



Development of in-vehicle warning device for railway level crossings

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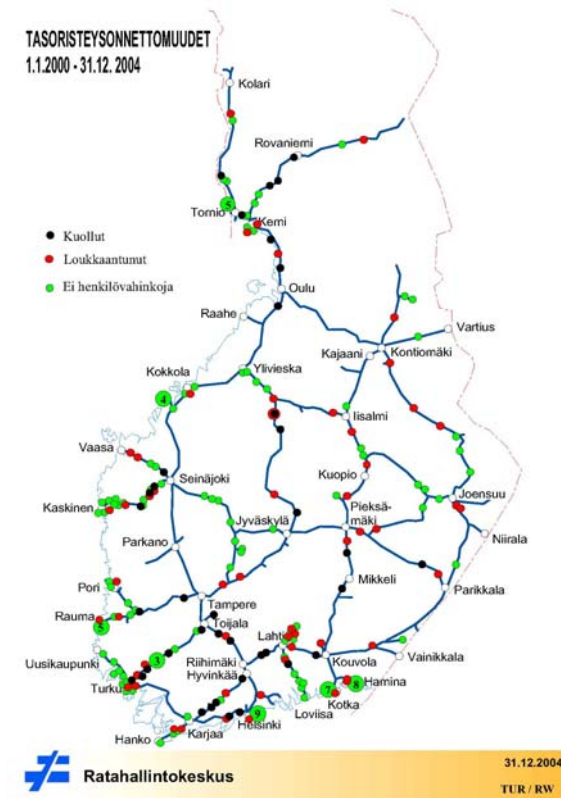
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BACKGROUND

- 52 accidents in year at railway level crossings, 7 dead, 2 seriously injured (year 2004, Finland)
- Removing all railway level crossings is prohibitively expensive
- Most railway level crossings located in rural areas with few traffic and far away from electric power grid. Investment in trackside active warning devices doesn't seem to be justified
=> Could an in-vehicle warning device improve safety?



METHOD

- Studying the existing in-vehicle warning systems and devices
- Defining the needed functionality
- Identifying the constraints that should be set to the device
- Evaluating the available technology
- Sketching technical solutions worth considering
- Evaluating the obtained solutions

REQUIREMENTS

- Should operate in all types of railway level crossings in Finland
- Minimal amount of false alarms, the system should warn the driver when he or she is driving to a level crossing and a train is approaching
- No new trackside infrastructure
- Should be economical to implement and operate
- Can be implemented with existing technology
- Shouldn't create the "false" feeling of safety



REQUIREMENTS (2)

- Should operate in all types of railway level crossings in Finland
=> Little assumptions can be made for the surrounding road network, movements off trains etc.
- Minimal amount of false alarms, almost all approaching trains should be detected
=> The technology used for communication between different parts of the system should be as reliable as possible
=> Need to know the positions/movements of trains, not just presence of a train!



REQUIREMENTS (3)

- No new trackside equipment needed
 - => The position information of trains should be produced by on-board equipment installed on trains
- Should be economic to implement and use
 - => The in-vehicle device must not be expensive to buy or to install in a car
 - => Costs caused by data communications should be kept low, costs to end-user should be kept to minimum
 - => Commercial-of-the-self (COTS) hardware should be used as much as possible
 - => Commonly available hardware and software components should be used to avoid high development costs

COMPONENTS OF THE PROPOSED SYSTEM

- Need for
 - data communications between different parts of the system
 - a way to know, whether a train is approaching a railway level crossing
 - a way to know, whether the car is approaching a railway level crossing
 - an in-vehicle warning device with suitable user interface

COMPONENTS OF THE PROPOSED SYSTEM (2)

- How to detect, whether a car is about to cross the railroad or not?
 - A database of all railway level crossings is available in Finland; the prices of GPS receivers are coming down
=> When the position of the car is known, the distance to the nearest railway level crossing can be calculated every second. The simplest way is to test, whether the newer distance values are smaller than the older ones **and** the newer values are below some defined threshold. If both of the previous are true, the car can be assumed to be coming closer to the railway level crossing

COMPONENTS OF THE PROPOSED SYSTEM (3)

