ETCS System Description

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Superseded documents

This Railway Group Guidance Note does not supersede any other Railway Group documents.

Supply

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# ETCS System Description

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Part 1  Introduction

1.1 Purpose of this document
This document describes the system architecture and behaviour of the European Train Control System (ETCS) as it will be implemented in Great Britain (GB). It covers the following aspects of ETCS.

a) The overall context of ETCS as part of the European Traffic Management System (ERTMS).

b) The system architecture of ETCS and the supporting equipment which it requires.

c) The system behaviour of ETCS in terms of:
   i) Application levels (also known as ‘levels’)
   ii) Modes
   iii) The protection functions which ETCS provides
   iv) ETCS data
   v) Signalling principles in relation to Level 0 and Level 2 without lineside signals.

A discussion of signalling principles in relation to Level 2 with lineside signals will be included in a later version of this document.

This document seeks to provide sufficient information to enable infrastructure managers and railway undertakings to understand the basic principles of ETCS and its part in the safe movement of trains. It accompanies the Operational Concept, Level 0 and Level 2 without Lineside Signals [1] and provides a greater level of technical detail about how ETCS will operate within GB. The Operational Concept [1] describes what is required for GB; this document describes how ETCS can be configured to meet those needs.

This document does not constitute a recommended method of meeting any set of mandatory requirements. Further, this document does not attempt to describe ETCS in detail. Full details can be found in the System Requirements Specification (SRS) for ETCS [2].

Further, this document does not address the interworking of ETCS with systems providing Automatic Train Operation.

1.2 Scope of this document
The scope of this document is ETCS as defined in version 2.3.0d of the ETCS System Requirements Specification [2].

The scope of this document covers:

a) The overall context of ETCS as part of the European Traffic Management System (ERTMS).

b) The system architecture of ETCS and the supporting equipment which it requires.

c) The system behaviour of ETCS in terms of:
   i) Application levels
   ii) Modes
   iii) The protection functions which ETCS provides
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iv) ETCS data

v) Signalling principles in relation to Level 0 and Level 2 without lineside signals.

A discussion of signalling principles in relation to Level 2 with lineside signals will be included in a later version of this document.

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1.4 Approval and authorisation of this document

The content of this document was approved by:

Control Command and Signalling Standards Committee on 29 October 2009

This document will be / was authorised by RSSB on 10 December 2009
Part 2 Overview of ERTMS and ETCS

2.1 The European Rail Traffic Management System (ERTMS) is a European-led system to achieve three main outcomes.

a) Facilitate, improve and develop international rail transport services within the European Union

b) Contribute to the progressive creation of the internal market in equipment and services for the construction, renewal, upgrading and operation of the trans-European rail system

c) Contribute to the interoperability of the trans-European rail system.

2.2 It is composed of four elements:

a) European Train Control System (ETCS). This is the train-control element and includes Automatic Train Protection (ATP). There are five levels of application (see 4.2), each offering different degrees of signalling protection and control, and sixteen different Operating Modes (see 4.3). Not all Operating Modes are available in all Application Levels

In normal operation, ETCS works on the principle of providing to the train a maximum distance that it can travel, the speed profile of the track ahead and other track information about the route that has been set. The train then permits the driver to drive the train, but should the distance or speed limit be exceeded, or be in danger of being exceeded, then the ETCS onboard equipment intervenes to control the train, bringing it to stand if necessary

b) Global System for Mobile communications – Railways (GSM-R). This is the telecoms element of ERTMS which, in some applications, carries ETCS data between trains and the trackside infrastructure. It also provides for voice communications. It is based on standard mobile telephone technology, but with a set of railway-reserved frequencies (hence the -R in GSM-R)

c) European Traffic Management Layer (ETML). This is a concept to optimise railway operations through improved management of train running to maximise the potential of a given layout and to reduce scheduling conflicts

d) European Operational Rules (EOR). This is a set of agreed rules to standardise certain aspects of rail operation across Europe.

2.3 Note, therefore, that ETCS is not the same as ERTMS. The terms are often erroneously used interchangeably. This document will talk primarily about ETCS, referring to the GSM-R element where necessary.
3.1 Introduction

ETCS is not a signalling system in and of itself. Along with other items, it forms part of a signalling system. ETCS is divided into two parts.

a) The ETCS onboard equipment
b) The ETCS trackside equipment.

3.1.2 Supporting equipment is also required to form a complete signalling system and, in some applications, to transfer data between the ETCS trackside equipment and the ETCS onboard equipment.

3.1.3 The ETCS onboard equipment architecture diagram is shown in 3.3.

3.1.4 Architecture diagrams for trackside equipment for Level 1 and Level 2 without lineside signals are shown in 4.2.

3.2 ETCS Trackside Equipment

3.2.1 General arrangement

3.2.1.1 ETCS trackside equipment always includes balises. It can also include Radio Block Centres (RBC), Euroloops and Radio In-fill Units.

3.2.2 Balise

3.2.2.1 The balise (or to give it its full title, Eurobalise), is a data configurable transponder that is mounted in the four-foot, similar to AWS magnets and TPWS loops. The balise can operate on all ETCS Application Levels. The balise needs no external power supply as it is energised by the passing train. Once energised, the balise transmits an electronic telegram back to the train.

3.2.2.2 The content of the telegram will vary depending on its purpose. Furthermore, a balise can either send the same fixed telegram in each transmission or it can be connected to a local switching unit to enable it to transmit a different message according to the inputs received.

3.2.2.3 A balise group consists of one to eight balises. Each balise is uniquely identifiable within each balise group and each balise group also has a unique identity.

3.2.2.4 Balise groups are used to help the train determine its direction of travel. The train normally determines its direction of travel from the order in which it passes over the balise group. Direction is more quickly established when a balise group consists of two or more balises.

3.2.2.5 Balise telegrams are made up of individual packets which contain the data required for the train. As trains can pass over balise groups in either direction, each packet can be made valid for either or both directions of travel.

3.2.2.6 Multiple balises, within a balise group, permit the transmission of more data. This also allows for redundancy as the same message can be transmitted from more than one balise. If one balise fails to be read for whatever reason, the other balise may be read thereby ensuring delivery of the telegram. Collectively, the telegrams from a balise group form an electronic message.

3.2.3 Radio Block Centre

3.2.3.1 The Radio Block Centre (RBC) operates on ETCS Application Levels 2 and 3. Where an RBC is provided, it forms the heart of the ETCS trackside equipment with balise groups being used for little more than position references.
3.2.3.2 The RBC is located with other signalling and controlling equipment systems at the controlling signalling or traffic management centre. The RBC sends electronic messages to, and receives electronic messages from, ETCS onboard equipment on trains within the area which the RBC is controlling. These messages are transmitted via GSM-R data radio. Each electronic message can contain one or more data packets. These data packets have the same structure as those transmitted by balises.

3.2.3.3 Crucially, the RBC monitors the interlocking and generates movement authority (MA) messages. An MA message is sent when the route has been set, all locking is in place and the conditions for the train movement have been satisfied and the RBC is in communication with a train that is able to enter that route.

3.2.3.4 The RBC also contains data that describes the route and speed restrictions that will be encountered (gradient and speed restriction data). This data is not contained in the interlocking but is necessary for the train to comply with the speed profile.

3.2.3.5 The RBC also receives information from the train, such as the train’s location and status.

3.2.3.6 The RBC provides the signaller with an interface through which the signaller can observe and influence aspects of the operation of the RBC.

3.2.4 Euroloop

3.2.4.1 The Euroloop only operates on ETCS Application Level 1. The Euroloop is a track-mounted loop that can transfer electronic messages to the train over a length of track, rather than at a defined spot as in the case of a balise group. This allows some operational flexibility over the location where the train receives trackside data. Each electronic message can contain one or more data packets. These data packets have the same structure as those transmitted by balises.

3.2.5 Radio In-fill Unit

3.2.5.1 The Radio In-fill Unit only operates on ETCS Application Level 1. A Radio In-fill Unit sends electronic messages to ETCS onboard equipment operating along a specific length of track, rather than at a defined spot as is the case for a balise group. This allows some operational flexibility over the location where the train receives trackside data. Messages are transmitted via GSM-R data radio. Each electronic message can contain one or more data packets. These data packets have the same structure as those transmitted by balises.

3.3 ETCS Onboard Equipment

3.3.1 General arrangement

3.3.1.1 The principal elements of ETCS onboard equipment are shown in Figure 1 and discussed in the following paragraphs. Note that the figure is simplified; there may be more than one of each piece of equipment indicated.
3.3.1.2 Each driving cab needs to be connected to a set of ETCS onboard equipment, but more than one cab of a locomotive or fixed formation multiple unit may be connected to the same equipment. Where locomotives or multiple units work in multiple only one set of ETCS onboard equipment will be providing supervision.

3.3.2 European Vital Computer

3.3.2.1 The train is equipped with a computer commonly referred to as the European Vital Computer (EVC). This is the heart of the ETCS onboard equipment. It is the EVC that provides the supervision of the train’s movements against all the inputs received from the trackside (balise groups / RBC / Euroloops / Radio Infill Units), onboard odometry, the driver and other stored information, and provides outputs to the driver through the in-cab display, the train’s braking system, other train functions through the Train Interface Unit (TIU) and transmits information back to the RBC (if provided).

