Generic Operational Requirements for Video based Applications at Level Crossings

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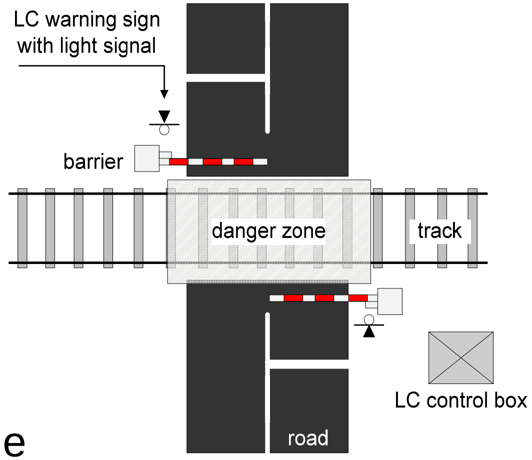
Content

- Motivation
- Current state
- Operational requirements
- Video based applications
- Summary

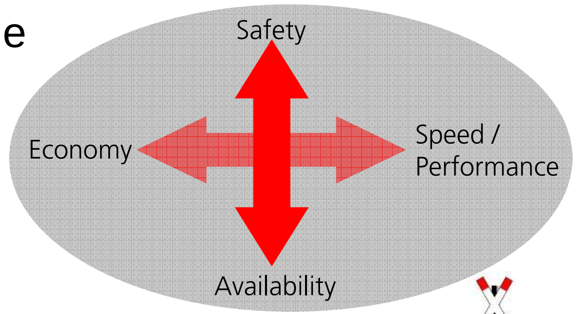
Motivation

- There are many level crossings (LC) all over the world
- There are numerous incidents at LC with high damages to material and fatalities
- There is no danger zone supervision at LC that have only flash lights or half-barriers
- Many accidents occurred due to
  - mistakes in noticing or obeying the warning signs
  - non detection of breakdown vehicles at danger zone



Target

- Identifying a LC safety system which is included in the European way of harmonized development
  - For a higher level of safety where needed
  - For a simpler way of approval where needed
  - For better operative conditions
  - For more cost-efficient solutions



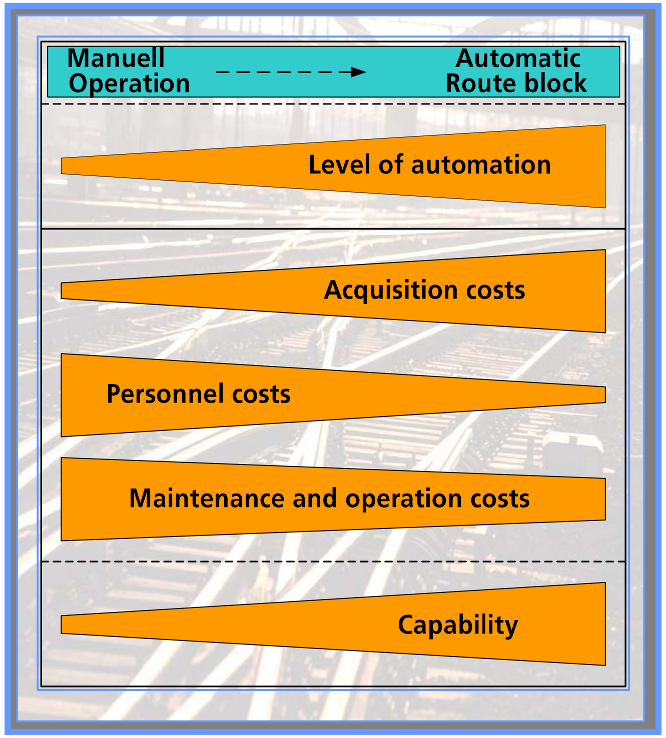
Motivation
Our project expertise in safety

