**Filter Information From ERTMS Trackside**

**Authors:**

Baseliyos Jacob, Stéphane Bésure, Yoann Guyot

**Reviewers:**

Reviewers of this document

**Date and version:**

31/10/2013 – v1 - creation

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**Input documents:**

Subset 26

**Description**

description

add schema here

**Operator View (Baseliyos Jacob Deutsche Bahn) :**

Operational Requiremts for German Track :

**VDE ETCS Track in Germany :**

* System will be used in Level 2 without any Lightsignalling on the Track
* Track will be a 2.3.0 d and a Baseline 3 up to 2018
* No Loop is necessary.
* Radio Link necessary for Level 2
* Fallbacksystem for this track will be L1 LS Mode
* Without any Loop in the L1 LS Mode
* In the Fallbacksystem L1 LS balises will be just set at branches and entry to

Station to reduce speed in the danger points

* So no Radio Link in L1 LS necessary

**Korridor A German Part :**

* System will be used partly in L1 LS without Loop Baseline 3
* System will be used partly in L2 Baseline 3
* Fallbacksystem PZB

**ICE-T Onboard equipment :**

* National Operation Germany up to 2017 on the VDE 2.3.0d

Needs : Radio Link, L2, L1 LS for Germany, but no Loop

* International Operation : Frankfurt/Munich – Wien (Austria)

Needs : Radio Link, L2 for the Wienerwald ETCS Track 2.3.0 d

L1 Loop detector for the ETCS Innsbruck track

**ICE-3 M Onboard equipment :**

* National Operation : Germany up to 2018 on the VDE Baseline 3

Needs : Radio Link, L2, L1 LS for Germany, but no Loop detection for Germany

* International Operation : Germany – Belgium

Needs : Radio Link, L2, L1 FS for Belgium side, no Loop detection necessary

STM PZB, TB+1 for the German and Belgium side

* International Operation : Germany – Netherlands

Needs : Radio Link, L2 and ATB STM for Utrecht – Amsterdam Line

STM PZB for Germany die

* International Operation : Germany – France

Needs : Radio Link, L2 for POS

STM PZB for Germany

STM KVB, TVM for France

**ICE -1 Onboard equipment :**

* National Operation : Germany up to 2018 on the VDE Baseline 3

Needs : Radio Link, L2, L1 LS for Germany, but no Loop detection for Germany

* International Operation : Germany – Switzerland on L2 2.2.2 + Track

Needs : L2, Fallbacksystem Integra

L1 LS Baseline 3 Package 44 for other konventionell tracks without loop detectio

No STM necessary as far the Package 44 is integrated in L1LS Balise

**Linking relevant in Subset 26 from table 4.5.2:**

|  |  |
| --- | --- |
| Check linking consistency | 3.16.2.3  3.4.4 |
| Check Balise Group Message Consistency if linking consistency is checked | 3.16.2.4.1  3.16.2.4.3 |
| Check Balise Group Message Consistency if no linking consistency is checked (because no linking information is available and/or because the function “check linking consistency is not active) | 3.16.2.4.4 |
| Check Unlinked Balise Group Message Consistency | 3.16.2.5 |
| Check correctness of radio messages | 3.16.3.1.1 |
| Check radio sequence | 3.16.3.3 |
| Check safe radio connection (only level 2/3) | 3.16.3.4 |

Additional requirements :

§ 3.4 and 3.16.2

§ 3.7.3.1

§ 8.4.2.1

§ 3.16.2.3.1

§ 3.16.2.3.2

§ 3.4.4.4.6/3.4.4.4.6

§ 3.16.2.7.2.1

§ 3.16.2.7.2.1

§ 3.16.2.4.3

§ 3.4.4.4.5

§ 3.16.2.7.1.1

§ 8.4.2 (Rules for Eurobalise telegram)

