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ERTMS USERS GROUP - ENGINEERING GUIDELINE

23. Balise Engineering for L2 and L3

Ref:	23. Balise Engineering for L2 and L3
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Modification history

Version	Date	Modification / Description	Editor
0.1	10/12/15	First draft	PS
0.2	14/06/16	Modification after review of AB, SMc and AJM Structure modification	PS
0.8	17/12/18	Merged version after ESG71	DC
0.9	17/12/18	Clean version. Candidate for version 1.0	DC
1.0	10/01/19	Version 1.0	DC

Table of Contents

1 Introduction

1.1 Background

1.1.1.1 In ETCS Level 2 or 3, the use of Balise Groups (BGs) is required to allow the movement of trains, to prevent accidents, to warn the driver or for other operational and safety reasons.

1.1.1.2 In order to take advantage of the experiences of the ESG (Engineering Support Group) members on this topic, the ESG has decided to create a guideline regarding the 'Balise Engineering Rules'.

1.1.1.3 This document intends to:

- give global implementation rules for balises;
- list and analyse the ETCS information (Packet) transmittable by balise;
- gather use cases in which functions are implemented by balise;
- give, if possible, advice and recommendations about the implementation of the BG (BG composition, BG location, Q_LOCACC definition, etc.); and
- provide a summary Table making the link between use cases and ETCS functions.

1.1.1.4 This analysis document is based on Subset-026 [1].

1.2 Scope and Field of Application

1.2.1.1 The scope of this document is EU-wide on ETCS projects.

1.2.1.2 This document applies to Baseline 2 and 3 MR1 and R2.

1.2.1.3 In the Opinion 2017 (Art10SP) there are some CR which could have impact on the balise engineering (E.g. CR994, 1120, 1295, 1306). The detailed impact has not been analysed.

1.2.1.4 The document focuses on balise-transmitted packets applicable to Levels 2 and 3. These packets may be equally applicable to Level 1.

1.3 Applicable system versions

1.3.1.1 These Trackside and Onboard system versions are managed by this guideline.

Table 1: System Version Management

<table>
<tr><td></td><td colspan="2">Trackside System Version</td></tr>
<tr><td>Onboard System Version</td><td>1.Y</td><td>2.Y</td></tr>
<tr><td>1.Y</td><td rowspan="2">This Guideline</td><td></td></tr>
<tr><td>2.Y</td><td>This Guideline</td></tr>
</table>

For each packet, the applicable version will be specified.

1.4 Intentionally deleted

1.5 Document structure

1.5.1.1 The present guideline is structured in the following way:

- ETCS Packet – Transmission channel
- Analysis of the ETCS Packet only transmittable by balise
- Analysis of the ETCS Packet that can be transmitted by balise or other means
- Analyse by function
- Summary Table

2 References and Abbreviations

2.1 Abbreviations

Abbreviation	Description
BG	Balise Group
ETCS	European Train Control System
EOLM	End-of-Loop Marker
L1, L2, L3	Level 1, 2, 3
MA	Movement Authority
P	ETCS Packet
PS	Passive Shunting (mode)
VBC	Virtual Balise Cover
SV	System Version
SB	Standby (mode)
LSSMA	Lowest Supervised Speed within the MA
NV	National Values
IM	Infrastructure Manager
LTO	Level Transition Order
LX	Level Crossing
STM	Specific Transmission Module
TSR	Temporary Speed Restriction

2.2 References

2.2.1.1 The following documents and versions apply:

Ref. N°	Document Reference	Title	Version
[1]		Subset-026 - ERA	V3.6.0
[2]		EUG_ESG-Balise_Engineering_CAPTURE	V0.3
[3]		Topic description: 13. Engineering rules for SH	V1.0
[4]		Topic description: 23. Engineering mitigation for SR hazards	V0.1

Ref. N°	Document Reference	Title	Version
[5]		Guideline: 66. Transition from Level 1-3 (SV1.y) to Level 1-3 (SV2.y) with NTC fallback	V0A
[6]		Guideline 71. Level transition from L2 to Level STM	V1.0
[7]		Level transition from Level STM to Level 2	V2.0
[8]		Subset-036	V3.1.0
[9]		Subset-040	V3.4.0
[10]	EUG_UNISIG_BCA	Baseline Compatibity Analysis. Final Report	V.1.0.0
[11]	EUG_18E020	Management of Shunting Activities utilising SH	V.1.0
[12]	EUG 18E120	START OF MISSION IN LEVEL 2/3, B3	V.1.0

3 Balise implementation rules/advice depending on their ETCS content

3.1 ETCS Packet – Transmission channel

3.1.1 Section goal

3.1.1.1 The goal of this section is to identify the transmission channels of the existing ETCS Packets, based on Subset-026 [1].

3.1.1.2 Identification of the transmission channel allows Packets to be sorted into three categories:

- ETCS Packets only transmittable by balise
- ETCS Packets that can be transmitted by balise or other means
- ETCS Packets that cannot be transmitted by balise

3.1.1.3 This section uses a generic table giving the following information:

Packet Number	***Packet Name*** *As defined in Subset-026* [1].	***Relevant to L2/3*** *Yes/No*

3.1.2 ETCS Packets only transmittable by balise

Table 2: ETCS Packets – Balise only

P#	Packet Name	Relevant to L2&L3
0	Virtual Balise Cover marker	Yes
2	System Version order	Yes
6	Virtual Balise Cover order	Yes
16	Repositioning information	No
46	Conditional Level Transition Order (CLTO)	Yes
67	Track condition Big Metal Masses (BMM)	Yes
90	Track ahead free up to Level 2/3 transition location	Yes
132	Danger for Shunting information	Yes
133	Radio infill area information	No
134	EOLM Packet	Yes
135	Stop Shunting on desk opening	Yes
137	Stop if in Staff Responsible (SiiSR)	Yes
141	Default Gradient for TSR	Yes

145	Inhibition of Balise Group message consistency reaction	Yes
181	Generic Limited Supervision (LS) function marker	Yes

3.1.3 ETCS Packet transmittable by balise or other means

Table 3: ETCS Packet - Balise transmission possible

P#	Packet Name	Relevant to L2/3
3	National Values (NV)	Yes
5	Linking	Yes (RBC) / No (Balise)
12	Level 1 Movement Authority (MA)	No
21	Gradient profile	Yes (RBC) / No (Balise)
27	International Static Speed Profile (SSP)	Yes (RBC) / No (Balise)
39	Track Condition Change of traction system	Yes (RBC) / No (Balise)
40	Track Condition Change of allowed current consumption	Yes (RBC) / No (Balise)
41	Level Transition Order (LTO)	Yes
42	Session Management	Yes
44	Data used by applications outside ERTMS/ETCS system	Yes
45	Radio Network registration	Yes
49	List of balises for Shunting (SH) Area	Yes (RBC) / No (Balise)
51	Axle load speed Profile	Yes (RBC) / No (Balise)
52	Permitted Braking distance information	Yes (RBC) / No (Balise)
65	Temporary Speed Restriction	Yes
66	Temporary Speed Restriction Revocation	Yes
68	Track Condition	Yes (RBC) / No (Balise)
69	Track Condition Station Platforms	Yes (RBC) / No (Balise)
70	Route suitability data	Yes (RBC) / No (Balise)
71	Adhesion factor	Yes (RBC) / No (Balise)
72	Packet for sending plain text messages	Yes
76	Packet for sending fixed text messages	Yes
79	Geographical position information	Yes
80	Mode profile	Yes (RBC) / No (Balise)
88	Level crossing information	Yes
131	RBC transition order	Yes
136	Infill location reference	No

