

# Subsystem Descriptions

For approval and authorisation of this document, please refer to the IECC Applications Manual Contents, RT/E/S/10040.

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# Amendment Record

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| 6.1   | 01/11/1999 | Sections 3.2.1 and 3.2.2 amended to remove references to MVME172-413 boards and replace them with references to MVME172-213 boards. Minor typographical errors in previous issue corrected.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 6.2   | 06/01/2000 | Sections 3.2.2, 3.3.1, 5.2.1, 7.3 and 11.3 amended as a result of document review and check of configuration limitations. 'industry pack' amended to 'IndustryPack'.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 6.3   | 20/06/2000 | Sections 8.1.2, 8.1.6, 8.2.1 and 8.2.2 amended to cover the introduction of the PC-based ISM Terminal.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 6.4   | 25/07/2000 | Typographical Correction.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 6.5   | 07/11/2000 | Section 1.2.1 amended. Values for maximum possible routes and maximum trains per timetable period amended in accordance with IECC Upgrade 002 changes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 6.6   | 20/03/2001 | Typographical Correction.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 7     | 22/05/2001 | Section 12.1.2 amended to cover the possibility that the simulator subsystem may be fitted with the CD-ROM facility.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 8     | 04/04/2003 | Railtrack amended to Network Rail.<br>Sections 1 and 2 amended for IECC SPAD Alarm.<br>Sections 1.2.1 and 1.3 reworded to state that 80 trains is theoretical limit (see SAO-IEC-D41) and 48 trains is recommended limit.<br>Section 1.3 reference to MVME101 and 162 boards deleted.<br>Section 2.1.4 amended for GPVDU windows in Upgrade 003.<br>Sections 3.2 and 3.2.2 amended for MVME172 board variants.<br>Section 6.1 (new numbering) amended for use of PSM logger.<br>New section 7 added to describe PSM operation.<br>Relay Interlocking Interface amended to Remote Interlocking Interface.<br>Descriptions and references to IFP, IGS, PCS and RDF removed. |

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- 9      02/02/2004      New Section 6 added for IECC PC Logger (IPL), subsequent sections renumbered.  
Section 7.1.7 (new numbering) amended to include reference to IPL.  
Section 8.1 (new numbering) amended to include reference to IPL.

| Author | Approved | Date | Authorised | Date |
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# I Automatic Routesetting Subsystem (ARS)

## I.1 FUNCTION

An IECC only has one ARS. Its main task is to issue route setting requests to the interlockings without manual intervention. These are based on an electronic copy of the timetable, routesetting strategies and the recent movement of trains.

It also provides:

- alarms, including Signal Passed at Danger (SPAD) alarms (Upgrade 003 only), to the signalling workstations;
- alternative route setting strategies to accommodate minor delays;
- contingency planning for large scale interruptions to the train service;
- on-line monitoring of automatic routesetting decisions; and
- an output to an event log for long term storage.

The area for which ARS can set routes is known as the ARS Control Area. It is divided into “sub-areas”, for which automatic routesetting can be individually turned on or off at the signalling workstation. This can be used, for instance, if an equipment failure disables part of the scheme. ARS can continue to set routes in the unaffected area.

ARS gathers train movement information from the interlockings and Train Describers (TDs) over an area wider than the ARS Control Area. This is known as the Data Collection Area, and is used to forecast and regulate the activity of trains.

### I.1.1 Timetable Handling

Timetable data is transmitted over the Information networks by the Timetable Processor subsystem (TTP).

The timetable data is normally issued to ARS in two twelve hour periods, trains being assigned to each period according to the time at which they are scheduled to start their journey within the ARS Data Collection Area. Up to four periods can be used over twenty four hours. The starting time of each period is set up through ARS data preparation. Amendment timetables, for changes to individual trains required at short notice, are also available.

### I.1.2 Routesetting

ARS continually monitors all trains in the Data Collection Area. If there is enough route set in front of a train, (e.g. if there are 2 or more green signals ahead), then no action is taken. Otherwise, ARS calls the next route for the train, provided that:

- the current time is not too far in advance of expected departure time;
- the train is not waiting for the Train Ready To Start plunger to be operated;

- the train is not waiting for joining trains; and
- the train is not waiting for connection.

