROM	Read Only Memory
RRI	Route Relay Interlocking
SIL	Safety Integrity Level
SPAD	Signal Passed At Danger
SR	Speed Restriction
SSI	Solid State Interlocking
STP	Special Timing Pattern
TCCS	Traffic Command and Control System
TIPLOC	Timing Point Location
TD	Train Description
TORR	Train Operated Route Release
TRTS	Train Ready To Start
TSDB	Train Service Database
TSR	Temporary Speed Restriction
TTE	Timetable Editor
TTP	Timetable Processor
TTS	Timetable Server
VDU	Visual Display Unit
WS	Workstation

5 System Function

5.1 Primary function of the system

ARS is designed to operate main signal running routes plus a limited set of shunting routes automatically in response to the approach of trains. The system is designed to perform this role even when the trains arrive in a sequence other than that defined in the timetable. The primary function of ARS is to route the trains in a sequence

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which shall minimise overall deviation from the timetable when a conflict occurs i.e. reduce potential delay.

ARS shall always allow the Signaller to remain in charge. The Signaller can therefore set routes ahead of ARS, restrict the area over which ARS works and restrict the set of trains for which it works. The Signaller can also interrogate ARS to explain routing actions (e.g. why it is routing one train in preference to another or why it is not setting a route for a train).

ARS shall be designed not to challenge the interlocking system. Thus, it shall not request routes which are unavailable or which lead up to or from a signal on which the "operation inhibitor" has been set by the Signaller.

ARS is triggered by train describer steps which, within the area of control, are generated by the specific control system. When triggered, ARS predicts the times at which the train will arrive at subsequent points on its journey. By comparing this with the predictions for other trains, potential conflicts are identified. When a conflict is identified, the effect of routing the conflicting trains in different orders is evaluated and the optimum routing order is determined.

5.2 Functional Overview of the system

The functional overview is identified below in figure 1; it shows general interfaces and more specifically system components of the ARS system as a whole.

- The main Interfaces of the ARS system as depicted in Figure 1, are with:
- The Signaller
- The Technician
- Interlocking
- Specialist Support Services
- NR Train Service Database

Figure 1: Functional Overview of the ARS system

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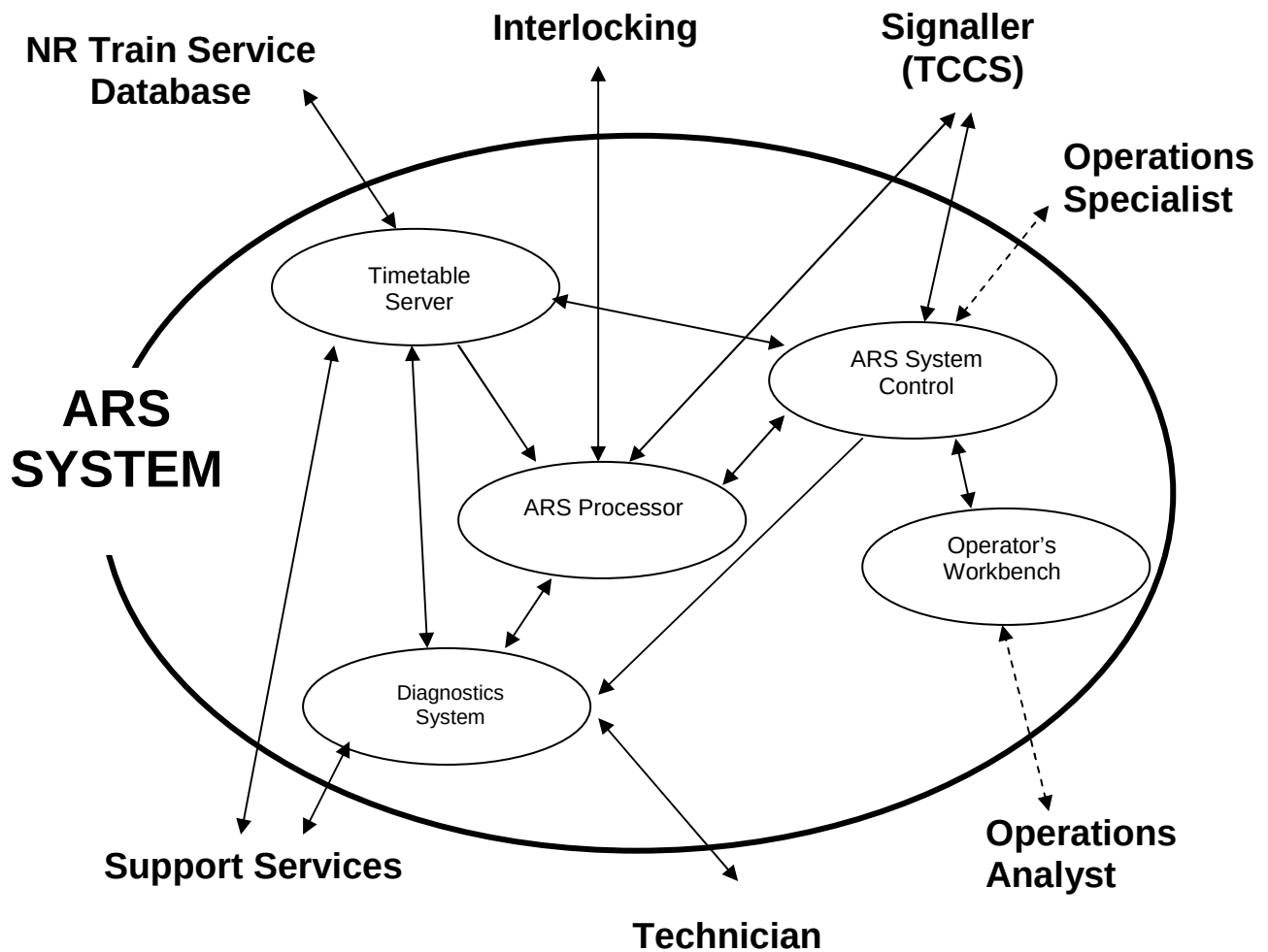