P#	Packet Name	Relevant to L2/3
138	Reversing area information	Yes (RBC) / No (Balise)
139	Reversing supervision information	Yes (RBC) / No (Balise)
180	LSSMA display toggle order	Yes (RBC) / No (Balise)
254	Default balise, loop or Radio Infill Unit (RIU) information	Yes
255	End of Information	Yes

3.1.4 ETCS Packet that cannot be transmitted by balise

3.1.4.1 These packets are not covered by the guideline.

Table 4: ETCS Packet - transmission by balise impossible

P#	Packet Name
13	Staff Responsible (SR) distance information from loop
15	L2/L3 Movement Authority
57	Movement Authority Request Parameters
58	Position Report Parameters
63	List of Balises in SR authority
64	Inhibition of revocable TSRs from balises in L2/L3
140	Train Running Number (TRN) from RBC
143	Session management with neighbouring Radio Infill Unit

3.1.5 Constraints

3.1.5.1 Balise Groups must be positioned according to the rules laid down in SS-040 [9] and SS-036 [8].

3.1.5.2 Telegrams within a Balise Group must comply with the rules laid down in SS-040 [9] and SS-026 [1].

3.2 Analysis of ETCS Packet – Introduction

Depending on the possible transmission channel of the related Packet, the structure of the analysis varies.

The analysis of ETCS Packets transmittable by balise is structured as follows:

- Possible transmission channel: Balise
- Goals and functions linked to the Packet: …

This section describes the utility and functionality (-ies) of the Packet. Where a function linked to the Packet is realised via several Packets, the function concerned is described separately in a specific point (*see* §4). Otherwise, the function is described in the present section.

- Use cases

The 'Use cases' section gives examples of situations in which such Packet / functions are used. Where functions linked to the Packet are realised via several Packets, the use cases are listed in the section dedicated to the ETCS function (*see* §4).

- Implementation advice and exported requirements from specification

Where possible, this section gives requirements, or at least advice, regarding the implementation of the ETCS Packet concerned. The advice / requirements may also provide information about the type of BG (i.e. fixed or switchable) and the BG location, etc.

- Packet content

This section contains the main information in the Packet, based on SS-026 [1].

- System Version Applicability

This section defines the System Version in which the ETCS Packet concerned is applicable.

3.3 Packet 0 – Virtual Balise Cover Marker

3.3.1 Possible transmission Channel

3.3.1.1 Balise

3.3.2 Goals and functions linked to the Packet

3.3.2.1 Packet 0 gives an indication to on-board that the telegram can be ignored if the associated VBC is active on board.

3.3.2.2 The function linked to this Packet is the function Virtual Balise Cover (*see* §4.1).

3.3.3 Use Cases

3.3.3.1 *See* Virtual Balise Cover, §4.1.4

3.3.4 Implementation advice / Requirements

3.3.4.1 Packet 0 (P0) has to be defined in each telegram that may, in a given situation, have to be ignored by the on-board system.

3.3.4.2 P0 is only applicable for one balise; therefore, all the balises in the BG should include P0 in order to avoid a message consistency error.

3.3.4.3 P0 cannot be defined as infill information.

3.3.4.4 Note – the NID_C of the telegram including P0 and the VBC marker value need to match the VBC code stored onboard for the balise to be ignored

3.3.5 Packet content

3.3.5.1 The only information contained in this Packet is the Marker number of the VBC.

3.3.6 System Version applicability

3.3.6.1 P0 is available with System Version number X = 2.

3.3.6.2 In the previous System Version 1.1, P0 is replaced by a P200.

3.3.6.3 A Baseline 2 Onboard will ignore P200.

3.4 P2 – System Version Order

3.4.1 Possible transmission Channel

3.4.1.1 Balise

3.4.2 Goals and functions linked to the Packet

3.4.2.1 The goal of P2 is to order the Onboard to operate in a given system version. By default, the Onboard determines the system in operation to be Version X (*see* Subset-104 for more details), as the System Version number X can be transmitted by any balise if this System Version X is higher than the currently operated one. Therefore, the only way in which a train can be ordered to operate in a System Version X lower than the currently operated one is by the transmission of a P2.

3.4.3 Use Cases

3.4.3.1 P2 shall be sent at the transition between two trackside areas, one operated with System Version number X = n and one operated with System Version number X lower than n.

3.4.3.2 Due to the differences between system version X=2 and X=1, onboard will respond differently to ‘stop if in SR’ message. Where trains of different versions can operate P2 can be used to provide consistent system behaviours. P2 is used to force the transition to TR mode when the train reads a BG containing ‘stop if in SR’ packet 137 and the BG is announced in the list of authorised BG in SR.

3.4.4 Implementation advice / Requirements

3.4.4.1 As the information contained in P2 is managed immediately by the train, P2 can be sent in the first BG reached by the train in the areas operated by a lower system version number X.

3.4.5 Packet content

3.4.5.1 The only information in P2 is the code of the system version operated by the Trackside. The meaning of the value defined in this variable is given in SS-026 ch.7 [1].

3.4.6 System Version applicability

3.4.6.1 P2 is available with System Version number 1.1, 2.Y.

3.4.6.2 A Baseline 2 Onboard will ignore P2.

3.5 P3 – National Values

3.5.1 Possible transmission Channel

3.5.1.1 Balise, RBC

3.5.2 Goals and functions linked to the Packet

3.5.2.1 P3 downloads a set of National Values to the train.

3.5.3 Use Cases

3.5.3.1 National Values are a set of variables in ETCS application and used to configure the ETCS Onboard so that it behaves in a specific manner within a national area (i.e. NID_C). These values are transmitted by either Balise or RBC at given locations, such as depot exits, and stored in the Onboard for use in specific scenarios, such as where there are system constraints and parameters, e.g. Speed Limit in SR.

3.5.4 Implementation advice / Requirements

3.5.4.1 The Trackside sends NV to ensure that the Onboard has the appropriate values applicable to the current National Area and to avoid the train running at an unsafe higher speed.

3.5.5 Packet content

3.5.5.1 The packet contains the national values applicable to the railway on which the train is operating. These include ceiling speeds and configuration of the Onboard system. Each Infrastructure Manager is responsible for setting the values to be sent to the train.

