

MEMORANDUM

To UNISIG
From Swiss ETCS System Manager, author: Bettina Wilhelm, SBB, I-AT-SAZ
Date 09.09.2019
Topic **Partial Implementation of CR782 in Switzerland**

1 Introduction

For running under ETCS supervision an on-board unit (OBU) requires certain location related trackside information, e.g. the length of the movement authority or the distance to the next speed restriction. The reference location for such location related trackside information is the last relevant balise group (LRBG).

While running the OBU calculates the estimated distance from the LRBG as well as a safe confidence interval, by considering the location accuracy of the LRBG and the over- or under-reading error of the odometry. Thus, ensuring that the real train front end is located inside the confidence interval defined by the min. and max. safe front end.

Subset-026, v2.3.0d, 3.6.4.3 [1] defines that the confidence interval shall be reset when the next linked balise group has been read. Because this definition does not cover all possible situations, the CR782 [2] was introduced in the Baseline 3 ERTMS specifications to clarify the relocation and the reset of the confidence interval when passing another balise group.

2 Problem description

Due to CR782, in Baseline 3 Subset-026, 3.6.4.3 [3] defines that the relocation of location related trackside information and the reset of the confidence interval always occurs when a new linked balise group, i.e. a balise group with Q_LINK = 1, becomes LRBG.

If linking (packet 5) is available on-board, the use of the linking information guarantees a safe relocation and reset of confidence interval.

In case no linking is available on-board, the relocation is performed nevertheless by assuming the estimated distance corresponds to the distance travelled. Similarly, the confidence interval is reset using the national or default value for the location accuracy. As both, the estimated distance and the national or default value for the location accuracy, can differ from reality, the real train front end can be outside the confidence interval after such a relocation. Depending on the real train front end being in advance or in rear of the confidence interval the consequences in target speed monitoring will be (see figure 1):

- The ETCS intervention (emergency brake or train trip) happens too late and the train can pass the danger point.
- The ETCS intervention happens too early and the train is braked unnecessarily or even tripped before reaching the signal at the end of the movement authority.

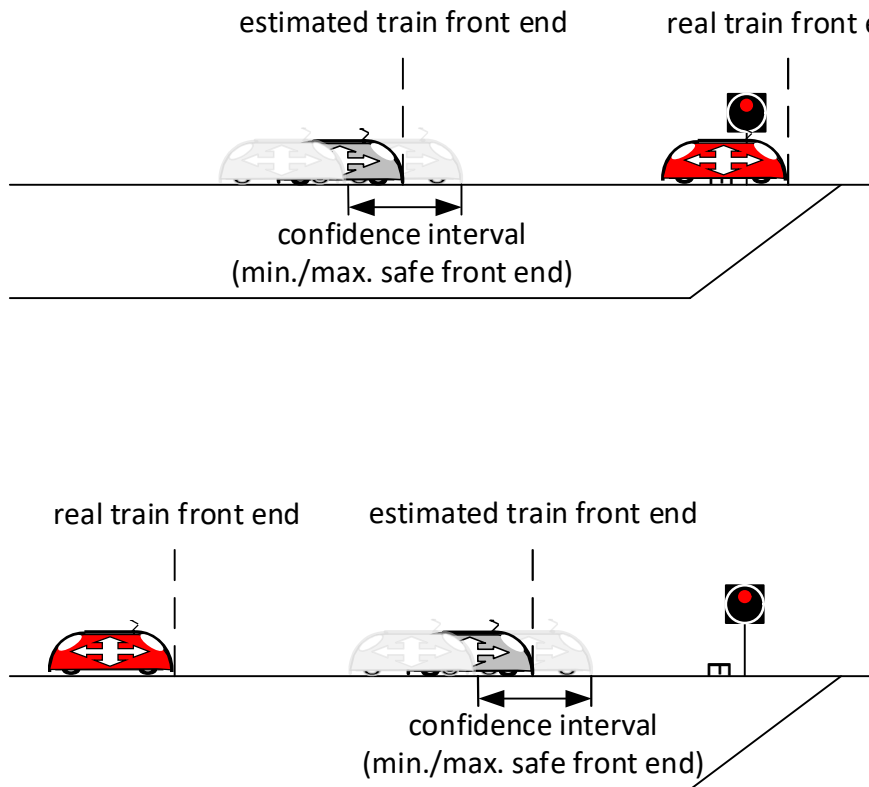


Figure 1: Real train front end versus confidence interval

Both consequences are not acceptable in operation. While a delayed ETCS intervention will lead to a potentially hazardous situation clearly affecting the safety, a premature ETCS intervention will negatively affect the stability and performance of the railway operation.

