

Appendix A: Deployment of ETCS in Heathrow Tunnels

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i. Glossary

CSR	Cab Secure Radio
CCS	Control, Command & Signalling
DfT	Department for Transport
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
GEST	GEstion des Signalisations Temporaires
GSM-R	Global System for Mobile Communications - Railway
GW-ATP	Great Western – Automatic Train Protection
HAL	Heathrow Airport Limited
HAL-ARP	HAL – Assurance Review Panel
IECC	Integrated Electronic Control Centre
NoBo	Notified Body
NR	Network Rail
NRN	National Radio Network
SOD	Safe Overrun Distance
STM	Specific Transmission Module
tph	Trains per hour
TSI	Technical Standard for Interoperability
TVSC	Thames Valley Signalling Centre
RBC	Radio Block Centre
RSSB	Rail Safety & Standards Board

ii. Related Documents

This Network Change should be read in conjunction with:

- HAL Network Change notice HAL-NC/G1/2016/GSMR/001
- Letter of No Material Effect NME/2016/CRLW/001 – Eurobalises to support Crossrail Class 345 transition – Up Airport and Down Airport Lines

1. Introduction

1.1. Crossrail Programme

Crossrail is the proposal for a new railway connecting Heathrow Airport and Reading (west of London), to Shenfield and Abbey Wood (north east and south east of central London respectively).

The project was developed to meet existing and future shortcomings of the rail network, as well as to provide a coherent transport link between key growth and regeneration areas across London.

The project delivers several important and strategic benefits for both London and the surrounding area. These include, but are not limited to:

- Sustaining economic growth;
- Removing current constraints on employment growth in Central London;
- Increasing rail capacity into the City and into Canary Wharf;
- Improving links to Heathrow Airport; and
- Linking central London to High Speed 1 (HS1) and Continental Europe at Stratford International.

The introduction of the Crossrail service will deliver a 4tph service to Heathrow from the Central Tunnel Section and via a new underground station at Paddington, replacing the existing 2tph Heathrow Connect service. This service is planned to commence in May 2018 from Paddington main line station, and is due to run services from the low level Crossrail station from December 2018.

Crossrail will be served by a new fleet of Rolling Stock (Class 345) that will be fitted with GSM-R radio equipment and ERTMS on board signalling equipment. The fleet will not be fitted with the GW-ATP system that is currently installed on the Heathrow Airport Ltd. infrastructure.



Figure 1 - Class 345 train

1.2. European Rail Traffic Management System (ERTMS)

The European Rail Traffic Management System (ERTMS) aims to replace the current mix of train command and control systems (Class B systems) in use throughout Europe with a common system. ERTMS has two basic components:

- European Train Control System (ETCS), comprising of an automatic train protection system (which will replace the existing Great Western Automatic Train Protection (GW-ATP) system currently in use on the Western Main Line), and
- Global System for Mobile communications Railway (GSM-R), a radio system for providing voice and data communication between the track and train. GSM-R already provides a modern replacement for existing train radio systems (CSR and NRN).

2. Project objective

The objective of the project is to provide ETCS (Level 2) overlay system on the Heathrow Airport rail network in order to support the introduction of the Crossrail service.

ETCS will be applied at Level 2 with lineside signals retained. This is necessary as not all rolling stock will be ETCS fitted at the time of commissioning. Trains not fitted with ETCS will be protected by the existing GW-ATP system.

This project is limited to the implementation of ETCS equipment on the trackside only (i.e. the ETCS Trackside Subsystem), no ETCS onboard equipment is being provided as rolling stock fitment is being managed by respective Railway Undertakings under separate arrangements.

3. General description of the system

3.1. ETCS Trackside Sub-System

The ETCS Trackside Sub-System contains the following constituents:

- Radio Block Centre (RBC)
- Eurobalises (or Balise) (switchable and non-switchable), There are no switchable Balises on Heathrow Infrastructure.
- Eurobalise (or Balise) Lineside Electronic Units (LEU)
- Maintenance & Supervision System (MSS)

These constituents are existing NoBo certified products but will be subject to the Network Rail product acceptance process to ensure their suitability for use within the Heathrow Tunnels.

3.2. System Architecture

The generic system architecture specified by Network Rail for this project is reproduced in Figure 2 below.