3.5.6 System Version applicability

3.5.6.1 P3 is available with System Version number X = 1 or 2.

3.5.6.2 For System Version 1.1 P203 is use to send the new NV added in Baseline 3.

3.5.6.3 A Baseline 2 onboard will ignore P203.

3.6 P6 – Virtual Balise Cover Order

3.6.1 Possible transmission Channel

3.6.1.1 Balise

3.6.2 Goals and functions linked to the Packet

3.6.2.1 The goal of Packet 6 is either:

- to order a virtual balise cover to be memorised, for a given duration, by the train; or,
- to delete a virtual balise cover previously memorised by the train.

3.6.2.2 The function linked to this Packet is 'Virtual Balise Cover' (*see* §4.1).

3.6.3 Use Cases

3.6.3.1 *See* Virtual Balise Cover function §4.1.4.

3.6.4 Implementation advice / Requirements

3.6.4.1 Packet 6 has to be transmitted to the train before reception of the corresponding Packet 0, except when a driver is setting a new VBC at Start of Mission (SoM).

3.6.4.2 Packet 6 should not be defined in an ETCS telegram containing a P0 characterised by the same VBC marker.

3.6.4.3 The Onboard deletes the stored VBC information provided by P6 if the NID_C defined in it is different from a read BG.

3.6.5 Packet content

3.6.5.1 The packet contains the Marker of related VBC and validity period of the VBC if 'set the virtual cover' has been ordered.

3.6.6 System Version applicability

3.6.6.1 P6 is available with System Version number 1.1, 2.Y.

3.6.6.2 A Baseline 2 Onboard will ignore P6.

3.7 P41- Level Transition Order

3.7.1 Possible transmission Channel

3.7.1.1 Any

3.7.2 Goals and functions linked to the Packet

3.7.2.1 The goal of P41 is to identify where a level transition will take place.

3.7.2.2 Where levels are mixed, the successive M_LEVELTR goes from the highest priority level to the lowest one.

3.7.3 Use Cases

3.7.3.1 Packet 41 may be used to announce a level transition at a future location and may be transmitted by Balise Group or RBC message.

3.7.3.2 Packet 41 may be used to cancel an announced level transition and may be transmitted by Balise Group or RBC message.

3.7.3.3 The Balise Group at a level transition will contain P41 or P46.

3.7.4 Implementation advices / Requirements

3.7.4.1 *See* Guideline 66 [5].

3.7.5 Packet content

3.7.5.1 The packet contains mainly the list (sorted by priorities) of permitted ETCS levels that the train will transition to unless the current level is in the list.

3.7.6 System Version applicability

3.7.6.1 P41 is available with System Version number X = 1 or 2.

3.8 P42 – Session Management

3.8.1 Possible transmission Channel

3.8.1.1 Balise, RBC

3.8.2 Goals and functions linked to the Packet

3.8.2.1 P42 is used to give the identity and telephone number of the RBC with which a session shall be established or terminated.

3.8.3 Use Cases

3.8.3.1 When a train enters a Level 2/3 ETCS area, or needs to connect to an RBC following a break in communication or SoM within a Level 2/3 area, it is essential that it should establish communication with the correct RBC through the GSM-R mobile radio network in order to receive the MA and other control commands from the RBC. P42 is used to command the Onboard to establish connection with RBC within the area using the given telephone number and identity of the RBC. The same application will be required to disconnect from the RBC when the train exits the Level 2/3 area.

3.8.4 Implementation advice / Requirements

3.8.4.1 P42 will be programmed within the balise telegrams in the BGs located at the Entrance and Exit border of Level 2/3 to connect with, and disconnect from, the RBC. The Onboard will communicate with, and use the commands from, the RBC to control the trains only while it is operating within (or near to) Level 2/3 areas.

3.8.5 Packet content

3.8.5.1 This packet contains mainly communication session order.

3.8.6 System Version applicability

3.8.6.1 P42 is available with System Version number X = 1 or 2.

3.9 P44 – Data used by applications outside the ERTMS/ETCS

3.9.1 Possible transmission Channel

3.9.1.1 Any

3.9.2 Goals and functions linked to the Packet

3.9.2.1 Messages between trackside and on-board devices, which contain information used by applications outside the ERTMS/ETCS.

3.9.3 Use Cases

3.9.3.1 P44 can be used outside the ETCS application by associating with NID_XUSER, which is the variable that uniquely defines the identity number of a specific user system for which the remainder of P44 is intended. The NID_XUSER and P44 can be used for more than one purpose, e.g. ASDO (Automatic Selective Door Operation), APCO (Automatic Power Change Over) and Speedo Meter Unit change, etc.

3.9.4 Implementation advice / Requirements

3.9.4.1 In order to use P44, the implementation project should request NID_XUSER from the authority (these IDs are assigned by the ERA at the request of a Member State).

3.9.5 Packet content

3.9.5.1 P44 contains the identity of the user system for which the remainder of the packet is intended.

3.9.6 System Version applicability

3.9.6.1 P44 is available with System Version number X = 1 or 2.

3.10 P45 – Radio Network registration

3.10.1 Possible transmission Channel

3.10.1.1 Balise, RBC, RIU

3.10.2 Goals and functions linked to the Packet

3.10.2.1 P45 is used to give the identity of the Radio Network to which a registration shall be enforced.

3.10.3 Use Cases

3.10.3.1 ETCS Level 2/3 works with the Radio Network to communicate with the RBC. When the train enters a Level 2/3 area, either at, or just prior to crossing, the border, the Onboard will be commanded to register with the GSM-R Radio Network by sending P45 from the BG. Following registration, it is then possible to use P42 (Session Management) to establish the connection with the RBC via the GSM-R Network.

3.10.4 Implementation advice / Requirements

3.10.4.1 P45 will be used in telegrams from the BG located before to the BGs containing P42. The distance between P45 and P42 depending on the maximum allowed speed as there should be enough time between P45 and P42.

3.10.5 Packet content

3.10.5.1 P45 contains the Radio Network identity.

3.10.6 System Version applicability

3.10.6.1 P45 is available with System Version number X = 1 or 2.

3.11 P46 – Conditional Level transition Order

3.11.1 Possible transmission Channel

3.11.1.1 Balise

3.11.2 Goals and functions linked to the Packet

3.11.2.1 The goal of P46 is to transmit the list of permitted ETCS Levels at the train's location and force a transition if the active Level of the train is not in the list.

3.11.2.2 The function linked to P46 is 'Conditional Level Transition Order', whose purpose is to ensure that each ETCS train runs in a permitted ETCS Level and/or to update the Level priority list.

3.11.3 Use Cases

3.11.3.1 Check if the train is operating in an authorised Level.

3.11.3.2 Correct driver error if there is any. E.g. exiting a depot and entering into the right level.

3.11.3.3 The Balise Group at a Level Transition Order will contain P41 or P46.

3.11.4 Implementation advices / Requirements

3.11.4.1 P46 should be installed near a transition zone and at locations where 'Start of Mission' is frequently performed.

3.11.4.2 In Baseline 3, P46 is rejected if 'a Level Transition Order is received in the same message, or if a previous Level Transition Order has announced a level transition still to be executed'.

3.11.4.3 In Baseline 2, the rejection of P46 is not specified. Refer to [10]

3.11.4.4 *See* Guideline 66. [5]

3.11.5 Packet content

3.11.5.1 The packet contains a priority order of levels that the train will transition to unless the current level is in the list.