Under some circumstances, the train can be routed to a path other than that described in the timetable: for instance, when the platform booked for a train is already occupied. The circumstances under which this is done are defined through ARS data preparation.

A priority strategy determines whether the train should have priority over other trains requiring a conflicting route. The strategy involves:

- checking where conflicting routes lie and identifying the conflicts;
- predicting the future behaviour of the trains; and
- assessing the relative priorities of different classes of train.

At some IECC installations, the ARS is provided with “area dependent strategies”, routesetting rules which are unique to that scheme.

When a route has been selected for the train, ARS checks to see if it is available. Each ARS holds a model of the route checking logic which is used in the interlockings it controls. ARS requests the route only if it believes that the move is safe and will be accepted by the interlocking. Note, however, that responsibility for safety rests entirely with the interlocking, and not with ARS. ARS also checks that the sub-area for the route is on before issuing a routesetting “panel request” to an interlocking.

### **1.1.3 SPAD Alarms (Upgrade 003 Only)**

ARS continually monitors the state of signal aspects and track section occupation, and issues an alarm to the signalling workstations if it detects that a SPAD has occurred. ARS maintains a model of the SPAD alarm state and can clear SPAD alarms in response to clearances received from the signalling workstations. ARS can also inhibit the generation of SPAD alarms in response to commands input by the signaller via the signalling workstations.

### **1.1.4 Contingency Plans**

The routesetting strategies described in section 1.1.2 usually allow for delays and small changes in the train service. Larger scale interruptions, such as equipment failure, are handled through Contingency Plans transmitted from TTP as required by ARS.

They contain modifications to the timetable which allow normal ARS functions to continue as far as possible until the equipment failure can be put right. Contingency Plans are introduced or withdrawn through the signalling workstations.

### **1.1.5 Interaction with Other Subsystems**

The IECC System Monitor (ISM) issues commands to the ARS during testing, initialisation and serious fault recovery. It also controls the operational mode and the processing state of the ARS. Commands entered at the ISM terminal can instruct ARS to perform non-intrusive diagnostics tasks (panel requests, SSI addresses, TD message monitoring), change mode of operation and changeover from Master to Standby.

ARS generates alarms for display on the General Purpose VDU (GPVDU) of a Signaller's Workstation. Several types of alarm are available:

- train specific alarms, (for instance when a train does not behave as expected);

- routesetting output alarms;
- link failures and system status changes;
- track circuit monitoring alarms; and
- SPAD alarms (Upgrade 003 only), these are also displayed on the signaller views.

ARS commands and enquiries can be entered at a signalling workstation, using the keyboard. These can:

- take a train out of, or put it under, ARS regulation;
- introduce or withdraw a Contingency Plan;
- specify whether trains should run to the standard timetable, the current contingency plan or a special timing pattern;
- turn Automatic Code Insertion (ACI) control on or off;
- turn a sub-area on or off;
- check whether a train is regulated by ARS;
- check the route-setting status of a train; and
- check the path of a train.

A response from ARS is displayed in the GPVDU ARS output window.

ARS can also receive SPAD alarm controls from the signalling workstation keyboard and trackerball (Upgrade 003 only). These can:

- clear a SPAD alarm;
- inhibit the generation of SPAD alarms at a signal for a long time period; and
- inhibit the generation of SPAD alarms at a signal for a short time period or for a one-shot event.

