Level Crossing Test Methodology

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Structure

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- Project context
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- Implementation of a level crossing
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- Application potential and future work
Introduction

- New technologies as well as modified systems need to be tested and validated
- LC are dependent on train control systems; therefore LC have to be considered due to new and modified systems for train control systems
- A product according to an European harmonized approach needs a conformity declaration (e.g. ETCS on board units)
- A consensus between suppliers, certifying entities and independent laboratories is required to reduce integration effort and to ensure comparability of results
- DLR’s task in SELCAT: Use of conformity testing laboratories and testing methodology
Project context

- For ERTMS/ETCS an European Standard for Testing Architectures (ETCS Subset 094) as well as a format and method for test definition (ETCS Subset 076) exist.

- Two laboratories fulfil these requirements:
  - LIF (CEDEX, Madrid, Spain)
  - RailSiTe (DLR, Braunschweig, Germany)

- Level Crossings are included in ETCS issue 3.0.
RailSiTe: Design

- Vehicle
  - Driver Movement (rotating wheels)
- Train Control System
- Operator
  - Physical Track
- Track
RailSiTe Design

➤ Distributed Architecture
➤ Air Gap
Current state of the RailSiTe

- ETCS test performed in
  - full operation
  - including interlocking
  - driver’s desk
  - environment visualization

- Level crossing integrated

- Certified by German notified body (EBC)
## Excursion: Kinds of LC safety systems

<table>
<thead>
<tr>
<th>Principle</th>
<th>Comment</th>
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<tbody>
<tr>
<td>Interlocked with main signal</td>
<td>Signaler controls LC due to track route locking (Hp)</td>
</tr>
<tr>
<td>Train Controlled (supervising by Operator)</td>
<td>In case of fail LC is closed (Fü)</td>
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<tr>
<td>Train Controlled (supervising by Driver)</td>
<td>Stand-alone system without integration in a control center (ÜS)</td>
</tr>
<tr>
<td>(gatekeeper)</td>
<td></td>
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Integration of LC in RailSiTe

1. Step: Integration complete LC-System here: stand-alone System

Tests of LC-System possible; but

- No detailed test concerning LC-System Components
- No assessment of impacts of level crossing failure to the entire train control system
- No assessment of further impacts to operation (timetable)
- No assessment of interlocking integrated LC
Integration of LC in RailSiTe

2. Step: Modification of LC-Control Unit

LC-System
- Barrier
- Warning sign
- Traffic light
- Signal
- Control Unit

railSiTe

Activity Signal

Status (succeeded, failed)

Data Base

Level Crossing Simulator

Route Map Controller

Route Map Controller
Integration of LC in RailSiTe

2. Step: Modification of LC-Control Unit

![Diagram of LC-Control Unit, Connector box, Motor, and signals such as Activity Signal 1 + 2, Status Signal, End Position Signal, Modified Status, and DLR Connector Box.]
Enhanced Test Options

- Detailed tests concerning LC-System Components
  - Simulation the whole LC-Process
  - Knowledge about timing
  - Variation of approaching time and approaching distance
  - Failure of any LC-Components
- Assessment of impacts to the integral train control system
  - Feedback of behavior other Train Control System Components
  - Determination of time of failure until reset
- Assessment of further impacts to operation
  - Impacts to the timetable
  - Propagation of delays
- Assessment of all kinds of LC
  - Control center integrated LC
  - Train Controled LC (supervising by Operator)
  - Others
Applied Approach Simulation

- Using simulation environment defined for ERTMS
- Two development steps were done
- Two layers of integration
  - Railway operation:
    - commands for closing and opening of the LC
    - Status reports for reaching end upper and lower end position as well as error codes
  - Road traffic supervision:
    - Danger zone supervision by Radar, Video etc.
    - Integration of traffic sign controls
- First layer is done, second to be done
Obtained results

- Draft specification of a laboratory architecture and interfaces are done in accordance to the ETCS subset 094

- Test method of subset 076 can be applied to LC, too
  Test cases and sequences have to be defined

- Integration and control of Hardware-in-the-loop is possible and leads to realistic results

- Integration and control of danger zone supervision by video has to be done
Application potential and future work

- Harmonized and comparable tests for LC in Europe in accordance with ERTMS are possible (Test demonstration can be visited in Braunschweig)

- Integration of danger zone supervision is object of current and ongoing research

- Conformity tests can be defined by method and approach developed by the DLR and used for ERTMS (method and tests sequences can be found at the ERA)

- A further perspective of this modeling is to develop and evaluate new kinds of LC as well as their integration with ETCS
Thank you for your attention!