In addition, Subset-026, 3.6.4.7 [3] defines, that the OBU shall calculate an additional confidence interval for location related information transmitted by an unlinked balise group, i.e. a balise group with $Q_LINK = 0$. This confidence interval is also reset when another linked balise group becomes the LRBG leading to the train front end potentially being outside the confidence interval.

Already during the discussion of CR782 significant safety concerns were voiced by the industry (UNISIG) and the railways (EEIG) [2]. These safety concerns lead to CR870 [4], but neither that CR nor any changes to CR782 were introduced into the ERTMS Baseline 3 specifications [3]. Instead it was noted, that it is the trackside's responsibility to provide linking information when necessary.

However, it was not considered that using linking could be difficult or even impossible for level 1 applications with complex trackside topologies or old interlockings / signalling systems that do not provide point positions dependent information.

In addition, in case of an unlinked balise group transmitting a temporary speed restriction (TSR) the use of linking is simply impossible, since an unlinked balise cannot be included in the linking information.

Consequently, several suppliers have not (fully) implemented CR782 in their Baseline 3 OBU [5], [6] due to safety concerns. To date, no problems have been observed in operation with their Baseline 3 OBU.

On the other hand, trial runs in level 1 with one Baseline 3 OBU [7] that has fully implemented CR782, lead in several occasions to premature brake interventions by the ETCS supervision. Without any changes this OBU is not suitable for operation due to significant safety and performance problems.

3 Solution

In accordance with the decision of the design authority team (DAT) of the Swiss ETCS system manager [8] and the NNTR CH-TSI CCS-008 of FOT [9] any Baseline 3 OBU intending to operate in Switzerland in level 1 or level 2 shall fulfil the following requirements in order to avoid any negative impact on the safety, performance or stability of the railway operation:

- Req. 1 CR782 [2] shall only be partially implemented, i.e. the paragraphs 3.6.4.3 b), 3.6.4.7.1 and 3.6.4.7.2 of Subset-026 [3] shall not be implemented.
- Req. 2 Instead the OBU supplier shall implement the relocation and reset of confidence interval in a safe way also for an unlinked balise group or for a linked balise group in case no linking is available on-board.
- Req. 3 The supplier shall analyse the chosen solution to ensure there are no unmitigated risks. Mitigation measures, if any, shall be addressed to the vehicle owner or rolling stock operator as exported constraints.

A possible solution to fulfil Req. 2 could be:

For each unlinked balise group an additional confidence will be calculated. This additional confidence interval is only deleted when the location related information is deleted on-board (i.e. each location related information element can use its own confidence interval). The same behaviour applies for linked balise groups when linking information (packet 5) is not available on-board.

For unlinked balise groups this solution proposal is in line with CR870 [4].

References:

- [1] ERA, UNISIG, EEIG ERTMS Users Group: System Requirements Specification, Subset-026; version 2.3.0d; 21.04.2009
- [2] ERA: CR782; downloaded from the CCM database on 28.08.2019
- [3] ERA, UNISIG, EEIG ERTMS Users Group: System Requirements Specification, Subset-026, version 3.4.0 or 3.6.0; 12.05.2014 or 13.05.2016
- [4] ERA: CR870; downloaded from the CCM database on 28.08.2019
- [5] OBU Supplier 1: Reference document – confidential
- [6] OBU Supplier 2: Reference document – confidential
- [7] OBU Supplier 3: Reference document – confidential
- [8] SBB, Swiss ETCS System Manager: Stand ERTMS Change DAT 358; 05.09.2019
- [9] FOT: Notified National Technical Requirements (NNTR), CH-TSI CCS-008; September 2019