3.11.6 System Version applicability

3.11.6.1 P46 is available with System Version number X = 1 or 2.

3.12 P65 – Temporary Speed Restriction

3.12.1 Possible transmission Channel

3.12.1.1 Any

3.12.2 Goals and functions linked to the Packet

3.12.2.1 It sets a Temporary Speed Restriction on a given piece of track.

3.12.2.2 The function linked by P65 is TSR - *see* §4.2.

3.12.3 Use cases

3.12.3.1 *See* Temporary Speed Restriction (TSR), §4.2.

3.12.4 Implementation advice / Requirements

3.12.4.1 Distance to the start of a Temporary Speed Restriction shall be defined so that all the trains operating in the line will have sufficient distance to brake to the required speed taking into account possible overspeed.

3.12.4.2 If possible, transmission by RBC is recommended.

3.12.5 Packet content

3.12.5.1 This packet contains a defined TSR speed in a specified distance.

3.12.6 System Version applicability

3.12.6.1 P65 is available in System Version number X = 1 or 2.

3.13 P66 – Temporary Speed Restriction Revocation

3.13.1 Possible transmission Channel

3.13.1.1 Any

3.13.2 Goals and functions linked to the Packet

3.13.2.1 It revokes a Temporary Speed Restriction by using the same identity as the given TSR, unless the TSR is irrevocable.

3.13.2.2 The function linked by P66 is TSR – *see* §4.2.

3.13.3 Use cases

3.13.3.1 *See* Temporary Speed Restriction (TSR), §4.2

3.13.4 Implementation advice / Requirements

3.13.4.1 A TSR imposed by a Balise Group can only be revoked by P66 sent from a Balise Group. Similarly, a TSR imposed via an RBC message cannot be revoked by P66 from a Balise Group.

3.13.4.2 P64 (sent by the RBC) can be used to inhibit a revocable TSR sent by a Balise Group. This function is not recommended since it cannot be cancelled by the Trackside, except where the line is a mixture of L1 and L2/3.

3.13.4.3 A Temporary Speed Restriction stored in the onboard is cancelled immediately if a P66 containing the same TSR ID is accepted.

3.13.5 Packet content

3.13.5.1 P66 contains the identity of the TSR to be revoked.

3.13.6 System Version applicability

3.13.6.1 P66 is available in System Version number X = 1 or 2.

3.14 P67 – Track condition – Big metal masses

3.14.1 Possible transmission Channel

3.14.1.1 Balise

3.14.2 Goals and functions linked to the Packet

3.14.2.1 The goal of this Packet is transmission of the position of a Big Metal Mass, e.g. metal bridge, concrete platforms and metal catenary.

3.14.2.2 The function linked by P67 is ‘Track condition – Big Metal Masses’.

3.14.2.3 This function is used to transmit to the train the position of zones in which BMMs are present and could disrupt trackside communication. In these zones, the Onboard will not react to alarms received from the balise-reading hardware.

3.14.3 Use Cases

3.14.3.1 The Metal Mask that the Onboard is required to tolerate is specified in SS-036 [8]. Metal masses that fall outside this mask should be announced using P67 to allow the ETCS kernel to ignore alarms raised by the on-board balise transmission equipment.

3.14.4 Implementation advice / Requirements

3.14.4.1 Distance to the leading edge of metal masses shall be defined so that all the trains operating in the line will have sufficient distance/time within which to act accordingly, allowing for Onboard processing time.

3.14.5 Packet content

3.14.5.1 The packet contains the distance for which integrity check alarms of balise transmission will be ignore at a specified location.

3.14.6 System Version applicability

3.14.6.1 P67 is available with System Version number X = 1 or 2.

3.15 P72 – Packet for sending plain text messages

3.15.1 Possible transmission Channel

3.15.1.1 Balise, RBC

3.15.2 Goals and functions linked to the Packet

3.15.2.1 To send text messages to the driver, which are displayed on the Driver Machine Interface (DMI).

3.15.3 Use Cases

3.15.3.1 P72 can be used to send any information from the Trackside to the driver; this information is displayed on the DMI in a brief text. e.g. the text message warns the driver ‘TSR ahead’ or ‘Stop if in SR’, etc.

3.15.4 Implementation advice / Requirements

3.15.4.1 In addition to the text messages themselves, texts will always specify where they are to be displayed and whether any acknowledgement is required from the driver.

3.15.5 Packet content

3.15.5.1 The packet contains the text messages showing on the DMI at a specific location for a defined period of time.

3.15.6 System Version applicability

3.15.6.1 P72 is available with System Version number X = 1 or 2.

3.16 P76 – Packet for sending fixed text messages

3.16.1 Possible transmission Channel

3.16.1.1 Balise, RBC

3.16.2 Goals and functions linked to the Packet

3.16.2.1 To send text messages to the driver, which are displayed on the DMI.

3.16.3 Use Cases

3.16.3.1 P76 can be used to send fixed text messages from the available table by selecting a number. E.g. Q_TEXT = 0 is ‘Level crossing not protected’.

3.16.4 Implementation advice / Requirements

3.16.4.1 In addition to the text messages themselves, texts will always specify where they are to be displayed and whether any acknowledgement is required from the driver.

3.16.5 Packet content

3.16.5.1 The packet contains a fixed text message showing on the DMI at a specified location for a defined period of time.

3.16.6 System Version applicability

3.16.6.1 P76 is available with System Version 1.0. Note that Q_TEXT values are not defined in baseline 2, the behaviour of the on board is unpredictable.

3.16.6.2 P76 is available with system version 2.Y.

3.16.6.3 P76 is ignored in System Version 1.1.

3.17 P79 – Geographical Position Information

3.17.1 Possible transmission Channel

3.17.1.1 Balise, RBC

3.17.2 Goals and functions linked to the Packet

3.17.2.1 P79 gives geographical location information for one or multiple references to the train.

3.17.3 Use Cases

3.17.3.1 There are various applications available with P79, including indication of whether the next BG is in the same country or another country when the train approaches the border crossing. The Onboard will display the geographical position only on driver request.

3.17.4 Implementation advice / Requirements

3.17.4.1 Please refer to section 3.6.6 Subset-026 [1] for more details.

3.17.5 Packet content

3.17.5.1 The packet contains mainly the location and direction from the geographical position reference BG.

3.17.6 System Version applicability

3.17.6.1 P79 is available with System Version number X = 1 or 2.

3.18 P88 – Level Crossing Information

3.18.1 Possible transmission Channel

3.18.1.1 Any

3.18.2 Goals and functions linked to the Packet

3.18.2.1 To provide level crossing information.

3.18.3 Use Cases

3.18.3.1 It will be possible for the Trackside to inform the ERTMS/ETCS Onboard of the conditions under which a LX must be passed. P88 will inform the Onboard whether the LX is protected or not and, if not protected, it will command the Onboard, specifying the speed at which to pass the LX, if stopping required on the approach to the LX, etc.