3.3.3 Train Interface Unit

3.3.3.1 The Train Interface Unit (TIU) is the means by which ETCS controls the train’s onboard functions. The main interfaces include the following:

a) Train braking system. An interface to the train’s braking systems, both service and emergency. The service brake interface is not safety-critical. The emergency brake interface is safety critical

b) Train control. ETCS is able to command the change of traction, the raising / lowering of an overhead pantograph and command the air tightness function to activate/deactivate where certain trackside data has been received

c) Engine control. An interface is included to cut the traction power. This is used when the ETCS onboard equipment is applying either the service or emergency brakes and needs to ensure that tractive effort is no longer being applied

d) Cab status information. This includes determining the position of the direction controller and whether the cab desk is open or closed.

3.3.4 Balise Reader

3.3.4.1 ETCS-fitted trains are equipped with a balise reader. It energises the balise, enabling the balise to transmit its telegram to the train. The balise reader then receives the telegram and passes it on to the EVC via a Balise Transmission Module (BTM).

3.3.4.2 The balise reader can also be used to receive messages from Euroloops and pass these on to the EVC via a Loop Transmission Module (LTM).
3.3.5 **Driver Machine Interface**

3.3.5.1 The ETCS onboard equipment communicates with the driver via the Driver Machine Interface (DMI), an in-cab display, located in a prime position on the driver’s desk. The DMI will provide the driver with all necessary ETCS information needed to determine:

a) The distance that the train has permission to travel

b) The maximum speed which the train should not exceed

c) The point at which the driver needs to start braking to avoid intervention by the ETCS onboard equipment.

3.3.5.2 The DMI screen may be touch-sensitive and/or have buttons to permit the driver to input train information, request permission to move and acknowledge certain events.

3.3.5.3 One version of the DMI is shown in Figure 2. Note that this DMI has a series of buttons, or soft-keys, on the right-hand side. Their function changes according to the current operating state.

![Figure 2 – ETCS DMI](image)

3.3.5.4 The principal areas of this DMI and the information they display are as follows.

a) Supervised distance information (area A). The figure shows a vertical bar with a distance of 880 m until the train needs to be driven at a different speed. It only appears when the driver is required to apply the brakes in order to avoid the ETCS onboard equipment intervening to control the train’s speed. To know what this future speed is, the driver needs to look either at the speed information (area B), or the planning area (area C)

b) Speed Information (area B). The speed is displayed in km/h. The figure shows the current speed as 103 km/h with a current permitted speed of 135 km/h (indicated by the yellow ‘hooked’ line around the speed dial), but with a future target speed of 0 km/h (indicated by the yellow line all the way around to 0). In the lower right-hand corner of the speed information is an oval symbol in a square box which means FS mode. This symbol will change according to the Operating Mode of the ETCS onboard equipment.
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c) The planning area (area C). This section of the DMI gives the driver an overview of the line ahead and provides advance information in this case over 4 km (the driver is able to adjust the distance for which information is displayed). The figure shows another vertical bar, in this case, with a ‘0’ in the middle. This ‘0’ indicates that the current track gradient is level throughout the next 4 km. To the right of this is another symbol (a zero again) shown on a logarithmic scale at a value of 880. This is indicating a future lower target speed of 0 km/h in 880 m. This is the same figure as shown in the supervised distance information (area A).

d) Supplementary Driving Window (area D). This is beneath the supervised distance information. This symbol will change according to the Application Level of ETCS. This area will also display text messages and other events requiring driver acknowledgement.

e) Monitoring windows (area E). These are provided to the bottom of the screen. This would show supplementary driving information such as the train’s current geographical position. It also displays the current time as shown in the figure.

f) Main Menu Window (area F). On the far right is the main menu window. These indicate typical functions offered by the buttons on the right-hand side of the DMI.

3.3.6 Odometry

3.3.6.1 The odometry system on board the train provides the train with both speed and distance travelled information. This has to be high integrity and so is usually provided by more than one mechanism. Typically, the EVC receives input from tachometers and also from a speed radar mounted underneath the train. The EVC uses this information to calculate the train’s speed and position so that it can supervise the train properly. The EVC can also use this information to periodically report its position to the ETCS trackside equipment.

3.3.6.2 The ETCS standards [3] require the odometry to have an accuracy no worse than ±(5m+5%) of the distance travelled since the passing of a balise group.

3.3.7 Juridical Recorder Unit

3.3.7.1 ETCS mandates the inclusion of an onboard data recorder, called the Juridical Recorder Unit (JRU). This is designed to withstand the most severe of expected train accidents so that after such an event, it is possible to reconstruct the ETCS events that could have contributed to the accident. To enable this to happen, the JRU records all the messages and telegrams sent and received by the train, driver interactions and certain EVC commands.

3.3.8 Specific Transmission Module

3.3.8.1 An STM allows the ETCS on-board equipment to provide the functionality of a national train protection system such as AWS, TPWS on BR ATP. The STM provides a capability to read messages from the national trackside equipment (for example, magnets and loops). When operating in STM mode the ETCS DMI provides some or all of the driver interface for the national system, and the ETCS TIU provides the train interfaces required by the national system (for example, brakes).

3.3.8.2 Use of an STM avoids the need to install a separate national train protection system with its own driver and train interfaces, and allows switching between ETCS and the national system under software control.
### 3.4 Supporting equipment

#### 3.4.1 General arrangement

3.4.1.1 ETCS forms part of a signalling system. Other, conventional signalling, equipment is necessary to form a complete signalling system. Some ETCS Application Levels also use the GSM-R data radio network to transfer data between ETCS trackside equipment and ETCS onboard equipment.

3.4.1.2 Conventional signalling equipment includes: interlocking, signaler interface, technician terminal, train detection, level crossings, points actuators, ground frame releases, plungers, indicators, and signage. Conventional signalling equipment may also include signals.

3.4.1.3 When the system is implemented as ETCS Level 2 without lineside signals, additional signage is provided in the form of ETCS block markers and shunt entry boards (see Figure 3). A block marker can mark the start or end of a signalled move. A shunt entry board can only mark the start of a signalled move. Each block marker and shunt entry board will be provided with an identification plate.

![Block Marker and Shunt Entry Board](image)

**Figure 3 – Block Marker and Shunt Entry Board**

3.4.1.4 A block marker may be designated as ‘passable’ by a passable plate (see Figure 4). Any block marker, without a passable plate, is non-passable. All shunt entry boards are non-passable.

![Passable Plate](image)

**Figure 4 - Passable Plate**

3.4.1.5 Permanent Speed Restriction boards may be provided for use in degraded mode operation, where the permissible speed is lower that the maximum speed supervised by ETCS in SR mode.
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3.4.1.6 Additional signage is also provided at the boundary of ETCS Level 2 without lineside signals area in the form of:

a) Warning of start of cab signalling boards
b) Start of cab signalling boards
c) End of cab signalling boards.

3.4.1.7 The current requirements for buffer stops will remain.

3.4.2 GSM-R data radio network

3.4.2.1 Although not part of ETCS, GSM-R data radio is used in some ETCS Application Levels to communicate between the RBC and ETCS onboard equipment.

3.4.2.2 The RBC is connected through a fixed telecommunications network to a mobile switching centre. This controls and manages the GSM-R system. The switching centre is then connected through to base transceiver stations. These are local communications masts fitted along the lineside that send information to, and receive information from, the trains by radio.

3.4.2.3 The trainborne GSM-R data radio equipment includes roof-mounted antennae to enable the train to communicate with the ETCS trackside equipment.

3.4.2.4 It is not necessary for the GSM-R data radio coverage to be continuous; radio holes can be planned in to the system design. However, when planning such radio holes, consideration needs to be given to how the train will operate, particularly in abnormal, degraded or emergency conditions.

3.4.2.5 GSM-R, as part of ERTMS, is also used as part of the voice communications channel between the signaller and the driver. The minimum signal strength requirements for reliable ETCS data communications are more stringent than those required for GSM-R voice, so some upgrading of the trackside GSM-R infrastructure may be necessary.

3.4.2.6 For more information on GSM-R for voice communications, the reader is referred to the GB Application of GSM-R, The Operational Concept [4].
Part 4  ETCS System Behaviour

4.1 Introduction

4.1.1 ETCS supervises the train to ensure that it does not travel further than it has permission to do so and that it does not move faster than it has permission to do so. The degree of supervision depends on the Application Level and Operating Mode of ETCS. The Application Level is the ETCS Level of the route and the operating mode is the controls which ETCS applies to any movements of the train.

4.1.2 As with conventional signalling, the signaller requests for routes to be set and cancelled in the interlocking. When a route has been set, locked and detected in the interlocking and is safe to use, the ETCS trackside equipment provides a Movement Authority (MA) to the ETCS onboard equipment of a train that is able to enter that route. This MA consists of the maximum distance that the train has permission to travel, the linespeed and track gradients within this distance. The ETCS onboard equipment combines this information with any onboard speed limits (for example, train speed) and then calculates a speed profile that the driver is not permitted to exceed. The speed profile is calculated down to zero speed at the end of its MA taking into account the train’s braking characteristics. This information is provided to the driver through the DMI.

4.1.3 At all times, the driver is responsible for the movement of the train. ETCS provides a supervision function. Should the driver attempt to exceed the distance or speed for which permission to move has been granted, ETCS warns the driver and then intervenes to either slow the train down or bring it to a stand.

4.1.4 According to the Application Level, information is transmitted to the train through a combination of balise groups and via the GSM-R data radio network. Using the GSM-R network, the train is also able to transmit information to the trackside, such as position reports and onboard status.

