DLR

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Requirements for Safety Relevant Positioning Applications in Rail Traffic

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Overview

- Data required
- Reliability
- Precision
- Availability
- Economic issues
- GNSS based positioning systems
- Solutions and outlook

Requirements for Safety Relevant Positioning Applications in Rail Traffic

You will get

- Information, how to find out what you need

You won‘t get

- Exact values

Data required

Position data

- WGS 84 coordinates
- Distance from certain location

Speed

Direction

Depending on application

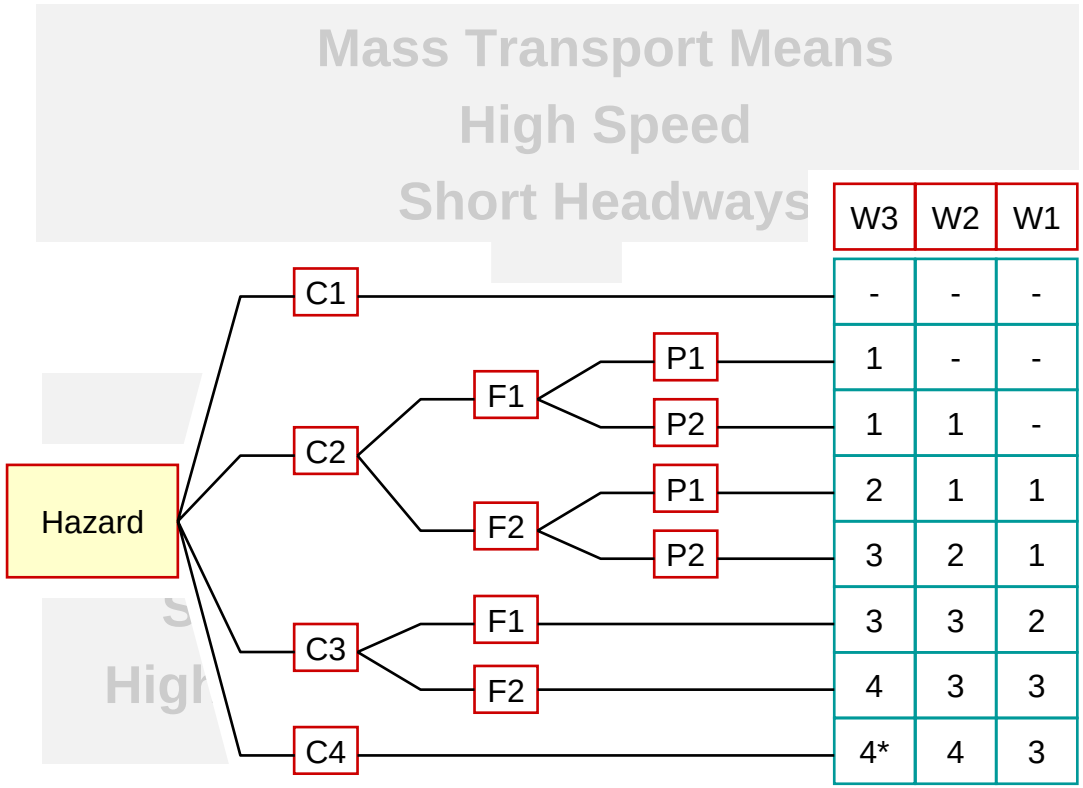
- Train Protection
- Route Protection
- Work Gang Warning
- Automatic Train Control
- Dispatching
- Passenger Information
- Waggon/Goods Tracing
- Energy Saving Train Control

Reliability - Railway Environment

Mass Transport Means
High Speed
Short Headways

High frequency of exposure
Limited possibility to control hazards
Severe consequences possible
High probability of hazardous event

Reliability - Railway Environment



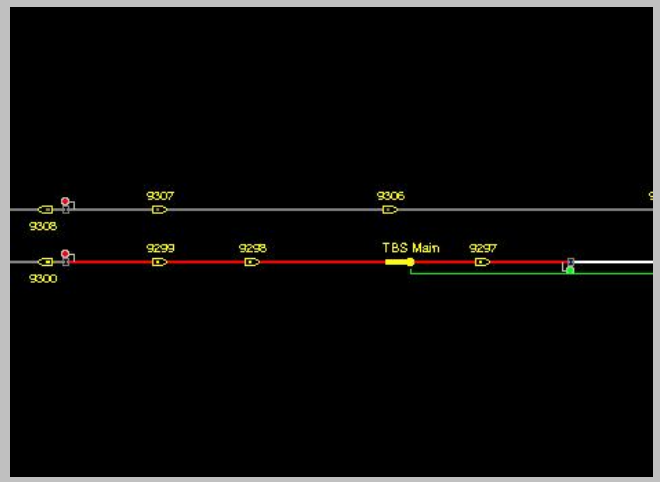
Therefore: **Safety related positioning applications in railway field require SIL 3 or SIL 4**

Precision (1)

Depending on application and sensors to be replaced

Safety related applications

- Train Speed Monitoring
- Train Protection
- Route Protection
- Track Vacancy Detection
- Work Gang Warning
- Notification of Accident
- Automatic Train Control



Precision (2)

Depending on application and sensors to be replaced

Two directions

- **Across the track**

  Track selectivity is needed

- **Along the track**

  Precision of sensor to be replaced is assumed to be sufficient

Sensors in use

- Wheel detectors
- Balises / Transponders
- IR beacons
- Track circuit
- Odometer
- VSB Radar
- GNSS based systems

Availability

Depending on application and sensors to be replaced

Possible requirements

- Continuously available
- Available when Train is on certain location
- Available upon request
- Available at certain event

Place of data processing

- Trainside
- Trackside

Economic issues

Two types of equipment

- Trackside equipment
- Trainside equipment

To be taken into consideration

- Length of track
- Train frequency
- Communication needs

Life Cycle Costs

- Acquisition and installation
- Operation, incl. communication
- Maintenance
- Removal

EU policy: Funding of trackside equipment only

GNSS based positioning systems

Problems / challenge

- **Availability of signal**
  - Shadowed signal in tunnels, roofed stations
  - Partially shadowed in forests, cuttings and hilly terrain
- **Accuracy of signal**
  - Multipath propagation and reflection in urban areas, gulches
  - Interference of signal
- **Reliability of calculated position**
  - Constellation of visible satellites
  - Questionable integrity of signal
- **Route Atlas / Digital Map**
- **Operators of GPS and GLONASS are military**

Solutions and perspective

Fusion of data of diverse sensors

- Odometer
- Transponders
- GSM
- Radar
- Inertial Systems
- Eddy-current sensor

New civil European satellite based navigation system GALILEO

- Increased accuracy and availability
- Integrity information