3.18.4 Implementation advice / Requirements

3.18.4.1 Please refer to section 3.12.5 Subset-026 [1] for more details.

3.18.5 Packet content

3.18.5.1 This packet contains basic information of a LX including distance to the start point, length of the LX and its protection status.

3.18.6 System Version applicability

3.18.6.1 P88 is available with System Version number X = 2.

3.19 P90 – Track ahead free up level 2/3 transition Location

3.19.1 Possible transmission Channel

3.19.1.1 Balise

3.19.2 Goals and functions linked to the Packet

3.19.2.1 P90 is a notification to the Onboard that the track ahead is free from the Balise Group transmitting this information up to the Level 2/3 transition location.

3.19.3 Use Cases

3.19.3.1 P90 is sent for transition to L2 or L3 from Level 0, 1, or L-NTC: if a Level 2/3 transition is announced and a communication session is already established, an MA request will be sent to the RBC when the information 'Track ahead free up to Level 2/3 transition location' is received from the Balise Group.

3.19.4 Implementation advice / Requirements

3.19.4.1 P90 should only be used when the Trackside can establish that the train is the first one approaching the transition location. This is often done by a switchable BG.

3.19.5 Packet content

3.19.5.1 The main information contained in P90 is the identity of the BG at the transition location.

3.19.6 System Version applicability

3.19.6.1 P90 is available with System Version number X = 1 or 2.

3.20 P131 – RBC transition order

3.20.1 Possible transmission Channel

3.20.1.1 Balise, RBC

3.20.2 Goals and functions linked to the Packet

3.20.2.1 P131 is used to order an RBC transition.

3.20.3 Use Cases

3.20.3.1 P131 is used to facilitate the RBC to RBC Hand-Over when the train crosses the border of between two RBC areas. This is essential for seamless operation of the train in an ETCS Level 2/3 area. A radio communication session with the Accepting RBC is opened by the Onboard based on the RBC transition order received from the 'Handing Over' RBC or from the Balise Group.

3.20.4 Implementation advices / Requirements

3.20.4.1 See SS-026 Chapter 5.15 and Chapter 3.15.1 [1]

3.20.5 Packet content

3.20.5.1 This packet contains "Accepting" RBC identity and RBC radio subscriber number at a specified location.

3.20.6 System Version applicability

3.20.6.1 P131 is available with System Version number X = 1 or 2.

3.21 P132 – Danger for Shunting information

3.21.1 Possible transmission Channel

3.21.1.1 Balise

3.21.2 Goals and functions linked to the Packet

3.21.2.1 P132 is used to transmit the aspect of a Shunting signal.

3.21.2.2 It gives the order ‘Stop if in SH’ mode or ‘Go if in SH’ mode.

3.21.3 Use Cases

3.21.3.1 See the Shunting guideline.

3.21.4 Implementation advice / Requirements

3.21.4.1 See the Shunting guideline [11]

3.21.5 Packet content

3.21.5.1 The packet contains the aspect of a ‘Danger for Shunting’ signal.

3.21.6 System Version applicability

3.21.6.1 P132 is available with System Version number X = 1 or 2.

3.22 P134 – EOLM Packet

3.22.1 Possible transmission Channel

3.22.1.1 Balise

3.22.2 Goals and functions linked to the Packet

3.22.2.1 P134 announces a loop.

3.22.3 Use Cases

3.22.3.1 P134 is used in BGs to act as an End-of-Loop Marker (EOLM) device at the beginning or end of a loop in a track. The BGs will send the EOLM information to passing trains so that the Onboard knows when the train is entering or leaving a track equipped with a loop.

3.22.4 Implementation advice / Requirements

3.22.4.1 The orientation of EOLMs is identical to Balise Group orientation. The general rules for BG orientation therefore also apply to EOLMs. EOLM information might be contained in a Balise Group that contains other information.

3.22.5 Packet content

3.22.5.1 This packet contains basic information of a look including the distance between the EOLM and the start point, length and direction of the loop.

3.22.6 System Version applicability

3.22.6.1 P134 is available with System Version number X = 1 or 2.

3.23 P135 – Stop Shunting on desk opening

3.23.1 Possible transmission Channel

3.23.1.1 Balise

3.23.2 Goals and functions linked to the Packet

3.23.2.1 If a PS engine desk is opened and previously received ‘Stop Shunting on desk opening’ information from a BG is stored on board, the Onboard will switch to SB (Standby mode).

3.23.3 Use Cases

3.23.3.1 To enable the IM to force authorisation of SH each time the cab is opened, irrespective of whether the PS was selected.

3.23.4 Implementation advice / Requirements

3.23.4.1 The train shall pass the BG before entering the Shunting area.

3.23.5 Packet content

3.23.5.1 The packet does not contain any information.

3.23.6 System Version applicability

3.23.6.1 P135 is available with System Version number 1.1, 2.Y.

3.23.6.2 A Baseline 2 Onboard will ignore P135.

3.24 P137 – Stop if in Staff Responsible

3.24.1 Possible transmission Channel

3.24.1.1 Balise

3.24.2 Goals and functions linked to the Packet

3.24.2.1 P137 is used to transmit to the train the order to stop if the active mode is SR and the override function is not active

3.24.2.2 In System Version X=2, if P137 is sent from a BG on an active list of BG in SR, P137 is ignored. In System Version X=1, P137 is not ignored.

3.24.2.3 Note: If a BG is encountered and not on an active list of BG in SR, the train will trip.

3.24.3 Use Cases

3.24.3.1 Used wherever the risk of overrun by a train in SR needs to be managed. For instance:

- At the exit of a siding giving access to the main track
- At each stop marker board
- At each optical signal from which a route can be set
- (Where flank protection is not provided)
- At a Level Transition Order location

3.24.4 Implementation advice / Requirements

3.24.4.1 See Start of Mission guideline [12].

3.24.4.2 The Balise Group should be placed in accordance with SS-040 [9] in order for it to read and process the message before the EoA is passed by the min. safe antenna position.

3.24.5 Packet content

3.24.5.1 This packet contains information indicating whether an Onboard operating in SR must stop or not.

3.24.6 System Version applicability

3.24.6.1 P137 is available with System Version number X = 1 or 2.

3.25 P141 – Default Gradient for temporary speed restriction

3.25.1 Possible transmission Channel

3.25.1.1 Balise

3.25.2 Goals and functions linked to the Packet

3.25.2.1 The goal of P141 is to define the gradient that the train must consider for TSR supervision where the gradient profile is not defined.

3.25.2.2 For X=2, in the absence of a gradient profile (e.g. in SR), the Onboard assumes the gradient to be 0.

3.25.2.3 For X=1, P141 is required for a TSR while in SR.

3.25.3 Use Cases

3.25.3.1 In the context of this document, this packet applies only in SR .

3.25.3.2 See §4.2.4.2

3.25.4 Implementation advice / Requirements

3.25.4.1 P141 should be included wherever a TSR is sent by a Balise Group, because the Default Gradient for a TSR stored in the Onboard will be valid until a new TSR Default Gradient is received.