4.2 ETCS Application Levels

4.2.1 Overview

4.2.1.1 ETCS offers 5 levels of application. These are:

- Level 0
- Level STM
- Level 1
- Level 2
- Level 3.

4.2.1.2 Strictly speaking, it is the ETCS onboard equipment that operates in a particular level, but this is dependent upon the supporting ETCS trackside equipment. These levels are described below.

4.2.2 Level 0

4.2.2.1 Level 0 covers operation of ETCS-fitted trains operating in an area of track that is not fitted with ETCS trackside equipment or on lines which are in commissioning, for example, where trackside ETCS infrastructure may exist but is ignored.

4.2.2.2 As such, Level 0 provides supervision against maximum train speed and maximum speed permitted in unfitted areas. The driver retains the responsibility of ensuring that the train does not travel further than the authority supplied by the lineside signalling and remains within the signed speed limits. Any national train protection systems will remain.
4.2.3 Level STM

4.2.3.1 This is a special Application Level to allow a national protection system to work with ETCS. A description of the STM is provided in 3.3.8.

4.2.4 Level 1

4.2.4.1 This level allows ETCS to work with the existing signalling system through the provision of a trackside spot-based update of signalling information to the ETCS onboard equipment. It is an overlay of ETCS on top of the existing signalling system. See Figure 5.

![Figure 5 – Level 1 (basic)](image1)

4.2.4.2 A balise group is placed a short distance on the approach to each signal. This balise group is electrically connected to the signal, or data link commanding the signal, via a local Lineside Electronics Unit (LEU) so that the information transmitted by the balise group to the train is determined by the signal aspect currently being displayed. Thus, the train can receive different MA data according to the signal aspect. Trains can be prevented from passing red aspects through the provision of a very short MA (that is, the distance from the balise group to the signal). In addition to the distance to go information, the track’s speed and gradient information is also transmitted, allowing the ETCS onboard equipment to supervise the train’s speed.

4.2.4.3 The limitations of a spot-based update of signalling information is that the signalling information held by the train and displayed to the driver is only as good as the last transmission spot that the train passed, that is, at the last signal. Thus, while the signal in Figure 5 is displaying a green aspect, if the previous signal had been displaying a yellow aspect, the train will be being supervised to stop as it expects the signal in Figure 5 to be red. The driver, seeing a green aspect, cannot drive to the signal aspects. This is overcome to a limited extent through the provision of infill balise groups, Euroloops or Radio In-fill Units.

4.2.4.4 Infill balise groups are placed at a further distance on the approach to the signal to which it applies and are also electrically connected to that signal. The train receives an earlier update to its MA and is not impeded in its journey. This is shown in Figure 6.

![Figure 6 – Level 1 (with infill balise group)](image2)
4.2.4.5 The more infill balise groups there are, the more accurate the signalling information held by the train, but this will cost more to install and maintain and still does not guarantee that the ETCS onboard equipment is in agreement with the signal aspect being displayed as signal aspects can change at any time. The number of infill balise groups will be determined based upon the performance requirements of the scheme design.

4.2.4.6 Euroloops and Radio In-fill Units provide a similar function to the infill balise group. With a Euroloop or Radio In-fill Unit, transfer of data between the train and trackside can occur over a length of track, rather than at a particular spot.

4.2.5 Level 2

4.2.5.1 Level 2 may work with or without lineside signals. Level 2 still requires train detection to provide the interlocking with train position information. Level 2 without lineside signals is the preferred, long-term implementation of ETCS in GB. As such, it will be discussed in more detail in this document.

4.2.5.2 In Level 2, signalling information is transmitted to the train via a radio link. This radio link uses GSM-R data radio (part of ERTMS).

4.2.5.3 For a train to operate on a line fitted with Level 2 without lineside signals it needs to be fitted with ETCS onboard equipment.

4.2.5.4 Level 2 with lineside signals can be a migratory step towards achieving Level 2 without lineside signals. For Level 2 with lineside signals unfitted and ETCS fitted trains can both operate, but only ETCS fitted trains will have the benefits afforded by ETCS.

4.2.5.5 More detailed information of the system description for Level 2 with lineside signals will be provided in a later issue of this document once the relevant operational concept has been accepted.

4.2.5.6 For Level 2, balise groups no longer provide distance to go, speed and gradient information. Instead, their main function is to provide a position reference. The ETCS onboard equipment is provided with a list of balise groups that the train will pass and the distance from one balise group to the next. The ETCS onboard equipment uses this information to:

    a) Confirm that the train is travelling along the expected route
    b) Confirm that the onboard odometry is performing within expected tolerances
    c) Reset the accumulated odometry error.

4.2.5.7 Figure 7 shows the Level 2 without lineside signals architecture. For a Level 2 with lineside signals the architecture is similar except lineside signals are provided and there is no requirement for block markers.
4.2.5.8 Level 2 permits a means to shorten a route in advance of a train without having to make use of timers, thereby considerably shortening the time taken to revoke a route for any given train. This functionality is called ‘co-operative shortening of MA.’ If the signaller wishes to co-operatively shorten the MA, the ETCS trackside equipment first requests permission from the ETCS onboard equipment to shorten the MA. If the ETCS onboard equipment determines that the shortened MA will not automatically cause the brakes to be applied due to the train’s proximity to the proposed nearer end of route, then the ETCS onboard equipment accepts the shortened MA and informs the ETCS trackside equipment that the train will no longer use the longer MA. Thus the route can be released. If the ETCS onboard equipment determines that the shortened MA will result in the train’s brakes being applied due to the train’s proximity to the proposed end of route, then the ETCS onboard equipment rejects the request to shorten the MA and retains the original, longer MA and informs the ETCS trackside equipment of this decision.

4.2.5.9 Level 2 also permits the emergency revocation of routes, shortening an MA immediately. According to the train’s position relative to the nearer end of route, the ETCS onboard equipment may automatically apply the train’s brakes.

4.2.6 Level 3
4.2.6.1 The Level 3 system architecture is similar to Level 2 without lineside signals except there is no requirement for trackside train detection equipment. However, to improve performance, trackside train detection equipment over switches and crossings is permitted.

4.2.6.2 Since trackside train detection is not required the ETCS onboard equipment is responsible for train detection. This is achieved by the ETCS onboard equipment being responsible for checking the train integrity and reporting completeness to the ETCS trackside.

4.2.6.3 Train separation is no longer constrained by the trackside train detection sections. The track occupancy is determined from the last train position report reported to the ETCS trackside.
4.3 ETCS Operating Modes

4.3.1 Overview

The ETCS onboard equipment has 16 different Operating Modes, each of which offers a different degree of supervision and protection (see Table 1). The full list of Operating Modes and a brief description of each is provided in the following sections. Further details of each operating mode can be found in the ETCS SRS [2].

<table>
<thead>
<tr>
<th>Mode</th>
<th>Level</th>
<th>Supervision</th>
<th>Protection</th>
</tr>
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</table>
|                 | 0     | STM 1, 2, 3 | Static Speed Profile | Axle load speed profile | Temporary Speed Restrictions | Mode related speed restriction | Train related speed restriction | Gradient | Distance | Release speed | Route suitability | Reverse movement | Roll away | Staff Responsible | Ceiling | Unfitted | Staff Responsible | Ceiling | Shunting | Staff Responsible | Ceiling | Shunting | Staff Responsible | Ceiling | Shunting | Staff Responsible | Ceiling | Shunting | Staff Responsible | Ceiling | Shunting | Staff Responsible | Ceiling | Shunting | Staff Responsible | Ceiling | Shunting | Staff Responsible | Ceiling | Shunting | Staff Responsible | Ceiling | Shunting | Staff Responsible | Ceiling | Shunting | Staff Responsible | Ceiling | Shunting | Staff Responsible | Ceiling | Shunting | Staff Responsible | Ceiling | Shunting | Staff Responsible | Ceiling | Shunting | Staff Responsible | Ceiling | Shunting | Staff Responsible | Ceiling | Shunting | Staff Responsible | 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4.3.2 Full Supervision

4.3.2.1 The full protection of the relevant Application Level is applied in Full Supervision (FS) mode, including the provision of an MA. It is planned that, where possible, all non-permissive moves in Application Level 2 without lineside signals will be made in FS mode.

4.3.2.2 To be in FS, the ETCS onboard equipment needs permission from the ETCS trackside equipment and needs to know the track gradient profile, the track line speed and the distance that it can travel. Should gradient and speed information only be known from the front of the train (for example, it only knows the gradient information forwards from a signal or block marker that the train is currently passing), then the train will transition into FS mode, but include a message on the DMI indicating that gradient and speed information is not available for the whole length of the train. This message will remain until the train reaches a location where gradient and speed information is available for the whole length of the train.

4.3.3 On-Sight

4.3.3.1 The full protection of the relevant Application Level is applied in On Sight (OS) mode, including the provision of an MA. The difference with FS is that the interlocking is permitting the train to move when it does not know that the track ahead is clear of an obstruction. The driver is now responsible for ensuring the train is driven at such a speed that it can be brought to a stand prior to meeting any obstruction. The ETCS onboard equipment also supervises the train to a ceiling speed. It is planned that all permissive moves and the first movement on the mainline up to the next track section in Application Level 2 without lineside signals will be made in OS mode.