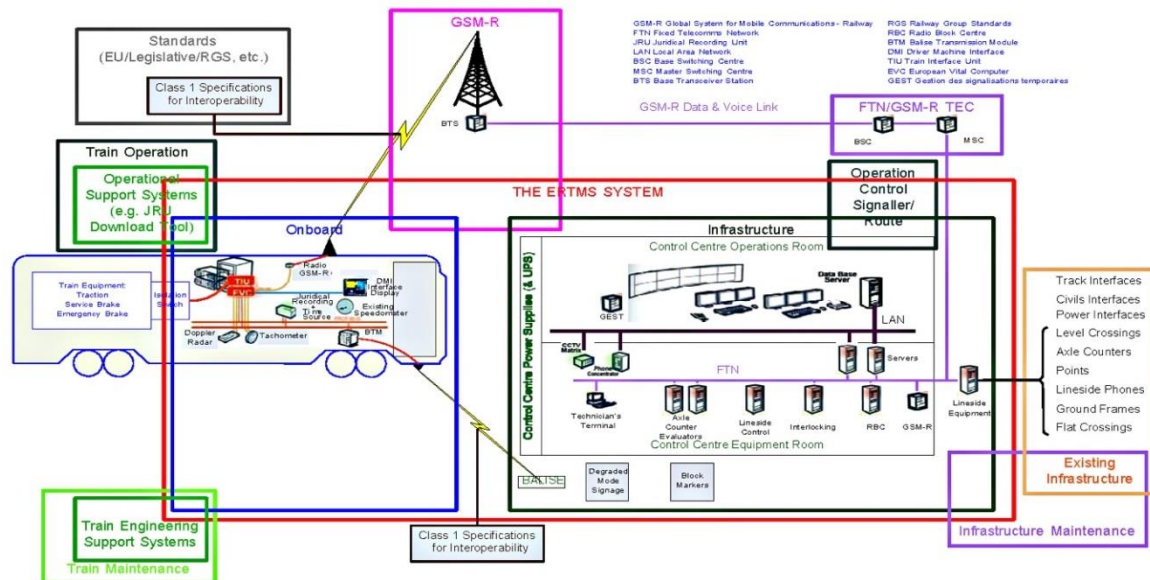


Figure 2 – Generic ETCS System Architecture

3.3. System Constituents

3.3.1. Radio Block Centre (RBC)

The RBC is the heart of the ETCS Trackside Sub-System as it contains most of the functionality associated with generation of ETCS Movement Authorities and other control information sent to or received from ETCS equipped trains under its control. Its main functions are:

- Generation and issue of Movement Authorities based on interlocking outputs and train position
- Generation and issue of emergency stop commands to trains
- Transmission of driver prompts (ETCS Text Messages)
- Management of ETCS modes at Start of Mission and other mission events, e.g. ETCS level transitions and recovery from Trip events.

Only a single RBC is required for this project (Stage A). A second RBC will be added for subsequent stages (stages B & C) which will be the subject of a separate Network Change Notice to be consulted by Network Rail.

3.3.2. Maintenance and Supervision System (MSS)

The MMS is a client/server based user interface operating system on standard commercial off the shelf workstations. The work station will be located within the equipment room at TVSC Didcot for use by maintenance technicians. An additional server interface will be provided adjacent to the signal control workstation associated with the ETCS Stage A area of control.

The primary role of the MSS is as a maintenance facility however the operation of the terminal does not require a high level of technical competence and as such will be configured for operational use to support the signaller. Through the server interface, the signaller is able to receive information about the status of the ETCS equipped trains under their area of control.

The operational terminal will not be used to assert any control over ETCS, however it may be used for the application and removal of Temporary Speed Restrictions once the policy for this process is established.

3.3.3. Eurobalise

Approximately 100 standard size Eurobalises will be fitted within the four foot of the tunnel as part of the construction works. Approvals for the introduction and fitment of the Eurobalises will be through the HAL-ARP process.

The Eurobalises in the tunnels will be fixed, used as position reference beacons for ETCS fitted trains.

A small number of switchable balises will be fitted outside HAL infrastructure boundary to support the Level 1 launch level transition process at the entrance to the Heathrow tunnels. These will be covered in a separate notice to be issued and consulted by Network Rail.

An important application of the balises is to support the ETCS Stop if in Staff Responsible (SR) mode. Balises will be installed at signals protecting points of conflict to prevent trains operating in Staff Responsible mode from reaching the SOD should they inadvertently pass a signal at danger without authority to do so from the signaller.

