

The Future Transport Connection



Instrumentation and Control Systems

- Industrial Monitoring
- Industrial Automation
- Industrial IoT
- Test & Measurement Devices
- Electronics development

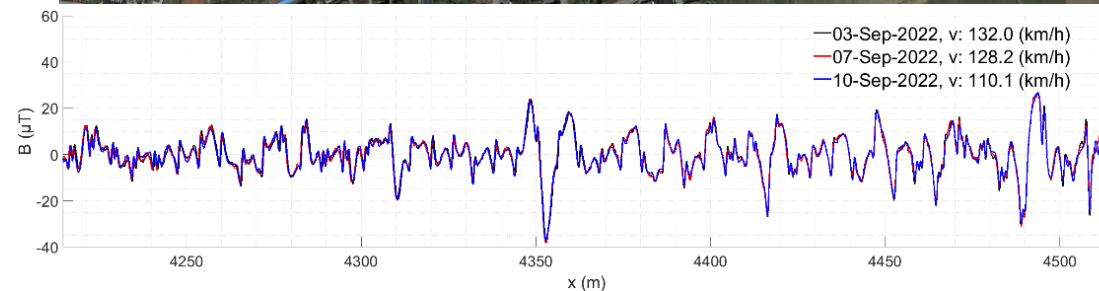
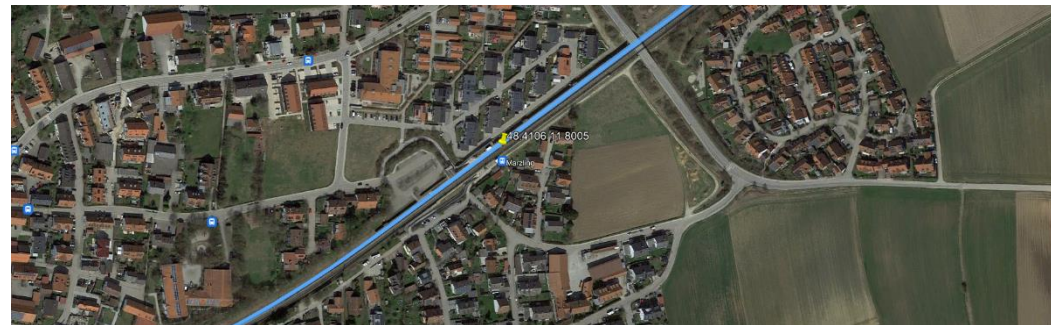
Rail

- Tracking, positioning, odometry
- Train identification
- Track monitoring



Tracking & Positioning:

- Magnetic sensor mounted below vehicle measures magnetic field
- Distinct magnetic track fingerprint is analyzed
- Velocity/distance (odometry) and/or location based on comparison with magnetic track map



Magnetic Positioning



Differences & Advantages:

- Independent of GNSS & environmental conditions
- Not susceptible to spoofing/jamming
- Infrastructure independent
- Intrinsically track selective

Applications

- Modular multi-application system
- Train protection systems / train control systems
- Rolling stock (cars, locomotives) tracking
- Independent on-Board positioning for automated train operation



Need for wireless communication (NB-IoT/LTE-M/NTN):

- Uplink of vehicle location & state
- Magnetic maps need regular updates (approx. 6 - 12 month)
 - Validate map version before operation
 - Notifications after map changes (e.g. track works)

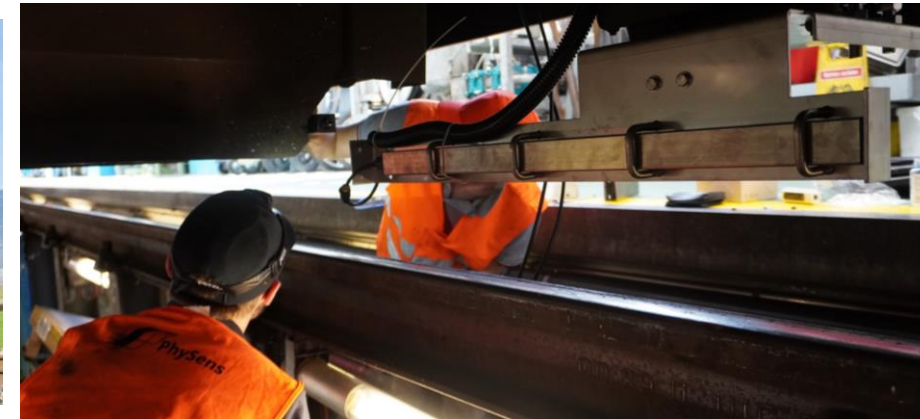
Communication Requirements:

- Global connectivity (cross border traffic)
- Independent of environment
(e.g. mountains, valleys, cities, forests)
- Space constraint, limited antenna size/locations
- Power efficient (battery based)



Multiple Systems in operation:

- RegionAlps/SBB (Switzerland)
R91 - St-Gingolph <--> Brig
- Havelländische Eisenbahn (Germany)
- DB Systemtechnik (Germany)





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