4.3.3.2 To be in OS, the ETCS onboard equipment needs permission from the ETCS trackside equipment and needs to know the track gradient profile, the track line speed and the distance that it can travel. Should gradient and speed information only be known from the front of the train (for example, it only knows the gradient information forwards from a signal or block marker that the train is currently passing), then the train will transition into OS mode, but include a message on the DMI indicating that gradient and speed information is not available for the whole length of the train. This message will remain until the train reaches a location where gradient and speed information is available for the whole length of the train.

4.3.4 Staff Responsible

4.3.4.1 Staff Responsible mode (SR) is offered to the driver when the ETCS onboard equipment does not have all the data necessary to enter FS or OS mode, typically at the start of a mission when the train has an invalid or unknown position.

4.3.4.2 The SR is also entered as a consequence of the driver selecting override.

4.3.4.3 In SR, the ETCS onboard equipment supervises the train to a ceiling speed.

4.3.4.4 It is possible to limit the distance travelled in SR either through a distance limit or through a balise group. Where a distance limit is provided, the train’s speed will be dynamically supervised down to a zero speed at the end of this distance. Where a balise group is provided this will cause the train to trip if it passes over it in SR mode.

4.3.5 Shunting

4.3.5.1 The driver manually selects Shunting (SH) mode and is now responsible for the movement of the train. The ETCS onboard equipment supervises the train to a ceiling speed. It is planned that all propelling moves and moves over
uncontrolled or undetected infrastructure in Application Level 2 without lineside signals will be made in SH mode.

4.3.5.2 It is possible to limit the distance travelled either through a distance limit or through a balise group. Where a balise group is provided this will cause the train to trip if it passes over it in SH mode.

4.3.5.3 When operating in Application Level 2, SH is the only mode\(^\text{10}\) that the train may be driven backwards from the front cab in GB.

4.3.6 **Unfitted**

4.3.6.1 When operating in Application Level 0 (that is, in an area of track not fitted with ETCS equipment), the ETCS onboard equipment operates in Unfitted (UN) mode. The train is supervised against a ceiling speed which will be the lowest of the maximum permitted speed for the traction unit or the maximum permitted speed of the train as entered by the driver.

4.3.6.2 Temporary Speed Restrictions (TSR) can also be applied in this mode using a balise group (although this is not fail-safe). The train speed is then dynamically supervised down to the lower TSR speed on the approach to the start of the TSR.

4.3.6.3 In UN the system allows the train to be driven forwards or backwards.

4.3.7 **Isolation**

4.3.7.1 The ETCS onboard equipment can be isolated from the rest of the train’s operating systems and enters Isolation (IS) mode. ETCS provides neither protection nor supervision (including emergency brake intervention) in IS mode. The ETCS onboard equipment can only be brought out of IS mode by a maintenance technician.

4.3.7.2 The use of a back-up speedometer in IS mode is described in the Operational Concept [1].

4.3.8 **Non-Leading**

4.3.8.1 An ETCS-fitted train or locomotive is in Non-Leading (NL) mode when all of the following are true. The ETCS-fitted train or locomotive:

a) Is mechanically, but not electrically, coupled with another vehicle

b) Is not the leading vehicle

c) Is providing tractive effort

d) Is controlled by a driver.

4.3.8.2 In NL the ETCS onboard equipment provides no active supervision, as this is provided by a different ETCS onboard equipment in the train.

4.3.9 **Trip**

4.3.9.1 If the ETCS onboard equipment determines that the train has exceeded its permitted MA, it applies the emergency brakes and enters Trip (TR) mode. To exit TR mode, the driver needs to acknowledge that the train has been tripped. A continuous emergency brake demand is made in TR mode.

\(^{10}\) RV and PT will also technically allow a reverse movement if allowed by the trackside application design, but this is not planned to be implemented in GB.
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4.3.10 Post-Trip
4.3.10.1 The ETCS onboard equipment enters Post-Trip (PT) mode when TR mode is acknowledged by the driver and, in GB, the train is at a stand. The emergency brake demand is released in PT mode.

4.3.11 Sleeping
4.3.11.1 A train, or locomotive, may have more than one set of ETCS onboard equipment. When one set is active, all other sets are in Sleeping (SL) mode.

4.3.11.2 In SL, the ETCS onboard equipment provides no active supervision, as this is provided by a different ETCS onboard equipment in the train.

4.3.12 Standby
4.3.12.1 This is the default mode of the active ETCS onboard equipment. The equipment is in Standby (SB) mode waiting to be activated into another mode.

4.3.13 System Failure
4.3.13.1 If the ETCS onboard equipment detects an ETCS failure, it enters System Failure (SF) mode. A continuous emergency brake demand is made in SF mode.

4.3.13.2 To exit SF the onboard equipment has to enter IS or NP.

4.3.14 Reversing
4.3.14.1 Reversing (RV) mode can be used for emergency egress (for example, from a tunnel) where permitted by trackside design. The driver can remain in what was previously the leading cab. This will not be used in the GB application.

4.3.15 No Power
4.3.15.1 Where there is no power applied to the ETCS onboard equipment, it is in No Power (NP) mode. A continuous emergency brake demand is made in NP mode.

4.3.16 STM European
4.3.16.1 STM European (SE) mode permits the use of national train protection equipment. The ETCS onboard equipment processes the information from the trackside national train protection equipment and converts this to a form equivalent to ETCS information and presents this to the driver. This mode is not planned to be used in GB and will not be available in future versions of the SRS.

4.3.17 STM National
4.3.17.1 STM National (SN) mode permits the use of national train protection equipment. The ETCS onboard equipment is used to provide controls and indications for the national train protection equipment on the ETCS DMI.

4.4 ETCS Protection Functions
4.4.1 Overview
4.4.1.1 ETCS provides a number of protection functions, not all of which are provided in every Application Level or Operating Mode. These are briefly described below.

4.4.2 Data Consistency
4.4.2.1 When operating, ETCS equipment assumes that the geographical data (that is, line speeds, distances, section timers) are correct. This data has to be checked for accuracy when it is entered into the ETCS equipment. However, the ETCS onboard equipment is able to perform certain data consistency checks. These include:
ETCS System Description

a) Linking. ETCS is able to check that messages from balise groups are received at the location where they are expected, if the balise groups are linked. The ETCS trackside equipment can send a list of balise groups and their location that a train will pass in the course of its journey. Should a balise group not be read, or be read in the wrong location, then ETCS can be configured to bring the train to a stand. This process is known as linking, and such balise groups are identified as part of this linked sequence. These balise groups are subsequently known as linked balise groups.

b) Message consistency. In some instances, if the messages received are not as expected (for example, data has been received for trains travelling in the opposite direction to one being travelled) then the ETCS onboard equipment can again be configured to bring the train to a stand.

4.4.3 Determine Train Speed and Location

4.4.3.1 The ETCS onboard equipment is able to determine its location and speed and report these to the ETCS trackside equipment. Its position is always reported relative to a balise group, and the train takes into account the distance between the front of the train and the antenna. Accurate positioning of balise groups is important.

4.4.3.2 Speed is determined by the onboard speed monitoring equipment. The ETCS onboard equipment then supervises the train so that the train does not exceed a given speed profile. See 4.4.5, 4.4.7 and 4.4.8.

4.4.3.3 Neither the train’s odometry nor the location of a particular balise group will be 100% accurate. This means that the estimated position of the train will not always be the same as the actual location of the train on the ground. When estimating its position, the train will either:

a) Under-read, that is, estimate that it has travelled less far forward than it really has, or

b) Over-read, that is, estimate that it has travelled further forward than it really has.

4.4.3.4 When necessary, for safety related reasons, the train utilises the worst case odometry error.

4.4.3.5 In order to manage inaccuracies in train odometry, the ETCS onboard equipment calculates a tolerance window either side of the estimated position of the train.

4.4.3.6 The furthest forward that the front of the train could be, with maximum under-reading error, is called the maximum safe front end. Similarly, the furthest forward that the rear of the train could be is called the maximum safe rear end. This is illustrated in Figure 8.

4.4.3.7 The furthest back that the front of the train could be, with maximum over-reading error, is called the minimum safe front end. Similarly, the furthest back that the rear of the train could be is called the minimum safe rear end. This is also illustrated in Figure 8.
4.4.4 Managing Movement Authority

4.4.4.1 An ETCS-fitted train manages MAs when it is in FS mode or OS mode. Managing the train’s MA means that the ETCS onboard equipment determines the train’s location relative to what is known as the End of Authority (EOA), and the Supervised Location (SvL). The SvL is one of either the: EOA, the Danger Point (DP) or the overlap (OL). The EOA, DP and OL are parameters that are passed to the ETCS onboard equipment by the ETCS trackside equipment as part of the MA. They correspond to trackside positions as shown in Figure 9.

Figure 9 – Movement Authority Locations

4.4.4.2 The EOA is the location that the train has permission to move towards. This location is always provided in an MA. It is often, though not always, marked with a signal or block marker as shown. It is at this location that the train is expected to come to a stand. It is also expected that the train will not pass the EOA. Should the train exceed the EOA, the ETCS onboard equipment will enter TR mode and automatically apply the train’s emergency brakes until the train has come to a stand.

4.4.4.3 The DP is a location further ahead of the EOA, where it is possible, if other events occurred, that the train could collide with another vehicle or derail. In the
figure shown, this is equivalent to the fouling point of the set of points. Not every MA will be provided with a DP as, in the case of plain line, it is meaningless.