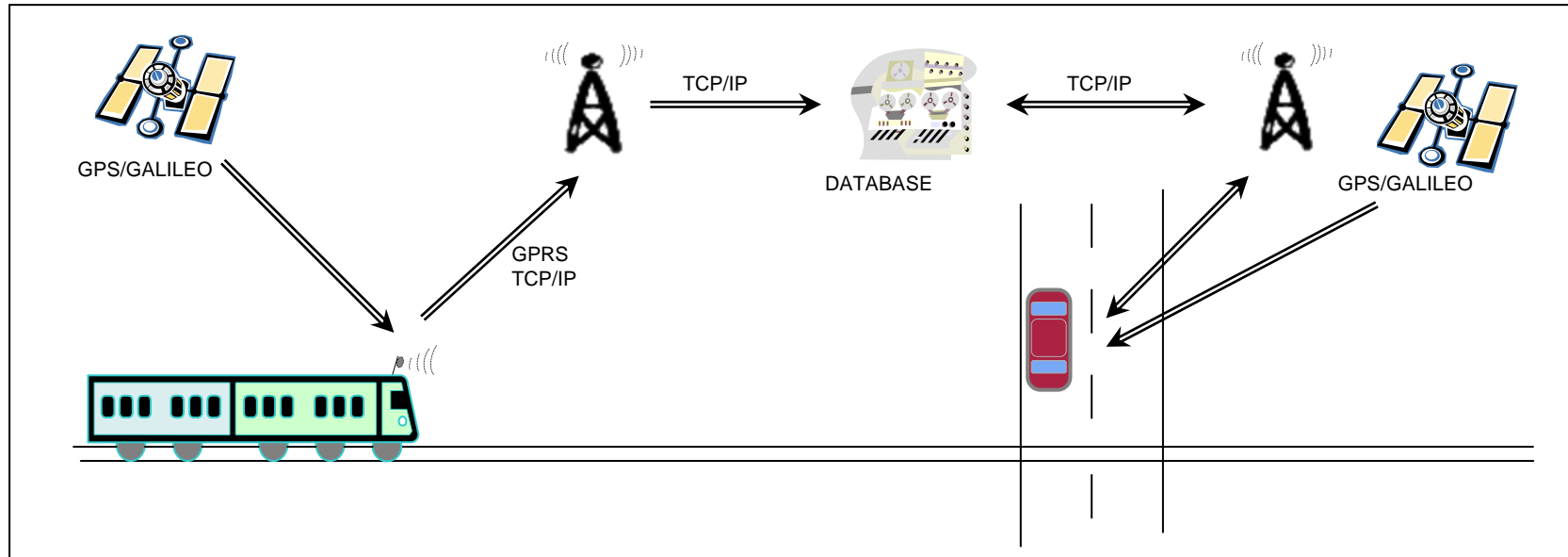
- How to detect, whether a train is approaching that specific railway level crossing?
 - A satellite navigation device installed on a train produces information on the location of the train. The train location data is transmitted to a server
 - One can assume that the speed of a train doesn't change rapidly
- => When the position of a train and location of the level crossing is known, one can calculate distance. When the newer distance values are smaller than the old values and they are below a defined threshold, one can assume, that a train is approaching!

COMPONENTS OF THE PROPOSED SYSTEM (4)

- Data communications
 - Should be cheap **and** reliable **and** widely available
=> GPRS (General Packet Radio Service)
- An in-vehicle warning device
 - Should be able to communicate with the user
 - Should have GPRS and GPS functionality or interfaces to connect them as peripherals
 - Open programming interfaces and suitable software development tools needed

=> May be a mobile phone, a laptop installed in car...
or a dedicated warning device

THE WHOLE PICTURE



The train equipment sends the location of the train to the database every tenth second, the in-vehicle equipment detects, when the car is approaching a railway level crossing, then fetches the train location data from the database and warns the driver if needed

ANALYSIS

- The described solution meets the requirements reasonably well
- Possible problems to be solved
 - Long delay of a GPRS connection
 - Reliable operation of GPS in railway environment
- Similar kind of systems have been patented in the USA
 - US 5739768, 1998, Train Proximity Detector
 - US 6345233, 2002, Collision avoidance using GPS device and train proximity detector
 - Fortunately, the former patent has been filed in time only in six EU countries; the application for the latter one has been deemed to be withdrawn in EU

MARKET SURVEY

- A market survey was conducted in spring 2005
 - 11 end-users from different organisations were interviewed
 - End-users' attitudes towards the system were mostly positive
 - The price of in-vehicle device and costs to end-user are critical

FUTURE

- A pilot study in 2006
 - A prototype will be built and tested
 - If the needed functionality has been achieved, the prototype will be piloted with real end-users
 - A rough estimate of the benefits and costs of a nationwide system will be calculated

THANK YOU!