§ 7.4.2.38 Packet Number 354

§ 3.16.2.4.5

§ 3.16.2.4.6

§ 3.16.2.4.6.1

§ 3.16.2.4.1/3.16.2.4.4 /3.16.2.5

§ 3.16.2.4.2./3.16.2.4.4.1/3.16.2.5.1

§ 3.16.2.4.4/ 3.16.2.5.1

§ 3.16.2.4.1/3.16.2.6

§ 2.16.2.6.2

§ 3.16.2.4.4.3/3.16.2.5.3

**Description (according to the analyziz from Jan Welvaarts NS/Lloyds)**

**Definitions:**

* OBU: the train borne equipment realizing the ERTMS functions as specified in the SRS
* RBC: radio block centre: device realizing the infrastructure part of the radio communication between OBU and ERTMS track side installations as specified in the SRS
* Balise: Beacon sending information from the ERTMS track side installations (a Telegram) to the OBU
* A Telegram: set of data sent by one balise.
* Balise Group (BG): Set of maximum 8 beacons whose Telegrams together form one Message
* Internal Number: number of a Balise within a BG
* Duplicated balise: Balise sending the same Telegram as another balise in the same BG. (but will be recognized as different balises because of their Internal Number within the BG  
  It is indicated in the Telegram if the Balise is the duplicate of the next or previous one)
* Balise Coordinate System: Passing Direction of the BG and location reference (= balise 1)
* Single Balise group: BG consisting of one Balise or a BG consisting of two duplicate Balises of which one was missed.
* Linked Balise Group: BG which sends information that it is linked
* Announced BG: BG identity and further information (expected orientation, distance,….) of BG’s which are not yet detected and whose “window of expectation” has not been passed.
* Window Of Expectation: area (nominal position +/- location accuracy) where an announced BG shall be detected.
* List of announced BG’s: registry of announced BG’s
* Expected BG: The nearest (first to detect) BG in the List of announced BG’s.
* Detected BG: BG from which the message is received by the OBU
* Missed Balise: Balise which is installed trackside, but which was not detected (correctly).
* Infill information: Information for which an announced BG is used as reference location.
* Repositioning information: update of the distance till the end of the current section.
* Expectation window: Area where an announced BG shall be found, taking into account (location accuracy of the BG installation (Q\_locacc), the position inaccuracy when reading a BG and the inaccuracy of the odometer).
* on-board over-reading and under-reading amount: odometer accuracy plus location detection (of a BG) accuracy.
* Estimated front end position:
* Maximum safe front end position:
* Minimum safe front end position:
* Minimum safe rear end position: Minimum safe front end position reduced with the train length.
* Safe train length: Estimated front end position reduced with the Minimum safe rear end position.

**Balise linking, Passing direction and balise consistency**

Paragraphs subset026 v3.3.0: **3.4 and 3.16.2**

***determining the balise orientation (passing direction)***

BG's are used as location references. Further the information sent by BG's might be valid for one direction only. Therefore the direction in which the BG was passed shall be determined. If the BG is used as a location reference the passing direction shall be stored in the “list of LRBG's” (see xxxx).

**Requirements:**

* Balises in a BG are located in order from one to (maximum) eight in the nominal direction. If a BG is detected the Passing Direction shall be determined from the order in which the Balises are detected (except for single BG’s).
* If an announced and linked single BG is detected, the Passing Direction shall be taken from the announced Passing Direction if available, if the information is not available the Passing Direction shall be “not known”.
* (level2/3 only:) If the Passing Direction is not known (single BG, not announced) then the OBU shall report the LRBG (being the detected single BG) and previous LRBG (if available) in a position report to the RBC.   
  The RBC shall (on reception of such position report) assign a Passing Direction to the single BG and sent it to the OBU.

The directional information is (and shall be reported in the position report as) unknown in the following cases:

* A not announced single BG is detected and the previous LRBG is not known.
* A single BG is detected while the driving direction has changed (once ore more often) since the previous LRBG was detected.

**Functions:**

* Determine the passing direction of a BG when it is passed:
* *see above requirements*
* If information concerning the passing direction of a BG stored in “the list of LRBG's” is received (PACKET ?????????????????) then the passing direction is updated. If the concerned BG is the actual LRBG all location and profile related data stored on board shall be updated.

***Receiving linking information***

BG’s can be announced by previous BG’s or by RBC's using packet 5. The (safety) consequence of missing a BG depends on the design of ETCS-track side installations. Therefore the (safe) reaction in case the BG is missed (“linking reaction”) is also specified in the announcement (train trip, service brake or no reaction).Packet 5 contains the following information:

* the identity of the announced BG (NID\_BG and NID\_C).
* the distance to the announced BG (from the announcing or, in case of radio message, from the reference BG: D\_LINK),
* the Passing Direction of the announced BG (relevant for single BG’s and for consistency checks). (Q\_ORIENTATION: nominal or reverse)
* The required reaction from the on-board in case the BG is missed (or not consistent). (Q\_LINKREACTION: train-trip, service brake, none)
* The accuracy of the positioning of the BG (Q\_LOCACC)

New linking information shall replace all stored linking information from the LRBG in case of non-infill information or from the reference location (i.e. next main signal) in case of infill information. (**3.7.3.1** m,n).