4.4.4.4 At a further distance, is the OL. It is optional to have an OL as part of an MA. Where an OL is provided in an MA, a timer can optionally be associated with it, in this instance the train relinquishes its right to use this section of the route when the appropriate conditions are met. This can provide the opportunity for the interlocking overlap to be released in the interlocking, thereby allowing it to be used for another train. For example, in Figure 9, the release of the interlocking overlap for use by train 1 would enable the interlocking overlap track section to be used by a route over the cross-over for train 2.

4.4.4.5 Using the EOA, DP and OL, the ETCS onboard equipment determines the SvL. It is the SvL that is used by the ETCS onboard equipment as the location that the train is absolutely prevented from passing. The SvL is determined as:

a) The OL (if any and before any time-out)

b) If not, the DP, if any

c) If not, the EOA.

4.4.4.6 This document will talk primarily about the EOA and the SvL, but note from the bullet points above, that in some instances, this could be the same location.

4.4.4.7 The ETCS onboard equipment will estimate the distance to travel before reaching the EOA based on its estimated position and the known location of the EOA. Due to inaccuracies in odometry, the estimated distance to the EOA will not necessarily be the same as the actual distance to the EOA. This is illustrated in Figure 10.

![Figure 10 – Estimated EOA Positions](image)

4.4.4.8 As with the EOA the estimated distance to the SvL will not be the same as the actual distance to the SvL. In order to ensure that the train never exceeds the actual SvL, the ETCS onboard equipment assumes worst case under-reading odometry error (that is, it supervises the train based on the maximum safe front end). The ‘assumed’ distance to the SvL, that is, the one the train supervises to, is therefore on the approach to the actual SvL.
4.4.4.9 On the other hand, the EOA is supervised assuming no odometry error, as this location is not as critical as the SvL. The supervision against the ‘assumed’ location for the EOA therefore matches the train’s estimated EOA location.

4.4.4.10 As an example, consider the following:

a) A train that passed a balise group in the last 100 m

b) The location of that balise group is known to an accuracy of ± 5 m

c) The train’s odometry is accurate to ± (5 m + 5%) of distance travelled since balise group. Note: the fixed ± 5 m tolerance is intended to cover the longitudinal uncertainty of the balise reader in detecting the balise reference location.

4.4.4.11 The calculated odometry error will be ± (5 m + 5 m + 5% of 100 m), that is, ± 15 m. The worst case under-reading odometry error will, therefore, be 15 m. However, the actual odometry error could be under-reading by only 2 m. Figure 11 shows the relationship between the actual locations and the assumed locations for both the EOA and the SvL.

4.4.4.12 For an explanation of the abbreviations EBI, SBI, W and P see 4.4.6.1.

---

**Figure 11 – Example Handling of Odometry Under-reading Error**
4.4.4.13 Figure 12 shows the same situation, but with an over-reading error of 2 m.

![Figure 12 – Example Handling of Odometry Over-reading Error](image)

4.4.4.14 It can be seen that:

a) In neither case does the assumed location of the EOA match the actual location of the EOA on the ground nor does the assumed location of the SvL match the actual location of the SvL on the ground

b) The assumed SvL will never be beyond the actual SvL, even for a worst-case under-reading error; it uses the maximum safe front end of the train

c) For an under-reading error, the assumed EOA will be beyond the actual EOA

d) For an over-reading error, the assumed EOA will be on the approach to the actual EOA

e) The resultant effect is to bring the assumed EOA and assumed SvL closer together by a value equal to the calculated worst-case odometry error.

4.4.4.15 However, if the distance between the EOA and SvL is sufficiently small and the calculated odometry error is sufficiently large, the ETCS onboard equipment will find that the assumed SvL is nearer the train than the assumed EOA. In this case, the train will ensure that all speed limits are calculated down to the assumed SvL. This clearly reduces operational flexibility as the train may be unable to reach the actual EOA and any corresponding signal or block marker. To overcome this, the interlocking overlap needs to be sufficiently large to take into account odometry error. Also, sufficient balise groups need to be placed on the approach to stopping locations so that the odometry error is minimised. The interlocking overlap length and number of balise groups will be determined based on the performance requirements of the scheme design.

4.4.4.16 For performance reasons, especially to improve capacity at operationally critical locations, a balise group can be used to improve a train’s position information by minimising its odometry error.
4.4.5 Determine Most Restrictive Speed Profile (MRSP)

4.4.5.1 The ETCS onboard equipment supervises the speed of the train. These restrictions will be against the lower of one or more of the following according to the Operating Mode of the ETCS onboard equipment:

a) Static Speed Profile (SSP). This is the linespeed of the infrastructure, including differential speed limits for particular train types, where applicable.

b) Axle-load Speed Profile (ASP). This is the axle-load specific speed limit of the infrastructure. The train needs to have an axle loading value stored onboard for this to be effective.

c) Temporary Speed Restrictions (TSRs). ETCS will supervise against TSRs.

d) Signalling related speed restriction. This applies to Application Level 1 only and is principally used in speed-signalling applications. The linespeed at the current signal is transmitted to the train.

e) Operating Mode speed limit. Certain Operating Modes have ceiling speeds and some of these Operating Modes are unable to supervise against the SSP. This makes these ceiling speed limits the principal means of speed supervision when driving in these Operating Modes. They are therefore typically much lower values than normal linespeeds.

f) Train-related speed restriction. This value is held by the train and entered by the driver at the start of the journey. Its value typically depends on the class of train, the load being hauled and any operating restrictions (for example, brakes out of service, broken window).

4.4.6 Train Speed Supervision

4.4.6.1 To supervise the train’s speed, the ETCS onboard equipment determines a series of supervision limits. There are four that apply at an increasing speed value and are described as follows:

a) The Permitted speed, or ‘P’ limit, which represents the speed that the train should not exceed. It is this speed limit that is indicated to the driver on the DMI.

b) The warning, or ‘W’ limit, which generates a warning to the driver should the train speed exceed it. This limit is calculated onboard the train so that it is lower than the Service Brake Intervention limit.

c) The Service Brake Intervention (SBI) limit which, if exceeded, results in the train’s service brakes being applied until the train speed is lower than the permitted speed. The GB application of ETCS will use the train’s service brake as the first means of train protection. Should the service brake fail to slow the train as intended, then the train’s emergency brakes will be applied.

d) The Emergency Brake Intervention (EBI) limit, which if exceeded, results in the train’s emergency brakes being applied. The GB application of ETCS will not release the emergency brakes until the train has come to a stand.

4.4.6.2 In the case of an intervention, the train attempts to provide supervision through brake application and, providing the EBI is not exceeded, control is immediately given back to the driver when the actual speed is below the permitted speed. This is not to be confused with a trip which occurs only when the end of authority is exceeded (see 4.4.4.2).
4.4.6.3 There are three forms of train speed supervision in ETCS, namely:

a) Ceiling Speed Monitoring

b) Target Speed Monitoring

c) Release Speed Monitoring.

4.4.7 Ceiling Speed Monitoring

4.4.7.1 Ceiling Speed monitoring is the speed supervision used by the ETCS onboard equipment when it determines that its speed profile is constant. There are fixed margins between the four supervision limits described above.

4.4.8 Target Speed Monitoring

4.4.8.1 Target speed monitoring is when the speed is dynamically supervised as the train approaches a lower Target Speed (for example, to a more restrictive linespeed or zero at the end of the distance within which the train has permission to run).

4.4.8.2 Target speed monitoring is available in FS, OS, SR and UN modes only, as set out below:

a) FS and OS modes. Target speed monitoring is applied whenever the train is approaching a lower target speed or EOA. In these modes, track gradients are taken into account

b) SR mode. Target speed monitoring is applied down to a zero speed on the approach to the distance limit that the train is permitted to move. In this mode, track gradients are not taken into account

c) UN mode. Target speed monitoring is applied on the approach to TSRs only, supervising the train down to the lower TSR speed. In this mode, track gradients are not taken into account.

4.4.8.3 Where the speed is dynamically monitored to a lower (non-zero) Target Speed, the supervision limits are calculated on board such that the train is supervised down to the lower speed. The P, W, SBI and EBI limits in the target speed monitoring section are calculated to intersect their values within the new ceiling speed monitoring section. For all curves, the worst-case odometry value is taken into account; in other words, the maximum safe front end of the train is used as the start of the lower target speed.

4.4.8.4 These intervention limits are shown in Figure 13.
4.4.8.5 Where the speed is dynamically monitored to a zero Target Speed (that is, an EOA), the supervision limits are calculated on board such that the train is supervised down to the zero speed as follows:

a) The P, W and SBI limits are calculated onboard to ensure that the train does not exceed the EOA. The service brake is applied should the SBI limit be exceeded. Exceeding the EOA would be classed as a SPAD. The SBI limit is calculated onboard the train so that once exceeded, the train’s service brakes will be able to bring the train to a stand before the EOA.

b) The EBI limit is calculated onboard such that the train will not exceed the SvL (which is either the end of an OL, a DP or the EOA), through the application of the emergency brake. The calculations will take into account the time taken to cut off the traction power (if this has not already happened) and the time taken for the full emergency brake effort to be applied.

4.4.8.6 These intervention limits are shown in Figure 14. It shows the SvL at a distance ahead of the EOA, that is, at a DP or OL.
4.4.9 Release Speed Monitoring

4.4.9.1 An over-reading odometry error could actually prevent a train from reaching the signal or block marker placed at the EOA. To overcome this, ETCS can change how it supervises the train on the approach to the EOA through the provision of a release speed.

