

Level Crossing Test Methodology

Carla Eickmann, Markus Pelz, Michael Meyer zu Hörste (DLR FS)



Structure

- Introduction
- Project context
- RailSiTe laboratory
- Implementation of a level crossing
- Applied approach and obtained results
- 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

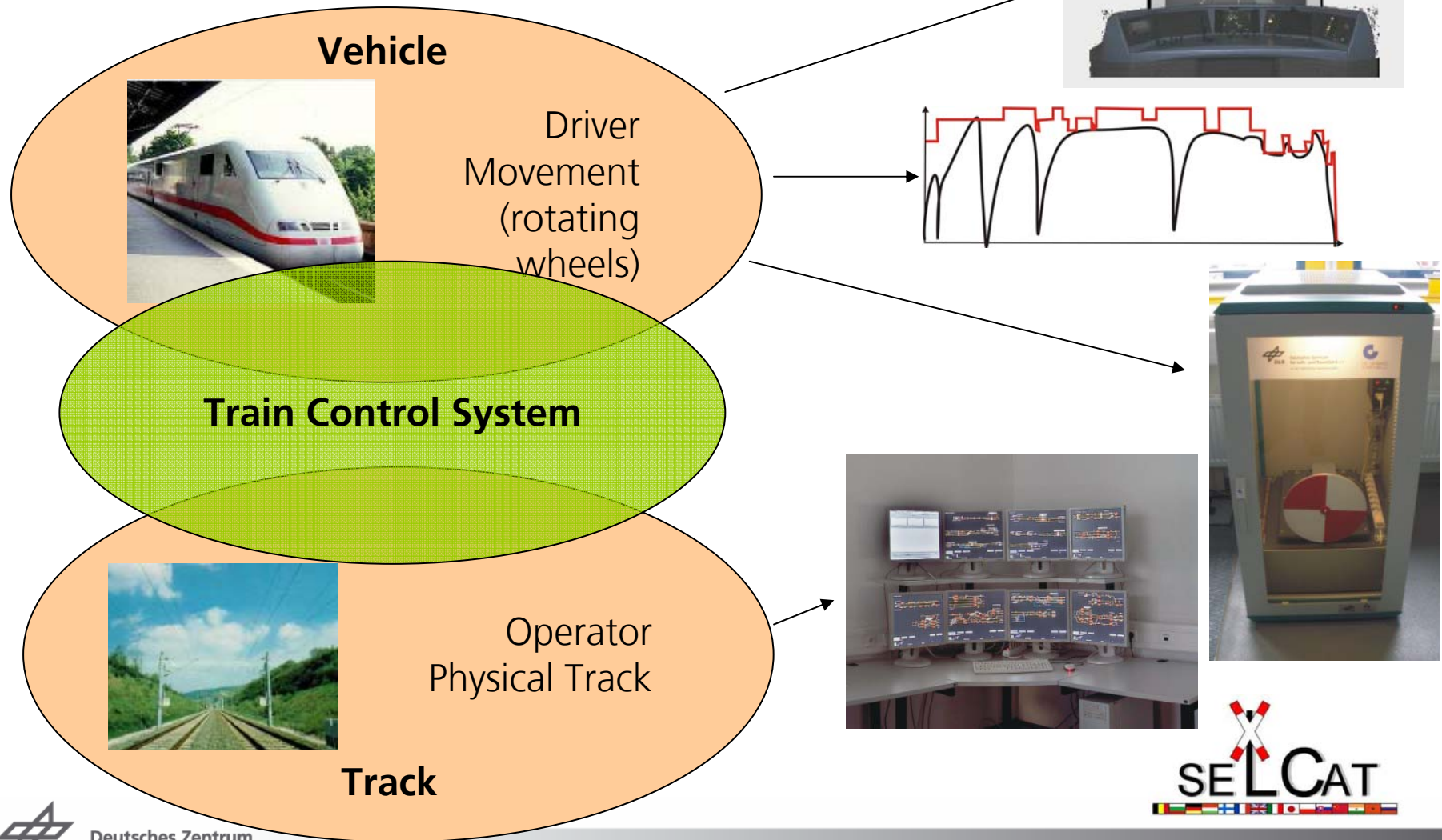


Project context

- 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



RailSiTe Design

- Distributed Architecture
- Air Gap



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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)



