In-vehicle warning system for railway level crossings - testing the technical implementation

Risto Öörni, Ari Virtanen, Veli-Pekka Kallberg

Objectives

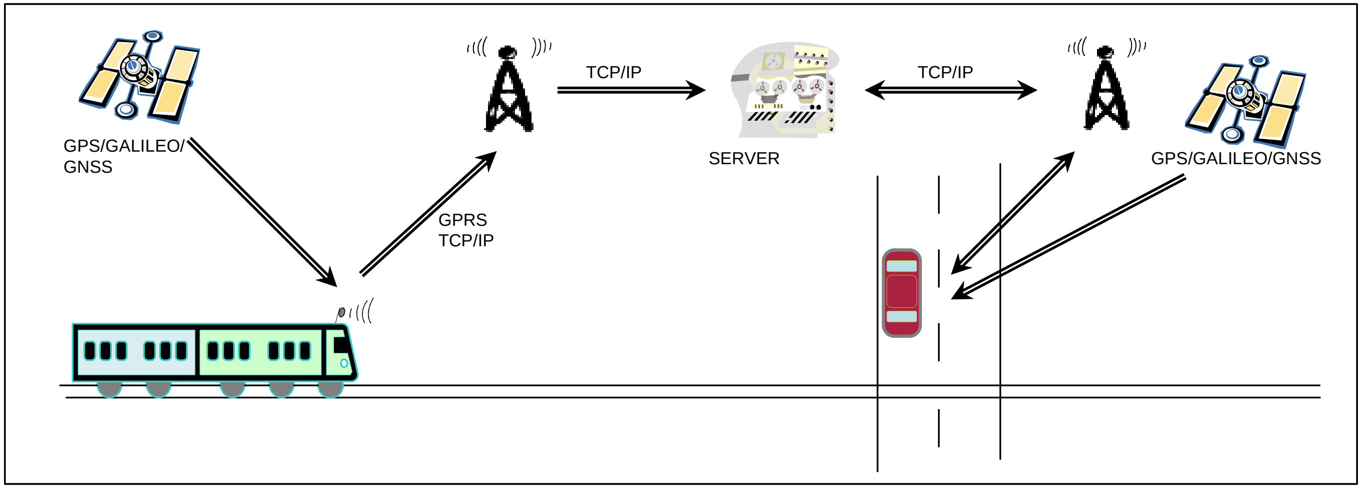
- implement an in-vehicle warning system for railway level crossings
- verify the functionality of the built prototype
- assess, whether the needed functionality has been achieved
- prepare recommendatios for future action

Methods

- The piloted system was implemented in a scale which allows testing (one train device, server and one in-vehicle device)
- The operation of the in-vehicle device and reliability of positioning and data communications were observed in a field test
- In the field test the following matters were documented with a video camera:
  – The operation of the in-vehicle device and the fixed warning systems installed on the level crossing
  – Movements of the vehicle and the rail-bus equipped with the train device
- Data communications between different components of the system were monitored with Ethereal protocol analyser

Lappohjan satama level crossing, Hanko

Technical architecture



- The train device sends the location of train to the server
- The state of every level crossing (approaching/alarm/ passed/no data) is calculated on the basis of the locations of trains and coordinates of level crossings. The server sends replies to queries sent by in-vehicle devices.
- The in-vehicle device detects the situations, in which the vehicle is approaching a level crossing. Detection is based on satellite positioning and a database containing coordinates of all level crossings in Finland. When the vehicle is approaching a level crossing, the in-vehicle device sends a query to the server and warns the driver if a train is approaching

Prototype

- The in-vehicle device, server and train device were implemented as PC computers
- GPRS and TCP/IP were used for data communications between different parts of the system
- Commercially available GPS devices were used for positioning
- During the field test the train device was installed in a rail bus running between Hanko and Karjaa

Results of the field test

- **During the testing day four tests were made**
- **Movements of the rail bus and the test vehicle and the operation of the in-vehicle device and the fixed warning system were successfully documented in three of the four tests**
- **In three successfully documented cases the warning system operated as expected**
- **In one unsuccessful case, the in-vehicle device warned the driver and the fixed warning system activated. Because of bad timing and poor visibility, the movements of the rail bus couldn't be documented.**
- **No false alarms were reported during the testing day**

Discussion and analysis

- **The in-vehicle device warned the driver in all four cases**
- **No false alarms were reported during the testing day**
- **Only small problems, which can be easily fixed, were reported**
- **In all successfully documented cases the in-vehicle device warned the driver as expected**
- **The needed functionality was achieved**

Conclusions (1)

- A production-phase system can probably be developed on the basis of the piloted system
- The safety effects of the system and potential challenges related to a large-scale implementation can be studied by starting a pilot, which operates in a limited geographical area
- Implementation with reasonable high quality is essential to achieve the expected safety effects

Conclusions (2)

- Before a production-phase system can be built, a realistic business model should be found
- The production-phase system should be a added as part to the overall ITS architecture
- User view and usability should be taken into account when designing the a larger pilot or the final production-phase system
- The real-life benefits aof the system should be assessed with proper evaluation studies

Questions?