3.25.4.2 P141 may be omitted if the application can be sure that P141 has not been sent to the Onboard, or a P141 with an acceptable default gradient is stored in the Onboard.

3.25.5 Packet content

3.25.5.1 Value of the Default Gradient for a TSR.

3.25.6 System Version applicability

3.25.6.1 P141 is available with System Version number X = 1 or 2.

3.26 P145 – Inhibition of Balise Group message consistency reaction

3.26.1 Possible transmission Channel

3.26.1.1 Balise

3.26.2 Goals and functions linked to the Packet

3.26.2.1 P145 ensures that the ETCS/ERTMS Onboard will not command application of the service brake after a missed telegram or after an error during the decoding.

3.26.3 Use Cases

3.26.3.1 This can be used to avoid performance consequences associated with a message inconsistency error; however, it should not be applied in balises which contain a critical message such as LTO or Stop if in SR (*See* SS-040 4.2.4.1).

3.26.4 Implementation advice / Requirements

3.26.4.1 Used at a start/depart location if it is possible that a BTM is located at a BG.

3.26.4.2 If it is necessary to use P145 in a critical Balise Group, it is recommended that a second Balise Group be added. e.g a BG providing a TSR.

3.26.5 Packet content

3.26.5.1 The packet does not contain any information.

3.26.6 System Version applicability

3.26.6.1 P145 is available with System Version number 1.1, 2.Y.

3.26.6.2 A Baseline 2 Onboard will ignore P145.

3.27 P181 – Generic LS function marker

3.27.1 Possible transmission Channel

3.27.1.1 Balise

3.27.2 Goals and functions linked to the Packet

3.27.2.1 P181 enables the generic toggling on/off of the display of the Lowest Supervised Speed within the MA.

3.27.3 Use Cases

3.27.3.1 P180 - LSSMA is used on the border lines between Switzerland and Italy to make sure that the correct speed profile is adopted. P180 is used to control when the LSSMA is displayed in the different areas.

3.27.4 Implementation advice / Requirements

3.27.4.1 Re. P181, see section 4.4.19.1.4.7 Subset-026 [1] for more details. P181 has to be stored in the Onboard to enable P180. Otherwise the LSSMA is ‘always’ displayed.

3.27.5 Packet content

3.27.5.1 The packet does not contain any information.

3.27.6 System Version applicability

3.27.6.1 P181 is available with System Version 2.Y.

3.28 P254 – Default balise, loop or RIU information

3.28.1 Possible transmission Channel

3.28.1.1 Balise, loop, RIU

3.28.2 Goals and functions linked to the Packet

3.28.2.1 It indicates to the Onboard that a balise telegram, loop message or RIU information contains default information due to a fault in the trackside equipment.

3.28.3 Use Cases

3.28.3.1 P254 can be used to indicate to the Onboard that the Trackside system has a failure, such as a Lineside Electronic Unit (LEU) failure, by sending a telegram, including the default balise information.

3.28.4 Implementation advice / Requirements

3.28.4.1 If one (and only one) of a pair of duplicated balise telegrams received by the Onboard includes the information ‘default balise information’, the Onboard will ignore any other information included in this telegram and will consider information from the telegram not containing ‘default balise information’.

3.28.5 Packet content

3.28.5.1 The packet does not contain any information.

3.28.6 System Version applicability

3.28.6.1 P254 is available with System Version number X = 1 or 2.

3.29 P255 – End of Information

3.29.1 Possible transmission Channel

3.29.1.1 Balise, Loop

3.29.2 Goals and functions linked to the Packet

3.29.2.1 P255 acts as a finish flag; the receiver will stop reading the remaining part of the message/telegram when receiving NID_PACKET = 255 (1111 1111).

3.29.3 Use Cases

3.29.3.1 It is always included as the last packet of a telegram.

3.29.3.2 It is used for the train positioning function.

3.29.4 Implementation advice / Requirements

3.29.4.1 There are no specific rules or requirements.

3.29.5 Packet content

3.29.5.1 This packet only consists of NID_PACKET containing 8 bit 1s.

3.29.6 System Version applicability

3.29.6.1 P255 is available in all versions.

4 Analyse by functions

4.1 Virtual Balise Cover function

4.1.1 Goal of the function

4.1.1.1 The goal of the function is to allow a train to ignore the telegram transmitted by a given balise.

4.1.2 ETCS Packets Involved

4.1.2.1 The Packets involved for this function are:

- P0 (or P200 for SV = 1.1)
- P6

4.1.3 Function realisation

4.1.3.1 A Virtual Balise Cover is defined, via P6 (*see* §3.5), by:

- a marker: identification number of the VBC
- an identifier of the country/region
- a validity period: time period during which a VBC can be active
- a qualifier: definition of whether the VBC is set or removed

Alternatively, the driver will be able to set a new VBC or remove an existing one during SoM.

4.1.3.2 A VBC is declared as ‘Active’ when the qualifier of the VBC is set to ‘Set a VBC’, as long as the validity period has not yet elapsed.

