Defining engineering design requirements to address operational scenarios for ERTMS infrastructure systems

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Overview

- Introduction
- Harmonising operational rules
- New demands on infrastructure subsystems
- Specifying design requirements for trackside subsystems
- Harmonising safety and dependability
- Perspective
Situation today

Source: ERRI A200
Harmonisation by fulfilling all national requirements

24 Antennas leading to effort in investment, space and maintenance!
Introduction

- ERTMS/ETCS is the coming standard for train control in Europe.
- Technical interoperability is ensured by the UNISIG specification ("List of Madrid").
- National rules and regulations for operation will used on the new ETCS lines without or only with small modifications.
- Harmonising operational rules is still needed to reach operational interoperability.
- Safety and dependability are assessed today due to national regulations.

ERTMS: European Rail Traffic Management System
ETCS: European Train Control System
Interoperability is harmonisation of technology as well as operation

Technical Interoperability:
- specification of the data exchange between on board and trackside systems
- functional specification of the systems
- definition of the non-functional characteristics, e.g. RAMS

Operational Interoperability:
- harmonised rules for safe normal (and later fall-back) operation
- harmonised use of the system: e.g. marker boards and written forms

RAMS: Reliability Availability Maintainability Safety
Harmonising operational rules

- **Definition of the domain:**
  - Types of trains: push/pull, multiple units, etc.
  - Roles of the personnel: signaller, driver, etc.
  - Etc,

- **Defining generic scenarios:**
  - Start a train
  - Running in normal operation
  - Etc.

- **Work done:**
  - EEIG ERTMS Users Group: Functional Analysis, scenarios, etc.
  - EuroInterlocking: trackside scenarios
Harmonisation needs time

Railway Operation Procedures:
- described in national rules and regulations as well as knowledge
- national different
- description only as text and figures
- Validation by use
- Comparison only partially possible
- no „purification“ of obsolete aspects possible due to feedback effects

Status DB AG 2005 after more than 10 years of common operation!

<table>
<thead>
<tr>
<th>DS 301</th>
<th>DV 301</th>
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<tbody>
<tr>
<td>§ 1 (7)</td>
<td>Wird im Einzelfall ein Signal nicht deutlich wahrgenommen, muss die Bedeutung angezeigt werden. Die große Vorsicht erfordert.</td>
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<tr>
<td>§ 1 (8)</td>
<td>Die durch Signale vorgeschriebenen Geschwindigkeiten gelten, sofern nicht im Fahrplan, durch einen anderen schriftlichen Auftrag (Ls, Befehl, Fahrplan-Meldung) oder durch andere Signale eine niedrigere Geschwindigkeit vorgesehen wird.</td>
</tr>
<tr>
<td>§ 1 (10)</td>
<td>Lichtsignale, an denen Halt gezeigt werden kann, sind durch Mastschilde gekennzeichnet, die das Verhalten bei Halt zeigend oder gestörtem Signal vorschreiben. Die Mastschilde können rückstrahlend sein.</td>
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</table>

Source: DB AG DS/DV 301
New demands on infrastructure subsystems

- Overall Interoperability is ensured by the on board subsystem of ETCS.
- Performance is defined mainly by the trackside parts of ETCS: RBC, Infill, Loops, etc.
- Migration via ETCS Net and the corridor concept => modular concepts and flexible combination are needed e.g. filling gaps between Level 2 areas with ETCS Level 1 Limited Supervision.
- Current performance must be kept or surpassed with ETCS.
- Complete new lines with specific requirements have to be integrated in existing networks, e.g. the tunnels AlpTransit Lötschberg and Gotthard.

RBC: Radio Block Centre
ETCS: European Train Control System
Existing specifications for the system as well as for on board and trackside subsystems

Overall system: subsets 026, 040, 041, 054, 055, 076, 108, 023, 030

RBC: subset ?, 032
RBC-RBC: subset 039
Infill: subsets 046, 047, 048, 032

DMI: subset 033, WGA9D

OBU: subsets 026, 027, 076, 108, 031
STM: subsets 035, 056, 057, 058, 059

EuroBalise: subsets 036, 049, 032
EuroLoop: subsets 043, 044, 045, 050
EuroRadio: subsets 037, 038, 093, 032, 060

STM: Specific Transmission Module
RBC: Radio Block Centre

DMI: Driver Machine Interface
OBU: On Board Unit

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Specifying design requirements for trackside subsystems

- Consistent representation of onboard as well as trackside operational rules is needed as basis.
- The trackside subsystem of ETCS bridges the gap between route protection and train control on board functionality and communication defined by European standards.
- Functional requirements must be specified together with non-functional requirements as performance and RAMS.
- This work must be done already for the tendering process!
- The final performance of the ERTMS system is limited mainly by the trackside subsystem.

RAMS: Reliability Availability Maintainability Safety
Harmonising safety and dependability (RAMS)

- Common safety targets and methods must be defined for cross acceptance and European certification and homologation.
- Current situation analysis and first definitions given by the projects SamNet and SamRail.
- A complete RAMS requirements specification for Europe must be done in the next step to reach a real “European Certification” of systems and subsystems.
- First definition of harmonised requirements proposed by the project EuroInterlocking.
- The European Railway Agency will play the central role in this process.
Harmonising safety and reliability

Example for the safety allocation problem

- Identification and comparison of rules and regulations for safe normal and fallback operation needed.
- Comparison of rules for the allocation and distribution of safety responsibility to trackside and on board.
Interoperability needs harmonisation of safety

Safety Interoperability:
- specification of the data exchange between on board and trackside subsystems
- functional specification of the system
- definition of the non-functional characteristics
Interoperability is needed to keep Railway competitive in Europe.

Interoperability contains several aspects: technical, operational and safety.

On board functionality and communication is well specified at the moment.

The specification of the trackside subsystem functionality of ETCS is still a national task and only a few harmonised specifications are available.

Operational and safety harmonisation started already, bit a long way must still be gone.

Nevertheless: ERTMS will be the future standard!
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Thank you for your attention!