- Analyzing safety systems by using Failure Mode and Effects Analysis
- Identification of accidents by using Why-Because-Analysis
- Safety cases for railroad vehicles
- Cross Acceptance of safety relevant applications
- Certification roadmap for signal in space for future GNSS
- Study about measures for improving safety
- Interlocking simulation at RailSiTe (DLR Railway test and validation laboratory)

Motivation

Our project expertise in operational requirements

- Operational rules definitions for ERTMS
- Operational requirements and operational impacts of new technology
- Development of adequate safety case procedures
- Integration of LC in testing and simulation facilities
- Economic evaluation of operation procedures



Current state
Video based applications

State of the art

- Train departure is dispatched by the driver
- Monitoring of LC danger zone

All applications are only supporting tools without safety relevance

Current state
Activation of LC safety systems

Interlock through main signal (Hp)
- Activating LC through interlocking system
- To set signals → LC must be safe
- *Principle: locking - verifying – driving*

Control through signaler (Fü)
- Activating LC through train
- Control LC at interlocking system → signaler
- *Principle: activating - driving - verifying*

Control through train driver (ÜS)
- Activating LC through train
- Control LC at LC signal → train driver
- *Principle: driving – activating – verifying*

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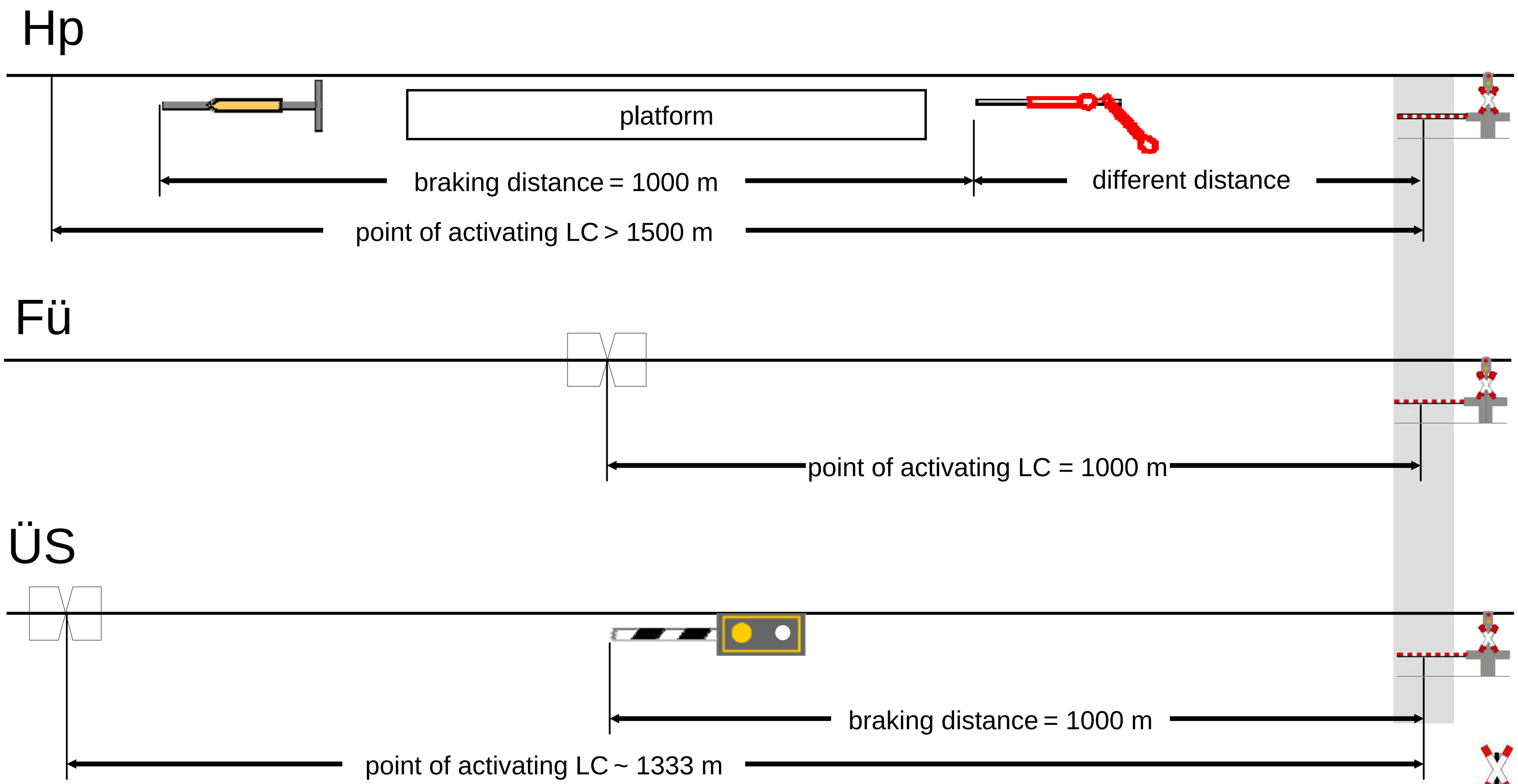
Current state