Figure 1 – ARS System / interface boundary

A brief description of the functionality of the system is also given below in terms of ARS components.

- **ARS Processor**

The ARS Processor provides the automatic route setting functionality for the system which consists of the calculations for train routing and the requests for specific routes to be set. The processors interface directly to Interlocking to establish route availability.

- **ARS System Control**

This system provides an interface to the TCCS to allow the Signaller to interact with the ARS System. It also provides a facility for an authorised operations specialist to interrogate the ARS system and to edit offline, the parameters that govern train pathing decisions. Validated parameter files can also be uploaded to the operational ARS under controlled conditions.

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- **Diagnostic System**

This system provides system performance and diagnostic facilities for the use of the Maintainer including event logging. Remote access allows specialist support from remote locations.

- **Operator's Workbench**

The Operator's Workbench provides off line ARS simulation and analysis facilities for the validation of altered parameters and train plans by an operations analyst.

- **Timetable Server**

The ARS timetable server is the system which interfaces with and receives information from the Network Rail Train Service database for use in the ARS system. Remote access allows specialist support from remote locations.

5.3 System Architecture

5.3.1 A number of different system architectures are possible to comply with this specification.

5.3.2 It is possible that some or all of the functionality defined equates to physical subsystems or the functionality is provided by an all embracing system.

5.3.3 The implication of the above is that some of the interfaces defined in this specification may be logical interfaces (for example being implemented via a shared data area in computer memory) rather than physical interfaces.

5.3.4 The requirements are defined in terms of what the ARS System shall do. This allows a particular function to be implemented in any required way, but ensures that the overall configuration provides the necessary functionality.

6 System Interfaces

6.1 Signaller's Interface

6.1.1 The Signaller shall have an access level defined as Level 4 (reference Section 8), which does not require password entry.

6.1.2 The Signaller's physical interaction with the ARS System shall be either through the Train Command and Control System (TCCS) or a separate VDU, keyboard, mouse pointing input device pointing input device and printer.

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6.1.3 The ARS system shall transmit information to the TCCS such that the Signaller may be able to uniquely distinguish the following:-

- ARS trains
- Non ARS trains
- Trains running to a Special Timing Pattern or a Perturbation Plan
- ARS sub-area status

6.1.4 The Signaller shall be able to:-

- Turn ARS sub-areas on or off
- Place a train under ARS control
- Remove a train from ARS control
- Run a train to a Special Timing Pattern
- Introduce a Perturbation Plan
- Withdraw a Perturbation Plan
- Run a train to a Perturbation Plan
- Run a train to the standard timetable
- Switch from normal ARS operation to first come route setting
- Switch on ACI for all identified trains at pre-defined ACI locations
- Switch on ACI for ARS trains on their planned path
- Switch off ACI globally or at specific locations
- Request timetable Simplifiers

6.1.5 The TCCS shall allow the Signaller to manage reminders applied to ARS sub-areas as defined in [NR/SP/SIG/10067](#).

6.1.6 The TCCS shall indicate to the Signaller the extent of the ARS sub-areas.

6.1.7 ARS shall provide the following information when requested by the Signaller:-

- The current ARS status of a train
- Why ARS is not setting a route for a train.
- The next location details on the path of a train as perceived by the ARS.

6.2 Technician's Interface

Requirements in this section are related to the Diagnostic System. The diagnostic system shall be used by the maintainer of the system and any 3rd party providing system support.

6.2.1 The Technician shall have password protected access defined as Level 2 (reference Section 8), which allows access to diagnostic facilities for monitoring and fault finding activities.

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6.2.2 The Technician's physical interaction with the Diagnostic System shall be by VDU, keyboard, mouse pointing input device pointing input device and printer.