**Variables**

A data structure shall be defined to store a “list of announced BG's” (in the order in which they will be passed). Per BG the following information shall be stored:

* The identity of the BG (given by NID\_BG and NID\_C)
* The distance from the reference location (LRBG) to the announced BG
* The accuracy of the location. (= Q\_LOCACC)
* The direction in which the BG will be passed.
* The required reaction if the BG is missed.

If a BG is found or missed it will be deleted from the list. Therefore the rearmost announced BG is the expected BG. The expectation window for the **expected BG** is from (rearmost) the distance from the LRBG minus Q\_LOCACC minus L\_DOUBTOVER till (furthest) the distance from the LRBG plus Q\_LOCACC plus L\_DOUBTUNDER. Exception: infill BG's shall be expected from the position of the LRBG.

**Requirements:**

**xxxxxx**

**Functions:**

“Store announced BG's”: If a packet 5 is received then:

* The “list of announced BG's” will be cleared.
* The distance from the actual LRBG shall be calculated for each of the announced BG's (in case the location reference given in the message is not the same as the actual LRBG).
* The resulting data shall be stored in the “list of announced BG's”

***Check the linking consistency***

A balise message is build from balise Telegrams. Each telegram header contains the information if the BG is linked (Q\_LINK, **8.4.2.1**). If a linked BG is received then it shall be checked against the “list of announced BG's”. Exception: when the “list of announced BG is empty”, i.e. there is no “expected BG”, then the consistency is not checked.

**Variables**

* A flag indicating if the received BG shall be taken into account (WHAT DOES THIS MEAN??????).
* A flag indicating that the linking reaction shall be executed.

**Requirements**

Each Telegram contains the information if the BG is linked. BG’s which are not linked might not be known to the RBC. However it can be useful to install a (temporary) BG to impose additional restrictions (f.e. during maintenance or installation work at the track). The information sent by those BG’s shall therefore be taken into account. To be able to determine the Passing Direction of an unlinked BG (not announced and not known by the RBC), an unlinked BG shall at least consist of two balises (INFRASTRUCTURE ENGINEERING RULE).

In some cases (for example after start up, a change of driving direction,.. ) the list of announced BG’s is empty (in “SRS vocabulary”: “no linking is used”).

**3.16.2.3.1** If one announced BG is found in rear of the expectation window, not found in the expectation window or the next announced BG is found then the linking reaction shall be executed.

**3.16.2.3.2** If the expected BG (with a known ID) is passed in the direction opposite to the announced direction the train shall be tripped.

**3.4.4.4.6/3.4.4.4.6**.1If the expected BG or the next expected BG is detected then the BG following the detected BG shall become the expected BG.

**3.16.2.7.2.1** If two consecutive announce BG’s are missed the service brake shall be commanded, the driver informed and the MA+trackdescription withdrawn. (A3.4.2.1 L,3.16.2.7.1.1), i.e. no BG will become the expected BG.

**3.16.2.7.2.1** WHAT DOES “KEEP LOOKING FOR” MEAN??????????????????? SHALL THE DETECTED BG STILL BE THE EXPECTED BG???? THIS COULD LEAD TO A LINKING CONSISTENCY ERROR!!!!!!!!!

If an announced BG (possibly with ID unknown) containing repositioning information is found twice within the expectation window and before another linked BG is found then the service brake shall be commanded (+ information to the driver and withdrawal from location based information).

**3.16.2.4.3** If a BG marked as linked is detected while it's identity is not found in the “list of announced BG's” and the “list of announced BG's” is not empty (i.e. linking is used on-board) then the information from the BG shall be ignored.

**Functions(NOT YET COMPLETE):**

* “check if information received from a BG shall be taken into account” (i.e. the flag “indicating that the BG shall be taken into account shall be set)   
  The information shall be taken into account as far it's valid for the passing direction and:
* The BG is marked as unlinked **or**
* The “list of announced BG's” is empty (“no linking is used on-board”) **or**
* The BG is marked as linked and   
  The passing direction of the BG can be determined (i.e. not a single BG) and  
  the BG contains repositioning information valid for the passing direction and   
  the identity of the expected BG is unknown and   
  the BG is found within the “expectation window” and   
  the BG is passed in the direction indicated for the expected BG **or**
* The BG is marked as linked and   
  the identity of the BG is equal to the identity of the identity of any of the announced BG's and   
  the BG is found between the rearmost and the furthest announced   
  the BG is found within the “expectation window” (3.4.4.4.5) and   
  the BG is passed in the expected direction.
* “Check if the linking reaction shall be executed”, (i.e. the flag indicating that the linking reaction shall be executed shall be set). This is done under the following conditions:
* A BG is detected with an identity equal to the identity of the expected BG and  
  the current location is in rear of the expectation window **or**
* The end of the expectation window is reached and  
  no BG with an identity equal to the identity of the expected BG has been detected **or**
* A BG is detected with an identity different from the identity of the expected BG and  
  the current location is inside the expectation window.
* “Update the list of announced BG's”, i.e.
  + Delete the “expected BG” from the “list of announced BG's” if a BG with the same identity as the expected BG is found inside the expectation window. **or**
  + If one (or more) of the conditions for executing the linking reaction is fulfilled. **or**
  + If two consecutive announced BG’s are missed, (i.e. the expectation window of the expected and the next expected BG are passed, or a further next expected (another announced) BG is found) then all announced BG will be deleted. (3.16.2.7.1.1)
* Guard if a repositioning BG is found twice within the expectation window.