## 1.2 ARS CONFIGURATION LIMITATIONS

### 1.2.1 Limits of a Single ARS

ARS is designed to regulate a maximum 80 trains at any one time. Other parameters are:

- a maximum of 650 berths, required to allow ARS to regulate trains;
- a maximum of 500 signals in the data collection area;
- a maximum of 225 points in the data collection area;
- a maximum of 1200 possible routes in the data collection area;
- a maximum of 900 track circuits in the data collection area;
- a maximum of 990 latches or flags in the data collection area;
- a maximum of 90 train ready to start indications;
- a maximum of 90 emergency replacement buttons on signals not fully SSI controlled;

- a maximum of 90 sub-areas;
- a total of, at most, 250 routes and berths in the path of any train;
- a maximum of 4 timetable periods over twenty-four hours;
- a maximum of 99 contingency plans;
- a maximum of 35 locations, at which the train stops, for each train;
- a maximum of 1500 trains per timetable period;
- a maximum of 12000 locations, at which trains are timed, in each timetable period; and
- a maximum of 600 train connections per period.

These parameters are based on the assumption that ARS controls, at most, 12 interlockings. They allow for reasonably complicated operations in the control area, but are theoretical, rather than practical, maxima (see section 1.3). These parameters can be modified, but only by changing ARS software.

### **1.2.2 Other Subsystems**

For ARS to function it must be connected, via the networks, to the following subsystems:

- a TTP, from which it receives time table information;
- a subsystem, usually a Signalling Display Subsystem (SDS or DIS), to provide the TD function; and
- one or more interlockings.

ARS is connected to the Signalling and Information networks. ARS communicates with the TTP via the Information networks, and with SDS, DIS and interlockings, via the Signalling networks.

It is possible, under certain circumstances, to provide signalling control and display, and the TD function, using equipment other than SDS or DIS. This, however is not ideal and requires special consideration of the necessary interfaces.

A TTP can be shared between a number of ARS subsystems on different IECCs.

## **1.3 HARDWARE LIMITATIONS**

There is a processing trade off between some of the limits stated in section 1.2.1. ARS will not function satisfactorily if most of the parameters are near to their maximum values. The number of trains has the most effect on ARS performance, and it is recommended that an upper limit of 48 trains is applied rather than the theoretical maximum of 80 trains.

## 2 Signalling (Signaller's) Display Subsystem (SDS) And Flexible Display Subsystem (DIS)

SDS and DIS are functionally equivalent but they have different hardware architectures. Both provide the interface between the signaller and the IECC.

SDS makes use of specialised graphics boards for the display activities. DIS makes use of a rack mounted PC equipment to provide the display activities and the control of the signaller's input devices. Each provides identical indications and controls to the signaller.

SDS and DIS are usually housed in a specially manufactured Signaller's Workstation. However, with regard to DIS, it is possible to use free standing monitors on a table-type construction, sometimes referred to as the Signaller's Desk. The monitors and input devices are placed on the desk and the remainder of the hardware is installed in a standard Euro-rack cabinet.

### 2.1 FUNCTION

SDS (or DIS) is responsible for:

- generating the displays on the workstation's colour monitors;
- processing commands from the trackerball and push-buttons;
- processing commands from the workstation's keyboard;
- transmitting messages to the interlockings and to ARS when controls are operated;
- providing the TD function; and
- generating audible and visual SPAD alarms (Upgrade 003 only).

#### 2.1.1 Signalling Displays

Of the colour monitors in a signalling workstation, all but one (the GPVDU) display diagrams of the area controlled. There are two types of diagram:

- (a) Overviews, showing a large part of the control area but not small scale detail, such as ground signals and track circuit joints;
- (b) Detail Views, showing a smaller area but in greater detail, including signal, point and track circuit identities if required.

The signaller can select the view shown on each workstation monitor. Displayed on the views are:

- track circuit occupation (track circuit red);
- signal aspects;

- route lights (track circuit white, normally grey);
- indication that a route is set (signal post white, normally grey);
- lie of points;
- contents of Train Describer berths; and
- other signalling information such as TRTS plungers, slots, route direction arrows, SPAD indications etc.

### 2.1.2 Trackerball Control

Each workstation is fitted with a trackerball, used to move a cross-hair (cursor) screen marker on the monitors. If the cursor is moved past the edge of one monitor, it jumps to the next. A set of pushbuttons is fitted next to the trackerball.