3.4. Data Management

A Data Management Plan has been produced by Network Rail to describe the processes to be applied to the acquisition and subsequent management of ETCS required data.

The configuration data required for ETCS operations covers;

- Infrastructure related data, e.g. locations of track features, gradients etc.
- Signalling Interlocking interfaces
- Balise data e.g. Level transition orders

3.5. GSM-R Radio Network

The GSM-R mobile communications for voice and data is covered by a separate notice and is required for the delivery of ETCS.

Deployment of GSM-R in the Heathrow Tunnels using Euroradio (see below) includes the provision of a fully redundant physical architecture to protect the system from the consequences of random equipment failures.

3.6. Euroradio Key Management

The Euroradio application uses cryptographic protection to ensure the security protection of the ETCS control data passed over the GSM-R network providing protection from malicious threats. The system is fully defined in the CCS TSI (SUBSET-038).

It should be noted that some of these fall outside the scope of the ETCS Trackside Sub-System but have been included for reference as they form part of the overall signalling system

4. Reasons for the proposed change

The delivery of ETCS (Level 2) overlay on the Heathrow Airport rail network is required to be delivered by 30th April 2017 to support Crossrail's Stage 2 dynamic testing programme and be authorised for operational use by May 2018 to support introduction of the commercial Crossrail service.

5. Specification of works

5.1. Geographic scope of works

The overall geographic area of ETCS overlay operation is from the tunnel portals, where Heathrow Airport network connects with Network Rail infrastructure, through to terminals 4 and 5 inclusive, as illustrated below:

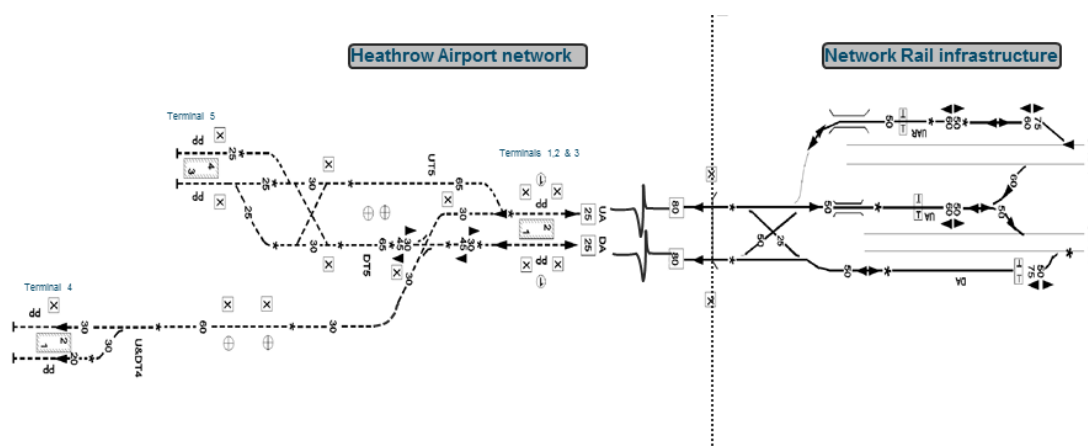


Figure 3 – Extract from Sectional Appendix – Illustrative purposes only

5.2. Physical Deployment

The ETCS Trackside Sub-System equipment will be installed at two locations:

- TVSC - RBC & MSS equipment in the Equipment Room adjacent to the Smartlock interlocking cubicles with an MSS client and user terminal on the Operating Floor.
- Trackside (HAL Network) – Balises in the four-foot for which cut-outs will be made to the Derailment Containment Device (DCD) – the concrete plinth between the running rails.
- Trackside (NR Network) – Balises in the four-foot and LEUs in trackside housings.

Please refer to attached scheme plan for more detail.

5.3. TVSC Works

In parallel, Network Rail will be undertaking:

- Necessary changes to the signaller and SSM workstations to allow for ETCS operation,
- Necessary enhancements to the maintenance technician capability.
- Modifications and interfaces to the signallers control interface at the TVSC, including alarms.
- Any upgrade required to the IECC system at TVSC to interface with ETCS.

5.4. Signalling modifications – conventional infrastructure

There will be no change to the existing conventional signalling infrastructure as part of this project.

5.5. Signalling modifications for ETCS provision – general

The ETCS infrastructure will be built in compliance with ETCS Baseline 3.0 and is designed to support the Baseline 3-fitted Class 345 Crossrail fleet.