***Check the message consistency***

A message is consistent if:

* All telegrams are received completely without errors (e.g. CRC faults) and no variables with a value “spare” are received and the telegrams belong to the same message (i.e. have the same value of M\_MCOUNT, see below)
* A telegram is also assumed to be received completely if it was missed or damaged, but duplicated in a well-received balise and the passing direction can be determined or is not necessary.

In case of switch able balises, the telegrams might be updated while a part of the balises has been detected, but not all. To check if all telegrams belong to the same message, a message counter (M\_MCOUNT) is defined in the Telegram header (8.4.2). All telegrams shall have the same message counter otherwise the message is not consistent. (3.16.2.4.5).

To allow fixed balises inside a BG with switch able balises a special value for M\_MCOUNT is defined, indicating that the telegram always belongs to the message sent by the BG (3.16.2.4.6). Further a special value for M\_MCOUNT is defined, indicating that the telegram never belongs to the message sent by the BG (3.16.2.4.6.1). (WHAT IS THIS GOOD FOR??????????????????)

**Requirements**

**3.16.2.4.1/3.16.2.4.4 /3.16.2.5** If a message from a BG is accepted according to “linking consistency” (see “check the linking consistency”) then a message is assumed to be inconsistent if:

* A balise is missed inside the group (1). **or**
* All balises are detected, but one or more telegrams are not decoded (1) **or**
* One or more variables in the BG message have invalid values (i.e. “spare”). **Or**
* The message counters of the different balises inside the BG do not match, i.e. more than one value (different from 255, see 3.16.2.4.6) are found for M\_MCOUNT or one of the values of M\_MCOUNT in the message is 254 (see 3.16.2.4.6.1).

(1):

**3.16.2.4.2./3.16.2.4.4.1/3.16.2.5.1** If the missed balise is duplicated or a balise telegram is not decoded, the message can still be consistent if the balise was duplicated and the duplicated balise is detected and decoded correctly and:

* The BG is linked and the “list of announced BG's” was not empty (i.e. linking was used on-board) **or**
* The BG is unlinked, but the direction can still be evaluated (HOW?? IS IT ALLOWED TO USE PARTLY DECODED INFORMATION FROM A BALISE, THUS ACCEPTING THE BALISE NUMBER, OR IF IT IS DETECTED THAT THE MISSED BALISE CAME BEFORE OR AFTER THE DETECTED AND DECODED BALISE, IS IT THEN ALLOWED TO BASE THE DECISION ON THE VALUE OF N\_PIG OF THE DETECTED BALISE ONLY?????????????????????????) **or**
* The BG does not transmit information valid for only one direction **and/or**
* The BG does only transmit data to be used outside the ETCS on-board.

**3.16.2.4.4/ 3.16.2.5.1** If a message from an unlinked BG or from a linked BG (when the “list of announced BG's is empty) is not consistent and no telegram from the BG contains the information “inhibition of BG message consistency reaction” (i.e. packet 145) then:

* the service brake shall be commanded
* the location based information stored on-board shall be shortened according to A3.4.1.2g,m (reference for unlinked BG's to 2.16.2.4.4.2 and 2.16.2.5.2)
* The driver shall be informed (3.16.2.4.4.3/3.16.2.5.3) about the reason of the intervention (i.e. text message XXXXXXXXX shall be displayed).

**3.16.2.4.1/3.16.2.6** If a message from a linked BG is not consistent while the “list of announced BG's” is not empty (i.e. linking is used on-board) then the on-board shall react according to the linking reaction, i.e.:

* if the linking reaction (as stored from Q\_LINKREACTION) in the “list of announced BG's” = “train trip” then ????????????????????????????
* if the linking reaction (as stored from Q\_LINKREACTION) in the “list of announced BG's” = “service brake” then
  + the service brake shall be commanded
  + the location based information stored on-board shall be shortened according to A3.4.1.2h (reference for linked BG's to 2.16.2.6.2)
  + The driver shall be informed (3.16.2.4.4.3/3.16.2.5.3) about the reason of the intervention (i.e. text message XXXXXXXXX shall be displayed).