4.4.9.2 Under release speed monitoring, a train is permitted to pass the estimated location of the EOA at a speed no greater than the release speed. Should the minimum safe front end of the train pass the estimated location of the EOA, the ETCS onboard equipment transitions to TR mode. This is because the ETCS onboard equipment can be sure that the front of the train has passed the actual location of the EOA when the minimum safe front end has passed the estimated location of the EOA.

4.4.9.3 The release speed is carefully determined such that, having entered TR mode, a train can be relied on to stop before the SvL. The release speed can either be:

a) Transmitted to the ETCS onboard equipment by the ETCS trackside equipment, or

b) Calculated by the ETCS onboard equipment, based on the separation between the EOA and SvL, taking due account of the worst-case odometry error.

4.4.9.4 Application design will determine whether the release speed is transmitted from the trackside or whether the ETCS onboard equipment should calculate it.

4.4.9.5 Normally the release speed will be calculated onboard so that the train will use its own braking model to determine the release speed such that it can stop before the SvL. However, a trackside release speed can be advantageous in the following cases:

a) To avoid a release speed that is operationally too high because an SvL is some distance from its EOA (and in extremis the release speed if calculated onboard could be as high as the permissible line speed), and
ETCS System Description

b) To allow a train to have a very close approach to buffer stops when the consequences of minor odometry error (within the tolerances SRS) would otherwise prevent this.

4.4.10 Supervise Train Movements

4.4.10.1 In certain Operating Modes, the train can be prevented from moving in a direction which is not intended. These include the following:

a) Backwards distance monitoring, which limits the distance that a train can reverse in RV mode or PT mode. For the GB application, this is set to 0 m

b) Roll away protection limits the distance that the train can move if the train movement conflicts with the current position of the train’s direction controller. If the controller is in neutral position, this protection will prevent forward and reverse movements. For the GB application, this is set to 2 m

c) Reverse movement protection limits the distance the train can move against the permitted direction of travel. The permitted movement direction of travel is the current MA. For the GB application, this is set to 2 m

d) Standstill supervision limits the distance the train can move where it has no authority to move. For the GB application, this is set to 2 m

e) Balise group lists can be used in both SR and SH modes, whereby a list of balise groups that a train may overpass is provided to the train. If a balise group not in that list is passed, then the ETCS onboard equipment applies the emergency brakes

f) A STOP message can be sent from a balise group that will cause a train in either SR or SH modes to stop if it is in that mode. The ETCS onboard equipment applies the emergency brakes. If the ETCS onboard equipment is in an Operating Mode other than SR or SH, then the message is ignored

g) The emergency brakes are automatically applied when the ETCS onboard equipment is in NP, TR and SF modes, preventing the train from moving.

4.4.11 Other functions

4.4.11.1 There are several other miscellaneous functions that ETCS provides. The important functions are described below.

a) Override. It is possible for the driver to temporarily override the speed and distance supervision provided by ETCS. This function limits the distance and time that the train can be driven without such supervision. If the train were in FS or OS mode and the override function is activated, the train exits these modes and enters SR Mode. Special operating rules then apply

b) Track Condition. The ETCS trackside equipment is able to inform the ETCS onboard equipment about certain track conditions that will affect the train. These can range from large metal objects (that could interfere with the balise reader causing the train to come to a stand), radio black holes and non-stopping locations

c) Juridical Data. In all Operating Modes (excepting NP and IS), the ETCS onboard equipment is continuously recording data which can be analysed in the event of an accident or incident

d) Text messages can be sent from the trackside equipment for display on the DMI. It is possible to make the display of the message appear only when the train is between defined locations on the track.
4.5 ETCS Data

4.5.1 Overview

4.5.1.1 ETCS is a data-driven system. While the ETCS trackside equipment and ETCS onboard equipment are able to perform checks that the transmission process has not corrupted the data, they both assume that the basic underlying data is correct and up-to-date. It is not able to check that a particular linespeed value is correct, or that a gradient is uphill rather than downhill, nor that the distance to the EOA is as indicated.

4.5.1.2 It is of the utmost importance that the data held by both the ETCS trackside equipment and ETCS onboard equipment is correct and up-to-date. This requires robust procedures to ensure:

a) Raw information is measured accurately
b) Raw data is transposed accurately into a form used by ETCS equipment
c) Transposed data is correctly entered into ETCS equipment
d) Data is stored securely with appropriate safeguards, change control and records management
e) Changes to infrastructure are promptly reflected in the data held by ETCS equipment.

4.5.1.3 Any changes to the infrastructure may also require the data to be revalidated. Consideration also needs to be given to how equipment will be maintained and correctly returned to service to ensure that the data it contains is still correct. Examples include replacing faulty ETCS equipment (trackside and onboard) and temporarily removing equipment to enable other maintenance work to take place.

4.5.1.4 Incorrect data within ETCS equipment is a major hazard and could easily lead to multiple fatalities. The appropriate procedures need to be adhered to when handling ETCS data, in either its raw or transposed form.

4.5.2 National and Default Values

4.5.2.1 Within ETCS, there is a group of data variables which are generally fixed for a specific region or country. The purpose of these variables therefore is to provide a uniform operational outcome to particular events.

4.5.2.2 These data variables are listed in Table 2. Each variable has a default value and can be assigned a national value. Where a national value is defined, this overrides the default value. Different sets of national values can be assigned within one country.

<table>
<thead>
<tr>
<th>National / Default Variable Name</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modification of adhesion factor by driver</td>
<td>Q_NVDRIVER_ADHES</td>
</tr>
<tr>
<td>Shunting mode (permitted) speed limit</td>
<td>V_NVSHUNT</td>
</tr>
<tr>
<td>Staff Responsible mode (permitted) speed limit</td>
<td>V_NVSTFF</td>
</tr>
<tr>
<td>On Sight mode (permitted) speed limit</td>
<td>V_NVONSIGHT</td>
</tr>
<tr>
<td>Unfitted mode (permitted) speed limit</td>
<td>V_NVUNFIT</td>
</tr>
<tr>
<td>Release Speed value</td>
<td>V_NVREL</td>
</tr>
</tbody>
</table>
### National / Default Variable Name

<table>
<thead>
<tr>
<th>Variable Description</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance to be used in Roll Away protection. Reverse movement protection and Standstill supervision</td>
<td>D_NVROLL</td>
</tr>
<tr>
<td>Use service brake when braking to a target</td>
<td>Q_NVSRBKTRG</td>
</tr>
<tr>
<td>Permission to release emergency brake</td>
<td>Q_NVEMRRLS</td>
</tr>
<tr>
<td>Maximum speed for triggering the override end of authority function</td>
<td>V_NVALLOWOVTRP</td>
</tr>
<tr>
<td>Permitted speed limit to be supervised when the ‘override EOA’ function is active</td>
<td>V_NVSUPOVTRP</td>
</tr>
<tr>
<td>Distance for train trip suppression when override end of authority function is triggered</td>
<td>D_NVOVTRP</td>
</tr>
<tr>
<td>Maximum time for train trip suppression when override end of authority function is triggered</td>
<td>T_NVOVTRP</td>
</tr>
<tr>
<td>Change of driver ID permitted while running</td>
<td>M_NVDERUN</td>
</tr>
<tr>
<td>System reaction if radio channel monitoring time limit expires (T-Contact)</td>
<td>M_NVCONTACT</td>
</tr>
<tr>
<td>Maximum time since creation in the RBC of last received telegram</td>
<td>T_NVCONTACT</td>
</tr>
<tr>
<td>Distance to be allowed for reversing in Post-Trip mode</td>
<td>D_NVPOTRP</td>
</tr>
<tr>
<td>Maximum permitted distance to run in Staff Responsible mode</td>
<td>D_NVSTFF</td>
</tr>
</tbody>
</table>

| Table 2 – List of National / Default Variables |

RSSB commissioned a study to identify what these values should be for GB. The objective of the project was to identify the baseline national parameters and their optimum value. This resulting report also contains the rationale for the selection of a particular value for each variable. It is planned for the national values to be specified in a future standard.

### Signalling Principles

#### 4.6 Overview

**4.6.1.1** ETCS forms part of a signalling system. Therefore, it plays its part in ensuring that the four fundamental principles of signalling are upheld. These four principles are as follows.

- **a)** Safe spacing. A train is given a route that is clear of other trains; it will not run into the rear of another train or vehicle

- **b)** No excess speed. A train will operate within the speed limits currently in force for the route and the train

- **c)** Route holding. The route, once given to a train, is not revoked or altered without some form of assurance that the train is not to make use of the route, or has finished using that route

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11 Mr. J.D. Mills presented a paper to the IRSE [7], in which he proposed three signalling principles. In 1985 Mr. T.M. George added a fourth principle. [8]
d) No conflicting moves. The route offered to a train is clear of any other route offered to other trains.

4.6.1.2 The degree to which ETCS upholds each of these principles is dependent on the Application Level and Operating Mode. The following sections describe how ETCS upholds these signalling principles assuming the train is being fully supervised by ETCS. Other operational movements, degraded and emergency working will be different.

4.6.2 Safe Spacing
4.6.2.1 For a non-permissive route, a train is given a route that is clear of other trains; it will not run into the rear of another train or vehicle.