4.1.4 Use Case

4.1.4.1 Testing ETCS trains

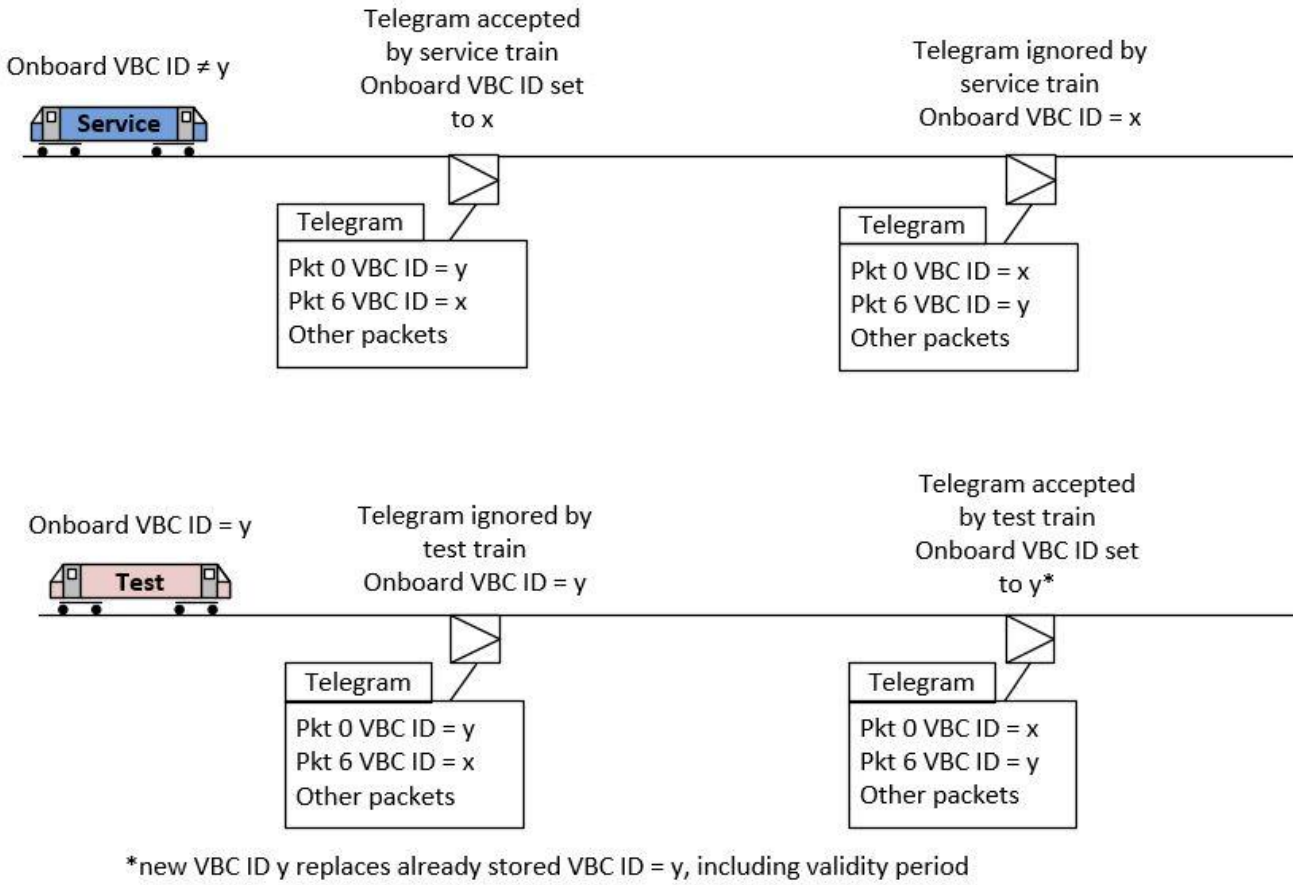

Figure 1. Sequence diagram for Service and Test trains reading different telegrams

Figure 1 indicates that the driver of the test train could set the stored VBC to y, which deliberately ignores some packets for testing reasons without interrupting normal service trains running on the same track.

Another functionality is during installation of ERTMS where using VBC all service trains will ignore the BG and only test train could test the new installation.

4.1.4.2 Level transition

The transition from an SV 1.Y line to an SV 2.Y line (with NTC fall back) is divided into the following functional steps: see Guideline 66 [5]

Step 1: Announce Virtual Balise Cover

Step 2: Level transition for B2 trains

Step 3: Cancel Virtual Balise Cover

Step 4: Level transition for B3 trains

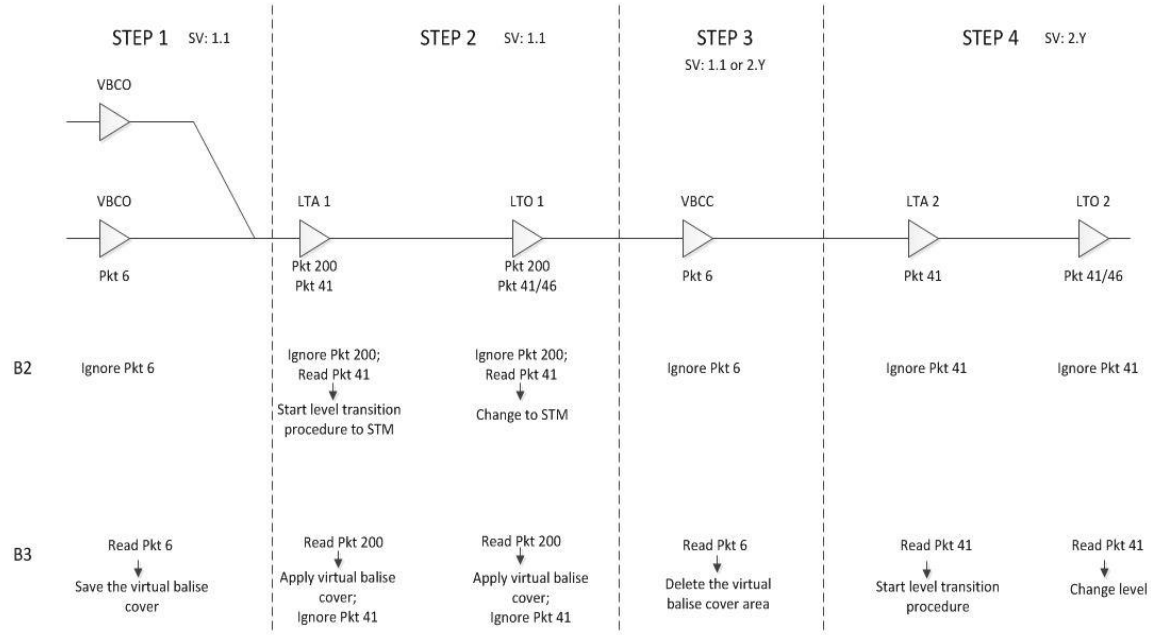

Figure 2. General sequence diagram for B2 and B3 trains

Baseline 2 trains: L2/3 to LSTM.

Baseline 3 trains: L2/3 to L1 LS (most likely) or L2/3.

4.2 TSR

4.2.1 Goal of the function

4.2.1.1 The goal of the function is to set a Temporary Speed Restriction and revoke a set TSR.

4.2.2 ETCS Packets Involved

4.2.2.1 The Packets involved in this function are:

- P65
- P66

4.2.3 Function realisation

4.2.3.1 The following information is transmitted via P65 from the Trackside to the train:

- Identity number of Temporary Speed Restriction
- Distance to beginning of Temporary Speed Restriction
- Length of the Temporary Speed Restriction
- Speed restriction value
- Indication of whether the train length delay applies or not

- Revocable or irrevocable Temporary Speed Restriction

4.2.3.2 P66 contains the identity of the TSR to be revoked.

4.2.4 Use Cases

4.2.4.1 In order to slow train down at Level Crossings

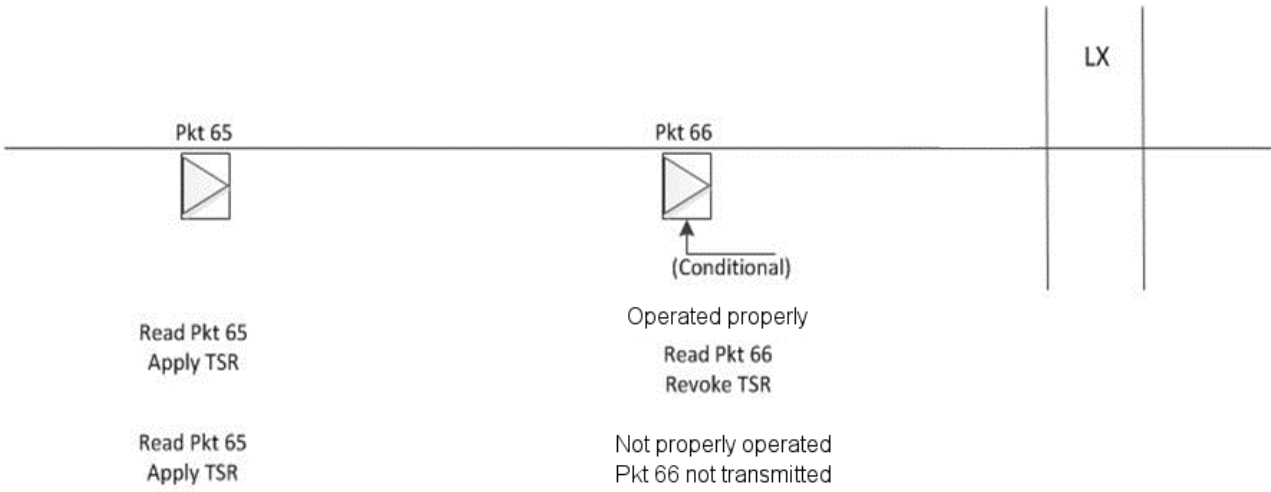

Figure 3. Apply or revoke TSR at LX

When a train passes the BG and reads P65, the TSR will be applied. The train will reduce speed approaching the level crossing.