Activating distances for LC at 120 km/h



Operational requirements
For safety systems at LC

New LC safety system has to

- be available and reliable during operation
- support staff **and** support safety technology
- reduce accidents at LC
- decrease waiting time for road traffic users
- decrease the extend of damage (reduce speed of collision)

LC safety system can be characterized by detection of obstacles at LC ➔ This case is the first regarded objective

Detection at LC has to

- activate and de-activate the LC safety system through train localization
- detect road traffic users at danger zone while train approaches
- warn signaler or train driver if obstacle is in danger zone

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Operational requirements
Using video to support state of the art technology

Potential solutions to support existing LC systems by using video

- At full barrier
  - Automatic danger zone supervision (high safety relevant)
  - Closed full barrier system within a “call” function to open barrier automatically

- At half barrier system and systems with flash lights
  - Automatic obstacle detection between barriers
  - Obstacle detection to inform, to warn, to brake the train
  - Detection of the closing barriers (availability)

- At passive (non-technical locked) LC
  - Live-view-transmission for train driver to enlarge his sight

Operational requirements
Using video to support state of the art technology

Example

- Supervision system at LC based on video
  - Activation of video supervision when LC is locked
  - The video based supervision system has to identify its own availability permanently
  - If not available → fall-back system has to start

- Fall-back system for using automatic video supervision
  - Closing the barriers
  - Train driver operational procedures
  - The signaler as fall-back together supported by live-view-transmission

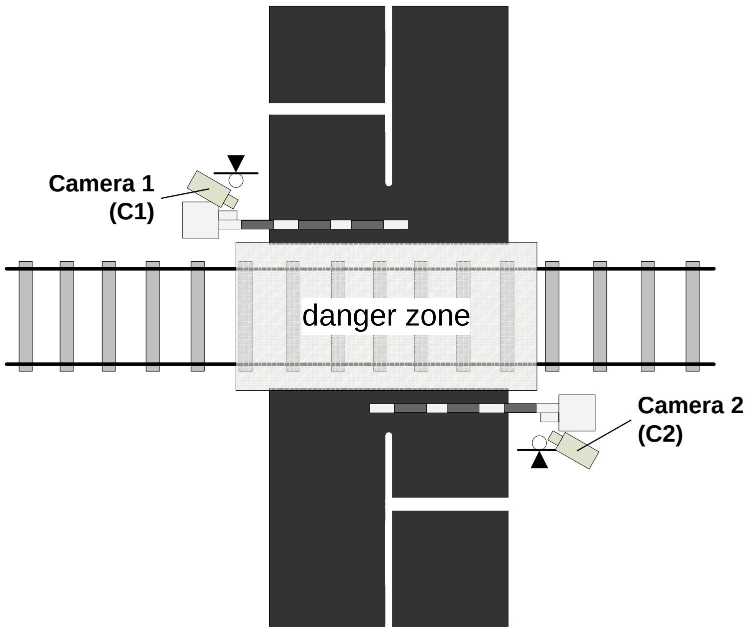
Idea of video based application (example)
Danger zone supervision at half barrier LC

Situation

- Level crossing secured with
  - half-barriers,
  - flash lights and
  - **no** danger zone supervision.