4.6.2.2 Non-permissive and permissive routes are set, locked and detected by the interlocking. The ETCS trackside equipment issues MAs to trains that are consistent with the routes that are set, locked and detected by the interlocking. This MA tells the train how far it has permission to travel. The ETCS onboard equipment then supervises train speed to ensure that the train does not exceed this distance. The ETCS onboard equipment calculates the point at which the brakes need to be applied to ensure that the EOA is not exceeded. If the driver fails to control the train correctly (such that the EOA would be exceeded), the ETCS onboard equipment automatically applies the brakes.

4.6.3 No Excess Speed
4.6.3.1 A train will operate within the speed limits currently in force for the route and the train.

4.6.3.2 ETCS applies the principle of no excess speed through ensuring the train remains at or below the Most Restrictive Speed Profile.

4.6.4 Route Holding
4.6.4.1 The route, once given to a train, is not revoked or altered without some form of assurance that the train is not to make use of the route, or has finished using that route.

4.6.4.2 Route holding continues to be provided by the interlocking alone. Once an MA has been issued for a route, the interlocking cannot release that route until it has obtained assurance that the MA has been either used or revoked.

4.6.4.3 ETCS provides a means to co-operatively release routes in advance of a train if the ETCS onboard equipment can confirm to the trackside that moving the EOA nearer to the train (the practical result of wanting to revoke a route ahead of a train) would not result in the train automatically applying the brakes due to its proximity to the new EOA.

4.6.4.4 Train operated route release is unaffected by ETCS (it continues to be triggered by a sequence of train detection state changes).

4.6.5 No Conflicting Moves
4.6.5.1 The route offered to a train is clear of any other route offered to other trains.

4.6.5.2 The interlocking alone will continue to apply this principle and ETCS has no affect on it.

4.6.6 Signalling Principles Supervision by ETCS
4.6.6.1 Table 3 sets out how the Signalling Principles are upheld in Level 0. Table 4 sets out how the Signalling Principles are upheld in Level 2 without lineside signals.
## ETCS System Description

<table>
<thead>
<tr>
<th>Operating Mode</th>
<th>Signalling Principles – Level 0</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Safe Spacing</td>
<td>No Excess Speed</td>
</tr>
<tr>
<td>FS</td>
<td></td>
<td>This mode is not available in Level 0</td>
</tr>
<tr>
<td>QS</td>
<td></td>
<td>This mode is not available in Level 0</td>
</tr>
<tr>
<td>SR</td>
<td></td>
<td>This mode is not available in Level 0</td>
</tr>
</tbody>
</table>

**SH**
- Route set by the interlocking or manually by a shunter
- Authority to move, consistent with the route set, confirmed verbally to driver by signaler
- Driver to drive train in accordance with signaler’s instructions
- Enforced by the driver being prepared to stop short of any obstruction, or Limit of Shunt board

**UN**
- Route set, locked and detected by the interlocking
- Conventional signalling system provides an MA to the driver consistent with the route that is set, locked and detected by the interlocking.
- Enforced by the driver driving within the limits of the MA and by any heritage train protection systems

### Safe Spacing
- Supervised by ETCS to the lower of the National Value, train speed and ETCS SH ceiling speed
- Enforced by the driver observing existing line speed information
- Driver prepared to stop short of any obstruction, or Limit of Shunt board

### No Excess Speed
- Provided by the interlocking only where interlocking controls such movements
- Provided by the shunter only where the shunter controls such movements

### Route Holding
- Provided by the interlocking only where interlocking controls such movements
- Provided by the shunter only where the shunter controls such movements

### No Conflicting Moves
- Provided by the interlocking only
- Provided by the interlocking only
### Table 3 – Signalling Principles enforced by Operating Mode in Level 0

<table>
<thead>
<tr>
<th>Operating Mode</th>
<th>Safe Spacing</th>
<th>No Excess Speed</th>
<th>Route Holding</th>
<th>No Conflicting Moves</th>
</tr>
</thead>
</table>
| **IS**         | - Route set, locked and detected by the interlocking  
          - Conventional signalling system provides an MA to the diver consistent with the route that is set, locked and detected by the interlocking.  
          - Enforced by the driver driving within the limits of the MA and by any heritage train protection systems | - Enforced by the driver observing existing line speed information | - Provided by the interlocking only | - Provided by the interlocking only |
| **NL**         | - Not applicable – see operating mode of leading vehicle | - Not applicable – see operating mode of leading vehicle | - Not applicable see operating mode of leading vehicle | - Not applicable – see operating mode of leading vehicle |
| **TR**         | - This mode is not available in Level 0 | - This mode is not available in Level 0 | - | - |
| **PT**         | - This mode is not available in Level 0 | - This mode is not available in Level 0 | - | - |
| **SL**         | - Not applicable – see operating mode of leading vehicle | - Not applicable – see operating mode of leading vehicle | - Not applicable – see operating mode of leading vehicle | - Not applicable – see operating mode of leading vehicle |
| **SB**         | - Not required – train has no authority to move  
          - ETCS prevents train movement | - ETCS prevents train movement | - Not required – train has no authority to move | - Not required – train has no authority to move |
| **SF**         | - Provided by the interlocking  
          - ETCS commands the emergency brake | - ETCS commands the emergency brake | - Not required – train has no authority to move | - Not required – train has no authority to move |
| **RV**         | - This mode is not available in Level 0 | - This mode is not available in Level 0 | - | - |
| **NP**         | - Not required – train has no authority to move  
          - ETCS commands the emergency brake | - ETCS commands the emergency brake | - Not required – train has no authority to move | - Not required – train has no authority to move |
| **SE**         | - This mode is not available in Level 0 | - This mode is not available in Level 0 | - | - |
| **SN**         | - This mode is not available in Level 0 | - This mode is not available in Level 0 | - | - |
## ETCS System Description

### Operating Mode

<table>
<thead>
<tr>
<th>Safe Spacing</th>
<th>Signalling Principles – Level 2 without lineside signals</th>
<th>No Excess Speed</th>
<th>Route Holding</th>
<th>No Conflicting Moves</th>
</tr>
</thead>
</table>
| FS           | - Non-permissive route set, locked and detected by the interlocking  
- The ETCS trackside equipment provides an MA to the ETCS onboard equipment consistent with the route that is set, locked and detected by the interlocking  
- Managed by the driver observing the distance to go on the DMI  
- Supervised by ETCS preventing the train exceeding the SvL  
- Under low adhesion conditions, existing rules apply | - Supervised by ETCS to the MRSP, including under release speed monitoring  
- Managed by the driver observing permitted speed on DMI  
- Managed by driver when display shows "ENTRY IN FULL SUPERVISION"  
- Managed by driver when approaching EOA when operating with a release speed | - Provided by the interlocking only  
- ETCS may use timers for the OL in the MA when the interlocking uses timers to release the interlocking overlap  
- ETCS may report the train has come to a stand and inform the interlocking to release the interlocking overlap and/or permit another train into the section where permissive moves are planned  
- ETCS may permit early release of routes through co-operative revocation of MA | - Provided by the interlocking only  
- The ETCS trackside equipment provides an MA to the ETCS onboard equipment consistent with the route that is set, locked and detected by the interlocking |
| OS           | - Permissive or non-permissive route set, locked and detected by the interlocking  
- The ETCS trackside equipment provides an MA to the ETCS onboard equipment consistent with the route that is set, locked and detected within interlocking  
- Managed by the driver observing the distance to go on the DMI  
- Supervised by ETCS preventing the train exceeding the SvL  
- Driver prepared to stop within distance the driver can see to be clear  
- Under low adhesion conditions, existing rules apply | - Supervised by ETCS to the MRSP, including under release speed monitoring  
- Managed by driver when display shows "ENTRY IN ON SIGHT"  
- Driver prepared to stop within distance the driver can see to be clear  
- Managed by driver when approaching EOA when operating with a release speed | - Provided by the interlocking only  
- ETCS may report the train has come to a stand and inform the interlocking to permit another train into the section where permissive moves are planned  
- ETCS may permit early release of routes through co-operative revocation of MA | - Provided by the interlocking only  
- The ETCS trackside equipment provides an MA to the ETCS onboard equipment consistent with the route that is set, locked and detected within interlocking |
### ETCS System Description