ETCS fitted trains will transition into and out of Level STM (Specific Transmission Module) when leaving or entering the ETCS Level 2 area.

5.6. Signalling modifications – balises

ETCS balises will be placed within the four-foot to provide additional information to the Class 345 trains.

The balises are passive devices and will have no impact on unfitted ETCS stock.

5.7. Signage & stop car markers

Signage will be provided to demarcate the start and end of ETCS operation, as per the scheme plan.

5.8. Integration testing

The information in this section is provided for context only.

Network Rail's Crossrail Programme will undertake a period of on-track tests, initially using the Network Rail-leased Class 313 test train as a reference and, once available, with the Class 345 Crossrail fleet.

At the time of testing, all physical assets (balises, signage etc.) will have been installed in the Core Area. Signalling data changes will be undertaken, and the system partially commissioned, to allow testing to take place.

Detail of testing regime will be communicated separately and will be submitted to HAL-ARP for approvals.

6. Proposed timescales

Works are scheduled to be carried out between June 2016 and April 2017.

It is planned that most of works will be delivered within possessions included within the Engineering Access Statement. However, some disruptive possessions may be required and if so any required disruptive possessions will be consulted through the normal planning process between HAL and Network Rail.

7. Consequence of the proposed change

7.1. ETCS fitted trains

The system design has taken into account the RSSB Rule Book published in December 2015 which includes new rules applicable for ETCS Level 2 with signal applications.

In addition, railway operations has been considered as an integral part of the system design process which has taken full account of operational needs and where necessary, the design has been amended to meet the operational requirements.

An example of this is where the original design specified the use of KPH measure as opposed to MPH. Following consultation the use of MPH has been confirmed as the unit of speed for the project by applying the UK Specific Case.

It is expected that further local instructions will be developed during the detailed design stage to assist drivers and signallers.

7.2. Unfitted trains

The ETCS signalling system will only be available to ETCS-fitted trains and will have no impact on non-fitted stock, which can continue to operate using the conventional lineside signaling and operating rules.

Unfitted trains will continue to be protected by GW-ATP irrespective of operation of ETCS. Drivers using unfitted stock will however need to be aware of the additional and visible trackside infrastructure.

8. Costs and compensation

Compensation will be calculated in line with Part G of the Network Code unless alternative arrangements have been made. All possession related compensation will be paid through the standard Schedule - 8 regime where applicable.

8.1. Additional terms and conditions

Once this Network Change has become an established HAL Network Change (as defined in Part G of the HAL Network Code), HAL may, if it wishes to make any modification to the terms or conditions (including as to the specification of the works to be done, their timing, the manner of their implementation, the costs to be incurred and their sharing, and the division of risk) on which the change was established, use the following variation procedure: HAL shall ensure the specific variation (or variations) is formally communicated to all parties to this notice (the original consultation notice) for consideration. The parties to the consultation shall consider and respond to the variation (or variations) in accordance with the procedures set out in Conditions G1 and G2 allowing for the changes in detail that must follow as a result of the procedure applying only to the proposed variation. It shall not be necessary for HAL to re-issue the entire HAL Network Change notice for consultation.

8.2. Specific exclusions

The following is specifically excluded from this proposal:

- The provision and/or fitment of ETCS on-board train equipment.

9. Distribution list

Organisation	Name	Email
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Train Operators

Heathrow Express	Warren Johnson	warren_johnson@heathrowexpress.com
MTR Crossrail	Ian Brightmore	ian.brightmore@mtcrossrail.co.uk
	Jonathan James	jonathan.james@mtcrossrail.co.uk
	Steve Agace	steve.agace@mtcrossrail.co.uk

Other Infrastructure Managers

Network Rail	Eduardo Da Silva	eduardo.dasilva@networkrail.com
Network Rail	Angela Bradbury	angela.bradbury@networkrail.com

Other Parties (for information purposes)

ORR	Central email address	operations.team@orr.gsi.gov.uk
Department for Transport	Central email address	passengerservices_access&operations@railexecutive.gsi.gov.uk
Crossrail Ltd	Tony Byrne	tonybyrne2@crossrail.co.uk
	Paul Richardson	paulrichardson@tfl.gov.uk
Passenger Focus	John Sears	john.sears@transportfocus.org.uk
ATOC	Miranda Cleary	miranda.cleary@atoc.org

Appendix B – Scheme Plan

Attached as a separate document