Solution

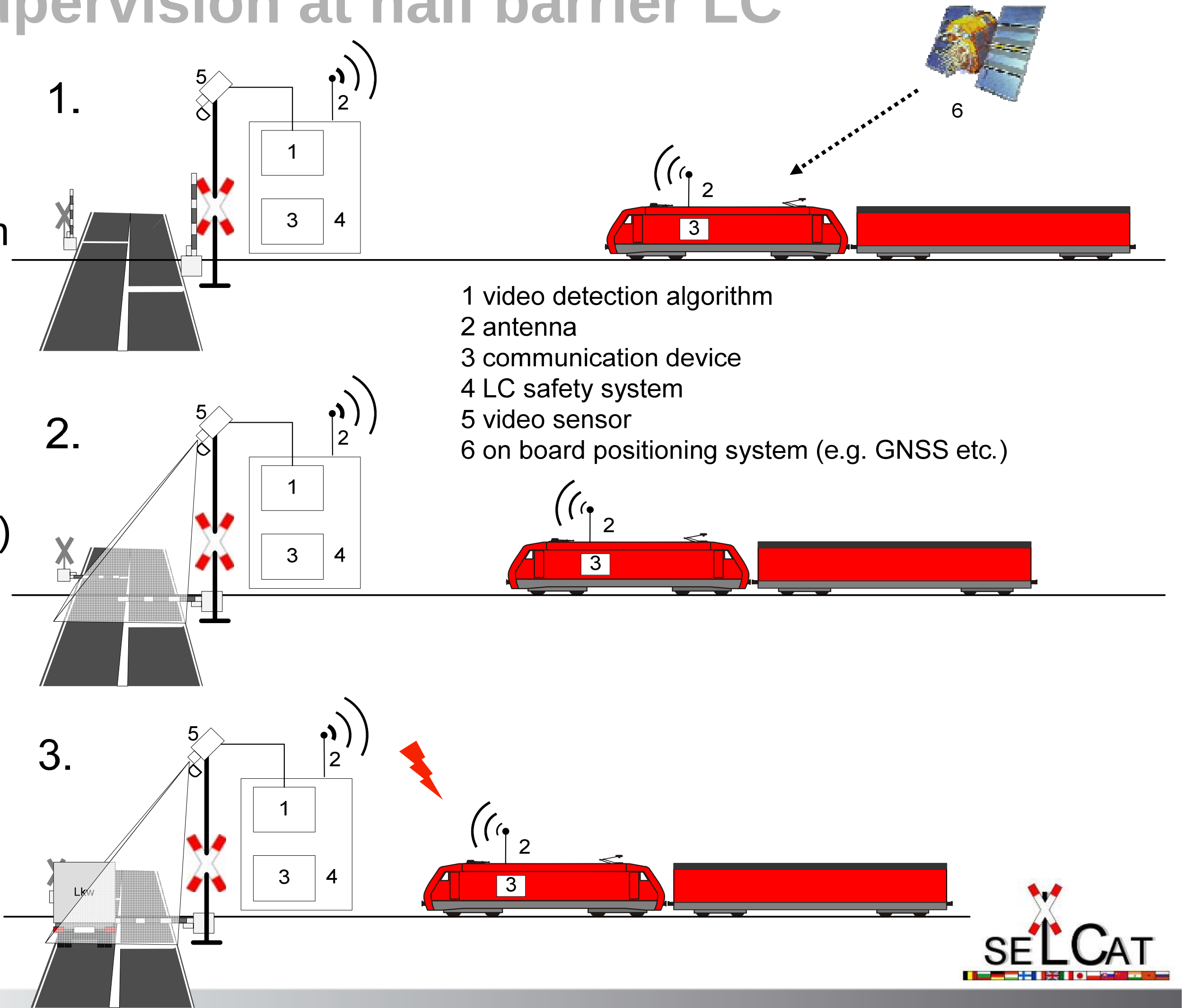
- Two camera system
  - Support existing safety system
  - One camera at each barrier
  - Mounted on warning sign
  - Each camera consists of
    - visible ranges (video) and
    - non-visible (infrared)