#### Operating Mode

<table>
<thead>
<tr>
<th>Safe Spacing</th>
<th>No Excess Speed</th>
<th>Route Holding</th>
<th>No Conflicting Moves</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SR</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Route set by the interlocking or manually by signaller</td>
<td>Supervised by ETCS to the lower of the National Value (SR speed) and train speed</td>
<td>Provided by the interlocking or manually by signaller</td>
<td>Provided by the interlocking or manually by signaller</td>
</tr>
<tr>
<td>Authority to move, consistent with the route set, confirmed through written order from the signaller</td>
<td>Managed by the driver observing any signs and route knowledge</td>
<td>Confirmed verbally to driver by signaller</td>
<td>Confirmed verbally to driver by signaller</td>
</tr>
<tr>
<td>Driver to drive train in accordance with signaller's instructions</td>
<td>Supervised TSRs (if provided)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Movements bounded by a balise group (enforced by providing a list of balise groups that a train may pass, or by a balise group commanding a train to stop if in SR mode)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Route set by the interlocking or manually by a shunter</td>
<td>Supervised by ETCS to the lower of the National value, train speed and ETCS SH speed limit</td>
<td>Provided by the interlocking only where interlocking holds such routes</td>
<td>Provided by the interlocking only where interlocking controls such routes</td>
</tr>
<tr>
<td>Authority to move, consistent with the route set, confirmed verbally to driver by signaller</td>
<td>Enforced by the driver observing operating rules</td>
<td>Provided by the shunter only where the shunter controls such routes movements</td>
<td>Provided by the shunter only where the shunter controls such movements</td>
</tr>
<tr>
<td>Driver to drive train in accordance with signaller's instructions</td>
<td>Driver prepared to stop short of any obstruction, block markers or stop boards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enforced by the driver being prepared to stop short of any obstruction, block markers or stop boards</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shunting movements bounded by a balise group (enforced by providing a list of balise groups that a train may pass, or by a balise group commanding a train to stop if in SH mode)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This mode is not available in Level 2</td>
<td>Managed by the driver observing any signs and route knowledge</td>
<td>Provided by the interlocking or manually by signaller</td>
<td>Provided by the interlocking or manually by signaller</td>
</tr>
<tr>
<td>IS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Route set by the interlocking or manually by signaller</td>
<td>Managed by the driver observing any signs and route knowledge</td>
<td>Provided by the interlocking or manually by signaller</td>
<td>Provided by the interlocking or manually by signaller</td>
</tr>
<tr>
<td>Authority to move, consistent with the route set, confirmed to driver through written order from the signaller</td>
<td>Confirmed verbally to driver by signaller</td>
<td>Confirmed verbally to driver by signaller</td>
<td>Confirmed verbally to driver by signaller</td>
</tr>
<tr>
<td>Driver to drive train in accordance with signaller's instructions</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Document withdrawn with effect from 05/03/2016
### ETCS System Description

#### Signalling Principles – Level 2 without lineside signals

<table>
<thead>
<tr>
<th>Operating Mode</th>
<th>Safe Spacing</th>
<th>No Excess Speed</th>
<th>Route Holding</th>
<th>No Conflicting Moves</th>
</tr>
</thead>
<tbody>
<tr>
<td>NL</td>
<td>Not applicable – see operating mode of leading vehicle</td>
<td>Not applicable – see operating mode of leading vehicle.</td>
<td>Not applicable – see operating mode of leading vehicle.</td>
<td>Not applicable – see operating mode of leading vehicle.</td>
</tr>
<tr>
<td>TR</td>
<td>Provided in accordance with mode prior to entering TR. Enforced by ETCS commanding the emergency brake</td>
<td>ETCS commands the emergency brake</td>
<td>Provided in accordance with mode prior to entering TR</td>
<td>Provided in accordance with mode prior to entering TR</td>
</tr>
<tr>
<td>PT</td>
<td>GB application of ETCS does not permit the train to move (National Value)</td>
<td>GB application of ETCS does not permit the train to move (National Value)</td>
<td>Provided in accordance with mode prior to entering PT</td>
<td>Provided in accordance with mode prior to entering PT</td>
</tr>
<tr>
<td>SL</td>
<td>Not applicable – see operating mode of leading vehicle</td>
<td>Not applicable – see operating mode of leading vehicle.</td>
<td>Not applicable – see operating mode of leading vehicle.</td>
<td>Not applicable – see operating mode of leading vehicle.</td>
</tr>
<tr>
<td>SB</td>
<td>Not required – train has no authority to move. ETCS prevents train movement</td>
<td>ETCS prevents train movement</td>
<td>Not required – train has no authority to move</td>
<td>Not required – train has no authority to move</td>
</tr>
<tr>
<td>SF</td>
<td>Provided by the interlocking. ETCS commands the emergency brake</td>
<td>ETCS commands the emergency brake</td>
<td>Not required – train has no authority to move</td>
<td>Not required – train has no authority to move</td>
</tr>
<tr>
<td>RV</td>
<td>This mode is not used in the GB application of ETCS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NP</td>
<td>Not required – train has no authority to move. ETCS commands the emergency brake</td>
<td>ETCS commands the emergency brake</td>
<td>Not required – train has no authority to move</td>
<td>Not required – train has no authority to move</td>
</tr>
<tr>
<td>SE</td>
<td>This mode is not available in Level 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SN</td>
<td>This mode is not available in Level 2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 4 – Signalling Principles enforced by Operating Mode in Level 2 signalling**
ETCS System Description

Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASP</td>
<td>Axle-load Speed Profile</td>
</tr>
<tr>
<td>ATP</td>
<td>Automatic Train Protection</td>
</tr>
<tr>
<td>AWS</td>
<td>Automatic Warning System</td>
</tr>
<tr>
<td>DMI</td>
<td>Driver Machine Interface</td>
</tr>
<tr>
<td>DP</td>
<td>Danger Point</td>
</tr>
<tr>
<td>EBI</td>
<td>Emergency Brake Intervention</td>
</tr>
<tr>
<td>EOA</td>
<td>End Of Authority</td>
</tr>
<tr>
<td>EOR</td>
<td>European Operating Rules</td>
</tr>
<tr>
<td>ERTMS</td>
<td>European Rail Traffic Management Systems</td>
</tr>
<tr>
<td>ESR</td>
<td>Emergency Speed Restriction</td>
</tr>
<tr>
<td>ETCS</td>
<td>European Train Control System</td>
</tr>
<tr>
<td>ETML</td>
<td>European Traffic Management Layer</td>
</tr>
<tr>
<td>EVC</td>
<td>European Vital Computer</td>
</tr>
<tr>
<td>FS</td>
<td>Full Supervision</td>
</tr>
<tr>
<td>GB</td>
<td>Great Britain</td>
</tr>
<tr>
<td>GN</td>
<td>Guidance Note</td>
</tr>
<tr>
<td>GSM-R</td>
<td>Global System for Mobile communications – Railways</td>
</tr>
<tr>
<td>ID</td>
<td>Identity</td>
</tr>
<tr>
<td>IRSE</td>
<td>Institute of Railway Signal Engineers</td>
</tr>
<tr>
<td>IS</td>
<td>Isolation</td>
</tr>
<tr>
<td>JRU</td>
<td>Juridical Recorder Unit</td>
</tr>
<tr>
<td>MA</td>
<td>Movement Authority</td>
</tr>
<tr>
<td>MRSP</td>
<td>Most Restrictive Speed Profile</td>
</tr>
<tr>
<td>NL</td>
<td>Non-Leading</td>
</tr>
<tr>
<td>NP</td>
<td>No Power</td>
</tr>
<tr>
<td>OS</td>
<td>On Sight</td>
</tr>
<tr>
<td>P</td>
<td>Permitted (speed profile)</td>
</tr>
<tr>
<td>PT</td>
<td>Post Trip</td>
</tr>
<tr>
<td>RBC</td>
<td>Radio Block Centre</td>
</tr>
<tr>
<td>RSSB</td>
<td>Rail Safety and Standards Board</td>
</tr>
<tr>
<td>RV</td>
<td>Reverse</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>SB</th>
<th>Stand By</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBI</td>
<td>Service Brake Intervention</td>
</tr>
<tr>
<td>SE</td>
<td>STM European</td>
</tr>
<tr>
<td>SF</td>
<td>System Failure</td>
</tr>
<tr>
<td>SH</td>
<td>Shunting</td>
</tr>
<tr>
<td>SL</td>
<td>Sleeping</td>
</tr>
<tr>
<td>SN</td>
<td>STM National</td>
</tr>
<tr>
<td>SPAD</td>
<td>Signal Passed At Danger</td>
</tr>
<tr>
<td>SR</td>
<td>Staff Responsible</td>
</tr>
<tr>
<td>SRS</td>
<td>System Requirements Specification</td>
</tr>
<tr>
<td>SSP</td>
<td>Static Speed Profile</td>
</tr>
<tr>
<td>STM</td>
<td>Specific Transmission Module</td>
</tr>
<tr>
<td>SvL</td>
<td>Supervised Location</td>
</tr>
<tr>
<td>TBD</td>
<td>To Be Determined</td>
</tr>
<tr>
<td>TIU</td>
<td>Train Interface Unit</td>
</tr>
<tr>
<td>TORR</td>
<td>Train-Operated Route Release</td>
</tr>
<tr>
<td>TPWS</td>
<td>Train Protection and Warning System</td>
</tr>
<tr>
<td>TR</td>
<td>Trip</td>
</tr>
<tr>
<td>TSR</td>
<td>Temporary Speed Restriction</td>
</tr>
<tr>
<td>UN</td>
<td>Unfitted</td>
</tr>
<tr>
<td>W</td>
<td>Warning (speed profile)</td>
</tr>
</tbody>
</table>
ETCS System Description

References

The Catalogue of Railway Group Standards and the Railway Group Standards CD-ROM give the current issue number and status of documents published by RSSB. This information is also available from www.rgsonline.co.uk.

Documents referenced in the text

[1] The British Application of ERTMS - The Operational Concept, Level 0 and Level 2 without Lineside Signals, RSSB-ERTMS-OC
[2] ERTMS/ETCS – Class 1 – System Requirements Specification, Subset-026 v2.3.0d
[3] ERTMS/ETCS – Class 1 – Performance Requirements for Interoperability, Subset-041 v2.1.0
[5] ERTMS/ETCS – Class 1 – FIS for the Train Interface, Subset-034 v2.0.0
[8] Update to figure 2 in Ref. [7], T.M. Green, 22nd August 1985