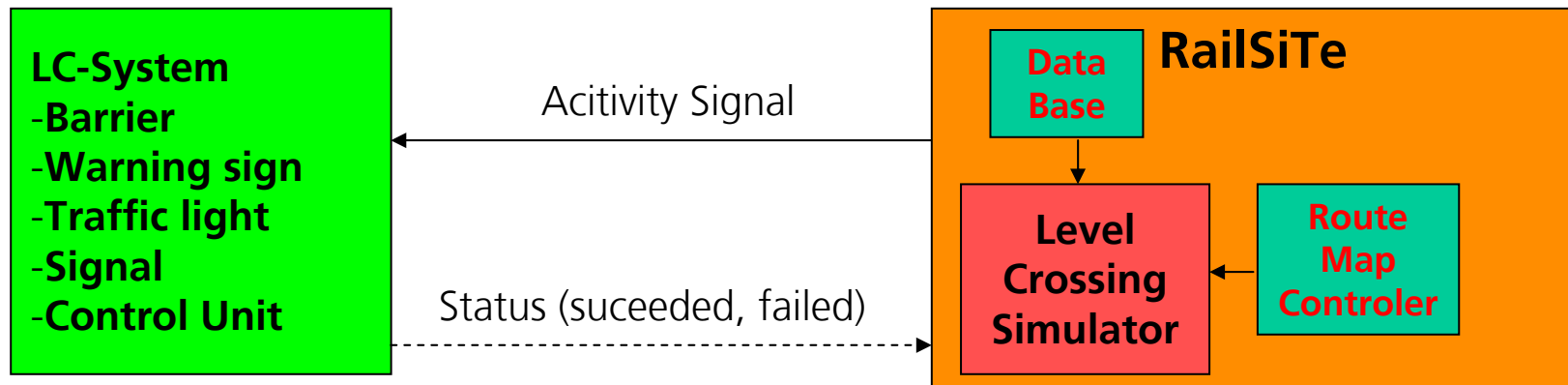
Excursion: Kinds of LC safety systems

Principle	Comment
Interlocked with main signal 	Signaler controls LC due to track route locking (Hp)
Train Controled (supervising by Operator) 	In case of fail LC is closed (Fü)
Train Controled (supervising by Driver) 	Stand-alone system without integration in a control center (ÜS)
(gatekeeper)	



Integration of LC in RailSiTe

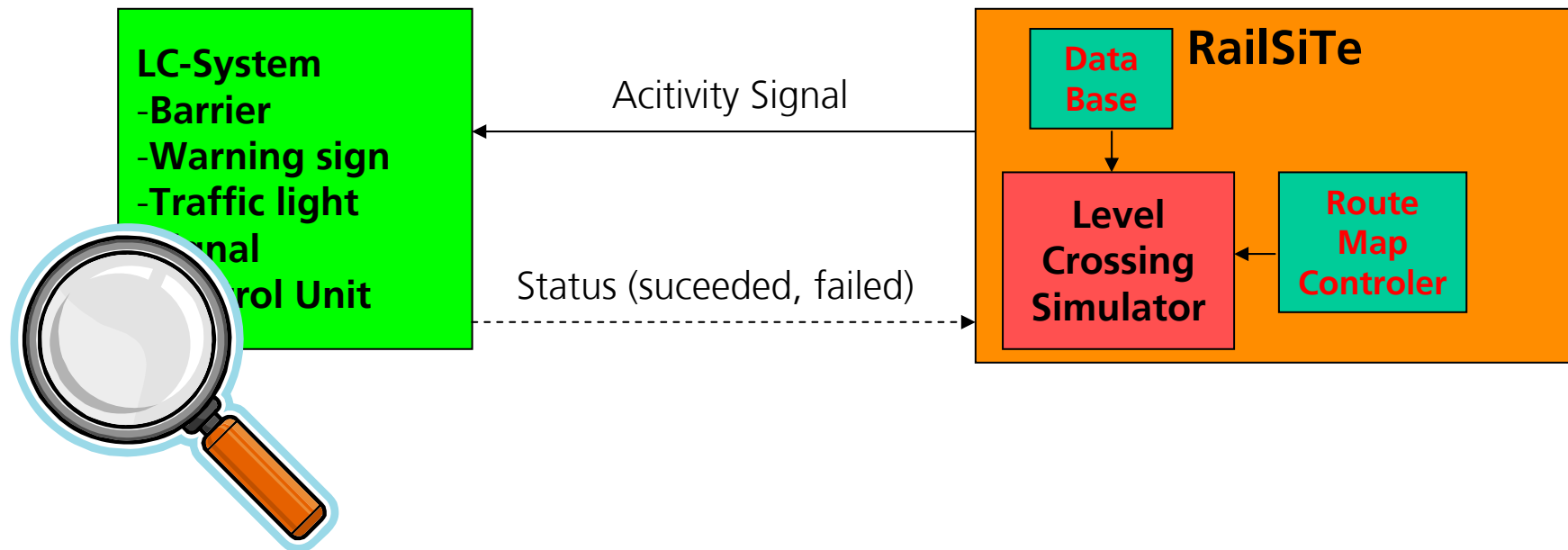
➔ 1. Step: Integration complete LC-System here: stand-alone System