**Functions:**

* Check the BG message consistency
  + Determine if the information/ which information shall be taken into account based on linking rules
  + Determine if the message is consistent (complete, without errors, etc.)
  + Determine if the linking reaction must be executed (plus additional actions)
  + Determine if the service brake has to be commanded (plus additional actions)
* Execute linking reaction (+……)
* Command service brake (+…..)

***Receiving “default balise information”***

RIU's, loops and (individual, not necessarily the complete group) balises can sent information indicating a fault in the underlying track side equipment. This is done using packet 254.

If the on-board receives a packet 254 then ???????????????????????????? IT SEEMS THAT IN THE RELATED PARAGRAPHS 3.16.2.4.8-9 ONLY A PART OF THE SPECIFICATION IS GIVEN.

relevant « filter » occurrences in Subset-26 :

* SUBSET-026-4-v330\_Modes-And-Transitions.txt:4.3.1.4 This document describes how the received information is filtered, respect to several criteria such as the level, the mode, etc.. (see chapter 4.8 “Acceptance of received information”).
* SUBSET-026-4-v330\_Modes-And-Transitions.txt:4.8.1.2 The following sections have to be interpreted by applying the filters as shown in Figure 3. The first filter is detailed in section 4.8.3 “Accepted information depending on the level and transmission media”, the third filter in section 4.8.4 “Accepted information depending on the modes”.
* SUBSET-026-4-v330\_Modes-And-Transitions.txt:Figure 3: schematic representation of the filtering of received information:
* SUBSET-026-4-v330\_Modes-And-Transitions.txt:4.8.5.1 If an order to switch to level NTC, 1, 2 or 3 at a further location has been received, the ERTMS/ETCS onboard equipment shall be able to store in a transition buffer (see figure 3, first filter) three sets of information obtained from three filtered messages.
* SUBSET-026-4-v330\_Modes-And-Transitions.txt:4.8.5.2 If a RBC transition order has been received and the Handing Over RBC is still the supervising one, the ERTMS/ETCS onboard equipment shall be able to store in a transition buffer (see figure 3, second filter) three sets of information obtained from three filtered messages from the Accepting RBC.

**Functions**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Occurrence** | **Type** | **Description** |
| Name | 1 | T\_Text |  |
| Definition | 1 | T\_Definition |  |
| *Input* | *0..n* | *T\_Variable* |  |
| *Output* | *0..n* | *T\_Variable* |  |
| *Local* | *0..n* | *T\_Variable* |  |
| *Parameter* | *0..n* | *T\_Constant* |  |
| *Requirement* | *0..n* | *T\_Requirement* |  |
| *Block* | *1 (optional)* | *T\_FunctionalBlock* |  |
| *Parent* | *0..1* | *T\_Function* |  |
| *Allocation* | *1* | *T\_System* | Kernel |
| Safety | 1 | Boolean |  |

**Variables**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Occurrence** | **Type** | **Description** |
| Name | 1 | T\_Text |  |
| Definition | 1 | T\_Definition |  |
| Source | 1 | T\_SourceDocument | Subset-26 |
| Nature | 1 | T\_VariableNature |  |
| MinimalValue | 0..1 | T\_Text |  |
| MaximalValue | 0..1 | T\_Text |  |
| SpecialValue | 0..n | T\_Text |  |
| Allocation | 1 | * Interface * Packet * Internal |  |
| *Requirement* | *1..n* | *T\_Requirement* |  |
| Store | 0..1 | T\_Variable |  |
| Resolution | 0..1 | T\_VariableNature |  |
| Safety | 1 | Boolean |  |

**Requirements**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Occurrence** | **Type** | **Description** |
| Name | 1 | T\_Text |  |
| Definition | 1 | T\_Definition |  |
| Nature | 1 | * Structural * Functional * Definition |  |
| Source | 1 | T\_SourceDocument | Subset-26 |
| Discussion | 1 (Optional) | T\_Text |  |
| Parent | 0..1 | T\_Requirement |  |
| Allocation | 0..1 | T\_System | Kernel |
| Safety | 1 | Boolean |  |

**Exported Requirements :**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Occurrence** | **Type** | **Description** |
| Name | 1 | T\_Text |  |
| Definition | 1 | T\_Definition |  |
| Source | 1 | T\_SourceDocument |  |
| Allocation | 0..1 | T\_System |  |
| Safety | 1 | Boolean |  |