6.2.3 The Diagnostic System shall allow the technician to check on any of the following:-

- The state of the ARS Processors
- The state of the ARS System Control
- The state of the TTS
- The state of all links on the ARS Network
- The state of the ARS interfaces
- The state of any remote diagnostic links provided as part of any system support contract.
- The state of variables within the ARS Processors
- The file name and properties of all software and parameter files in use
- The state of log files

6.2.4 The Diagnostic System shall be equipped with a remote link to allow the technician or 3rd party support, to interrogate the system from a remote location.

6.2.5 The remote link shall be protected by firewall, virus checker and shall only communicate with defined addresses.

6.2.6 On receiving new configuration files, the technician shall be able to check the integrity of the files.

6.2.7 The Diagnostic System shall allow the technician to be able to command any of the following actions

- Transitions between states of the ARS Processors
- The TTS to send a new timetable to the ARS Processors
- The ARS Processors to revert to their default data settings
- The above actions shall not be available over the remote link to the support offices

6.2.8 The Diagnostic System shall be able to operate in the following modes.

- Logged off
- Logged on

6.2.9 When the Diagnostic System is powered up, it shall operate in the logged off mode allowing the technician to log in.

6.2.10 In the logged off mode, the Diagnostic System shall allow enquiries but not commands to be entered.

6.2.11 In the logged on mode, all facilities shall be available to the technician.

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6.2.12 If the technician does not operate the system for 15 minutes, it shall revert to the logged off mode.

6.3 System Support Interface

System support shall be provided by the developer or system provider. This level of support would normally be in accordance with a formal support contract.

6.3.1 System Support shall have password protected access defined as Level 1 (reference Section 8), which allows a high level of access to the whole system as well as to the diagnostic facilities for monitoring and fault finding activities.

6.3.2 System Support shall be able to access the system either locally or remotely via the Diagnostic system.

6.3.3 Where provided, System Support may also have remote access to the TTS.

6.3.4 It shall not be possible to alter operational parameters from a remote connection.

6.4 Interlocking Interface

The interaction between the ARS Processors and the Interlocking involves safety critical operations.

6.4.1 The ARS shall not challenge the interlocking by requesting routes that are not available.

6.4.2 The ARS shall not request routes within a sub-area when the sub-area is turned off.

6.4.3 The status of the ARS sub-areas shall be stored within the interlocking and the ARS Processors. If this is not feasible an equivalent process achieving the safety requirements shall be implemented.

6.4.4 Four key ARS sub-area states shall be stored within the interlocking for each ARS sub-area:

- sub-area key state – this shall record the Signaller has selected automatic operation for that sub-area, i.e. commanding the sub area on or off.
- sub-area processor state – this shall record whether the ARS system is ready and available to carry out route setting in an area.
- sub-area status state – this shall record whether automatic operation is allowed as defined by the interlocking control tables and external events (e.g. overrun protection, interlocking power failure etc).
- sub-area reminder state – shall be provided for the reminder device function.

The provision of these status bits within the interlocking provides the necessary cohesion between the interlocking and the ARS system.

6.4.5 There shall be clear distinction made between routes set manually by a Signaller and routes set automatically by the ARS processor. The interlocking is required to log this route setting information.

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6.5 Network Rail Train Service Database Interface

The user interface to the TTS shall be through the ARS System Control (Level 1, 2 and 3) or the the Diagnostic System (Level 1 and 2).

6.5.1 The TTS shall receive a new download from the Train Service Data Base (TSDB) automatically every 12 hours.

6.5.2 It shall be possible to request a download of a TSDB timetable.

6.5.3 It shall be possible to edit the downloaded timetable. The ARS System Control shall provide comprehensive editing facilities, allowing the user to display the details of the train's timings and to make detailed amendments to any feature of the train's timetable.

6.5.4 Remote access to the TTS shall be provided to allow 3rd party System Support. The remote link shall be either combined with or additional to the Diagnostic System remote link.

7 Functional Requirements

7.1 ARS General Requirements

7.1.1 The ARS system shall be configurable by data for each application.

7.1.2 The ARS system shall synchronize its clock to the time received from the TCCS.

7.1.3 ARS Software and data shall be updated from the Diagnostic System.

7.1.4 Transfer of software and data from the Diagnostic System shall be validated for correct and valid transfer.

7.1.5 If a transferred system update is not correct and or invalid i.e. corrupted in some way, the received files shall be ignored, and a report shall be made to the Diagnostic System.

7.1.6 The data received from the Diagnostic System shall be known as the default data.

7.1.7 The ARS System shall permit changes (defined in section 8) to be made to selected parameters by the appropriately authenticated user.

7.1.8 The ARS System shall permit Special Timing Patterns and Perturbation Plans to be edited or defined by the appropriately authenticated user.

7.1.9 If a Perturbation Plan is in operation and a train which matches the applicable TD enters the area, then that Perturbation Plan shall automatically be applied to that train.

7.1.10 The ARS System shall send a message to the TCCS when the ARS processors start up or changeover control to report a status message.