- 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

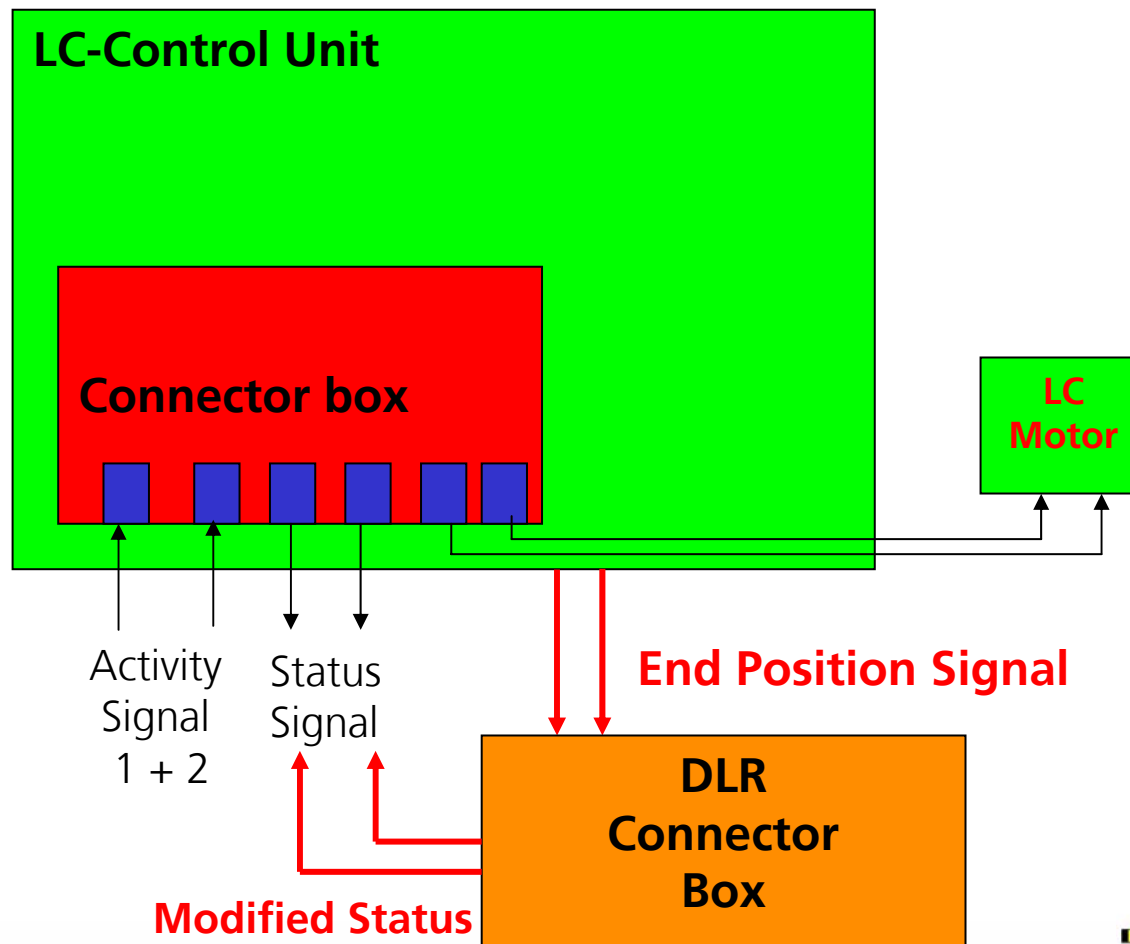
Integration of LC in RailSiTe

→ 2. Step: Modification of LC-Control Unit



Integration of LC in RailSiTe

→ 2. Step: Modification of LC-Control Unit



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 Controlled 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!



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