Idea of video based application (example)
Danger zone supervision at half barrier LC

Operational integration

- Activation by transmission via broadcast
- Reduced waiting time for road traffic users (optimized activation time)
- Detection of road traffic users which are between the barriers
- Warning and automatic braking in case of danger



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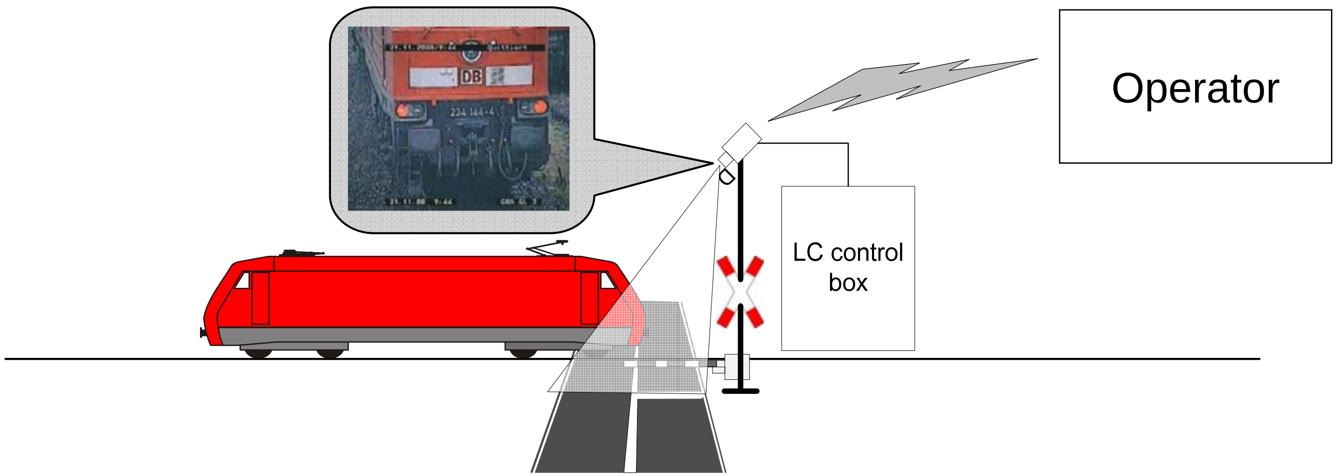
Idea of video based application (example)

Danger zone supervision at half barrier LC

Conclusion

- Supervision; obstacle detection; end of train detection (for de-activating LC)
- Video-system (alert) output application possibilities
  - Warning to the operator / signaler (→ *to long reaction time*)
  - Warning to the train driver (→ *human factor, concentration*)
  - Automatic braking system with radio system (RCAS[1]) (→ *safe transmission*)



[1] Railway Collision Avoidance System

Summary

- The implementation of video based technology can help to increase the safety at level crossings.
- Innovative systems using video based technology can be an economical alternative to existing units.
- Important facts for the impact of a video based system
  - Describing the rules for a fall-back system
  - Don’t forget the transmission!
  - Don’t forget the human factors → road and rail (situation awareness)!
- To implement and admit an innovative system,
  - intensive test campaigns are necessary,
  - the specific operational requirements have to be defined,
  - discussions with assessors can help to find a suitable solution.

- The Institute of Transportation Systems of the DLR is developing a video based system for LC and will evaluates it several field tests.

Thank you for your attention

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