When the level crossing has operated properly (e,g, Flashing lights on) P66 will be read and the TSR cancelled immediately. The train approaches the level crossing at normal speed.

When the level crossing has not been properly operated (e.g. Flashing Lights OFF) indicates that the level crossing is not working, so P66 will not be sent. The TSR still applies.

4.2.4.2 Slow train down in SR

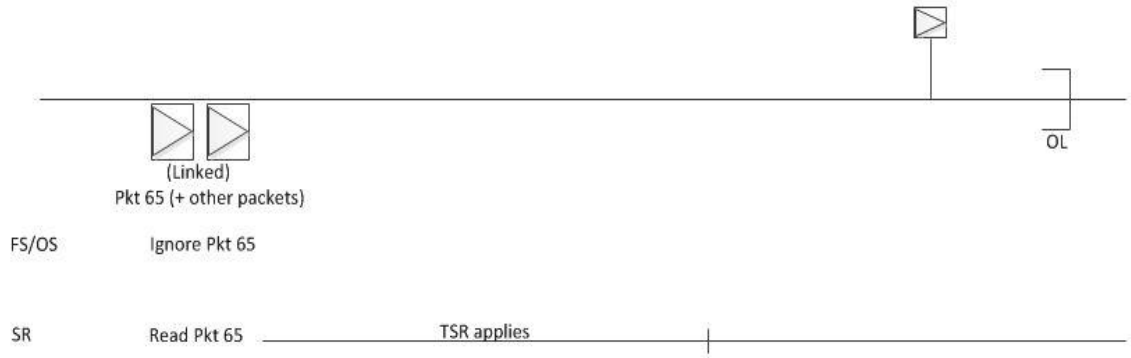

Figure 4. use of linking information to apply TSR in SR mode

Full Supervision (FS)/On Sight (OS) mode: Linking information is used in the Onboard and P65 is not included in the linking information, therefore, the BG is not taken into account. The BG message is rejected and the TSR is not applied.

SR: Linking information is unavailable, therefore, the BG is taken into account. The BG message is accepted and the TSR is applied. This affords the driver early warning and slows the train down on its approach to the Stop Marker Board in case, for some reason, it is not visible (e.g. weather conditions or vegetation, etc.). Another scenario is where the freight train requires a longer overlap distance (450m); in this situation, the TSR ensures that the train stops before the end of the overlap.

P141 is sent together with P65 if the train is on a downhill slope to make sure that the potential overrun distance is within the safe range.

4.2.4.3 Point protection in case of override

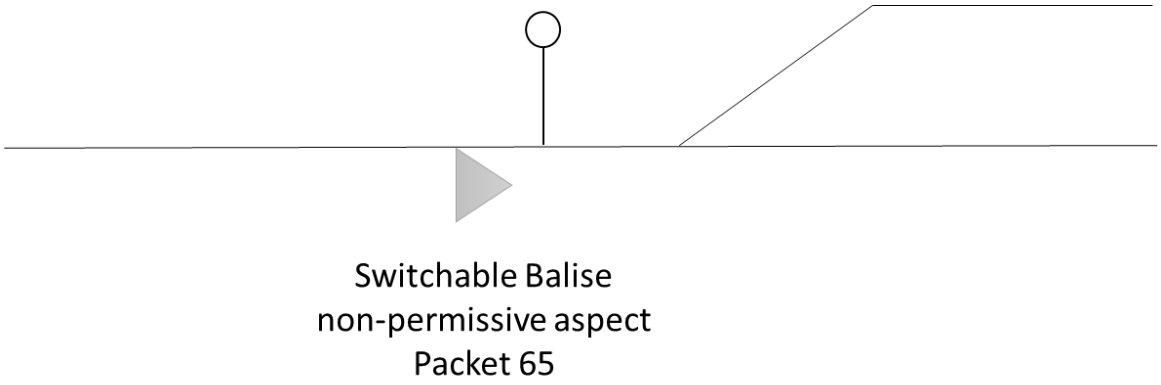

Figure 5. use of irrevocable TSR for points protection

When the signal shows a non-permissive aspect, P65 is sent with an irrevocable TSR with the most restrictive speed associated with the points concerned.

This TSR protects the points when the RBC cannot send an MA to the Onboard and the driver has to select ‘override’ at the signal.

5 Appendix

For different ‘use cases’, information about the ETCS functions that may be required. This does not mean that other ETCS functions are not possible.

Table 1 : Use case - ETCS function correspondence

Use Cases	SiiSR	DFSH	Train Location accuracy	National ATP/LNTC	RBC - RBC HOV ANN	RBC - RBC HOV EXE	Radio Network registration	Session establishment	Terminate session	LTA Entry in L2	LTO Entry in L2	LTA Exit from L2	LTO Exit from L2	Text msg	National Values	Reverse	Track condition NSA	Track condition Lower pantograph	Track condition-powerless section	Cancellation LT	Conditional Level Transition Order	Track Condition BMM	TSR
Transitions :																							
Entry:																							
ETCS L1															■					■			
ETCS L2							■	■		■	■				■					■	■		
ATP[1]				■																■			
Exit:																							
ETCS L1																				■			
ETCS L2												■	■							■			
GSM-R							■		■					■									
RBC - RBC						■									■								
Country Border						■								■	■								
Signalling elements:																							
Main Stop Signals	■	■																					
Shunting signals		■																					
Stop marker board	■																						
Shunting Limit Panels		■																					
Line Panel[2]														■									
Signal Side Change														■									
Buffer stop																							
Track Configuration:																							
Access to main tracks from deviated track	■	■																					
Automatic block section																							
Long section																							
Reduced gauge														■									
Others:																							
Near a decrease in speed																							
Near an increase in speed				■																			
ATP functions				■																			
Working area														■									■
Tunnel														■									
Depot exit															■								
Train location															■								
Change of traction power zone																		■					
Powerless zone																			■				

[1] *Note: the use case ‘Exit from ATP’ is not considered as it is equivalent to ‘Entry in L1’ or ‘Entry in L2’.*

[2] *The line panels indicate the line number at line transitions.*

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