To operate the equivalent of a push button on a panel, the signaller moves the cursor to the symbol on the display which represents the control, and pushes the workstation's "Set" button. The symbol often changes colour or flashes to show that the control is in use. To set a route, this is done twice: once on the entry signal and once on the exit signal. In this way, the procedure mimics as closely as possible a standard panel e.g. to set a route the cursor is placed on the entry signal and the "Set" button is pressed, followed by placing the cursor on the exit signal and pressing the "Set" button again.

### 2.1.3 Keyboard Control

As an alternative to using the trackerball, the signaller can enter commands using the keyboard. For instance, to set a route he might enter the following command:

"R72A SET"

The key words of each command ("SET", "CANCEL", etc) are entered using special function keys, grouped separately from the main "qwerty" keys.

The keyboard is always used to enter certain commands, in particular TD and ARS enquiries. Some keyboard commands can be employed in conjunction with the trackball and trackerball buttons e.g. to cancel a train description from a berth, the cursor is placed on the appropriate signal, the "TBIC" key is pressed followed by pressing the "Set" button.

Almost all ARS commands generate a reply in the ARS window of the GPVDU. Some commands also change the signalling displays: for instance, switching on an ARS sub-area changes the sub-area indications.

SDS (or DIS) only permits one Signalling command to be processed at any one time.

### 2.1.4 General Purpose VDU Display

One of the monitors on each signalling workstation is divided into sections or 'windows'. This monitor is known as the General Purpose VDU (GPVDU). The layout of the GPVDU (pre-Upgrade 003) is shown in Figure 7001-6A. The layout of the GPVDU (Upgrade 003 and later) is shown in Figure 7001-6B.

The window sizes and usage for the two GPVDU layouts are as follows (the window sizes given are the number of lines and characters available for messages, and exclude window titles and borders etc.):

- (a) Train Describer Maps  
This is an 80 character by 24 line window showing Train Describer maps from adjacent signal boxes or other SDSs or DISs.
- (b) Train Describer Alarms  
This is a 43 character by 4 line (43 character by 6 line in Upgrade 003) scrolling window. The title of the window and the number of outstanding alarms, displayed in the area colour, are also shown.
- (c) ARS Alarms  
This is a 43 character by 6 line (43 character by 8 line in Upgrade 003) scrolling window. The title of the window and the number of outstanding alarms are also shown.
- (d) System Alarms  
This is a 43 character by 6 line (43 character by 5 line in Upgrade 003) scrolling window. The title of the window and the number of outstanding alarms are also shown.
- (e) Train Describer Output  
This is a 43 character by 10 line (37 character by 7 line in Upgrade 003) scrolling window with the title of the window. Train describer messages that do not require acknowledgement are displayed in this window.
- (f) Signalling Alarms  
This is a 43 character by 2 line plus 43 character by 4 line (43 character by 9 line in Upgrade 003) scrolling window. The title of the window and the number of outstanding alarms are also shown.
- (g) General Output (Present only in pre-Upgrade 003)  
This is an 80 character by 4 line window. It was only used for RDF.
- (h) Keyboard (Command Line) Input  
This is an 80 character by 3 line (82 character by 3 line in Upgrade 003) window which is used to echo the commands entered at the keyboard. The window is untitled.
- (i) ARS Output  
This is a 43 character by 10 line (44 character by 17 line in Upgrade 003) window which is used to display ARS messages not requiring acknowledgement. It shows ARS responses to the signaller's commands and route setting enquiries.
- (j) Signalling Output  
This is an 38 character by 10 line (37 character by 9 line in Upgrade 003) window which is used to show responses to signalling commands which do not require acknowledgement.
- (k) SPAD Alarms (Present only in Upgrade 003 and later)  
This is a 43 character by 14 line window which is divided into two windows. The upper scrolling window is labelled 'SPAD Alarms' and is used to display up to 10 SPAD alarms simultaneously. It shows the window title, total number of SPAD alarms and

number of unacknowledged SPAD alarms. Below it is an unlabeled non-scrolling window designated 'Last SPAD Received' which is used to display the last SPAD alarm received.

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