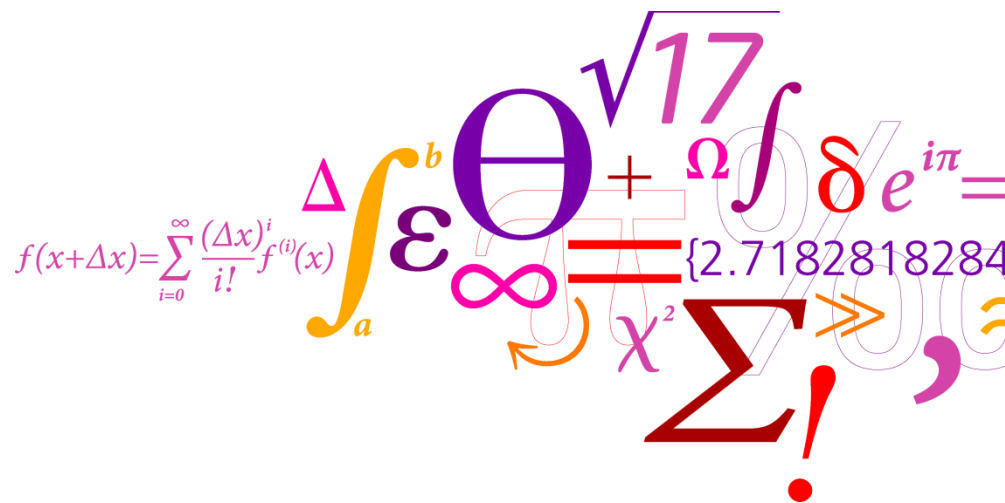


Communication solutions for the future ERTMS

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RobustRailS Mini-Conference
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DTU Fotonik
Department of Photonics Engineering



Agenda

1. Background and motivation
2. ERTMS over LTE
3. More communication in railways
4. Conclusions



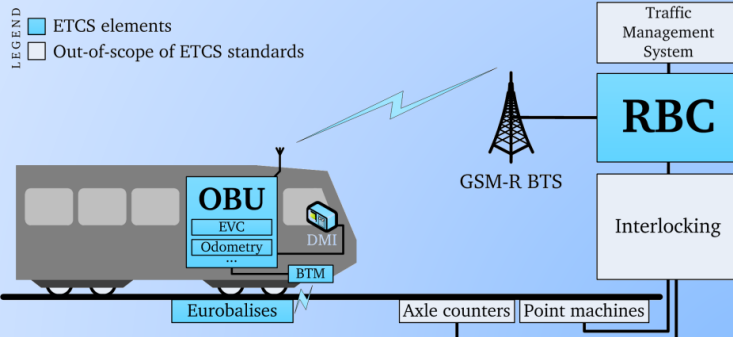
Photo credits: Rafał Żmuda

Background and motivation: State-of-the-art

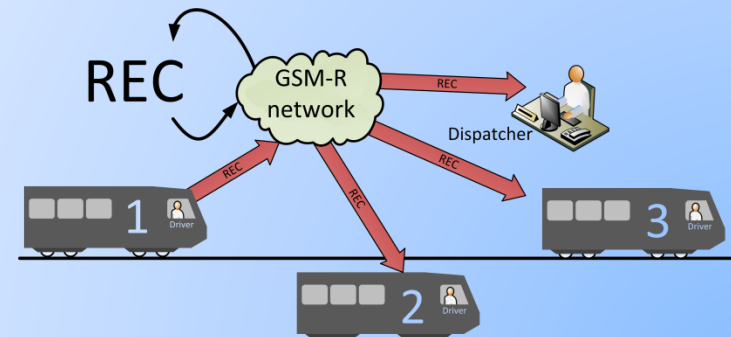
ERTMS

European Rail Traffic Management System

European Train Control System (ETCS)

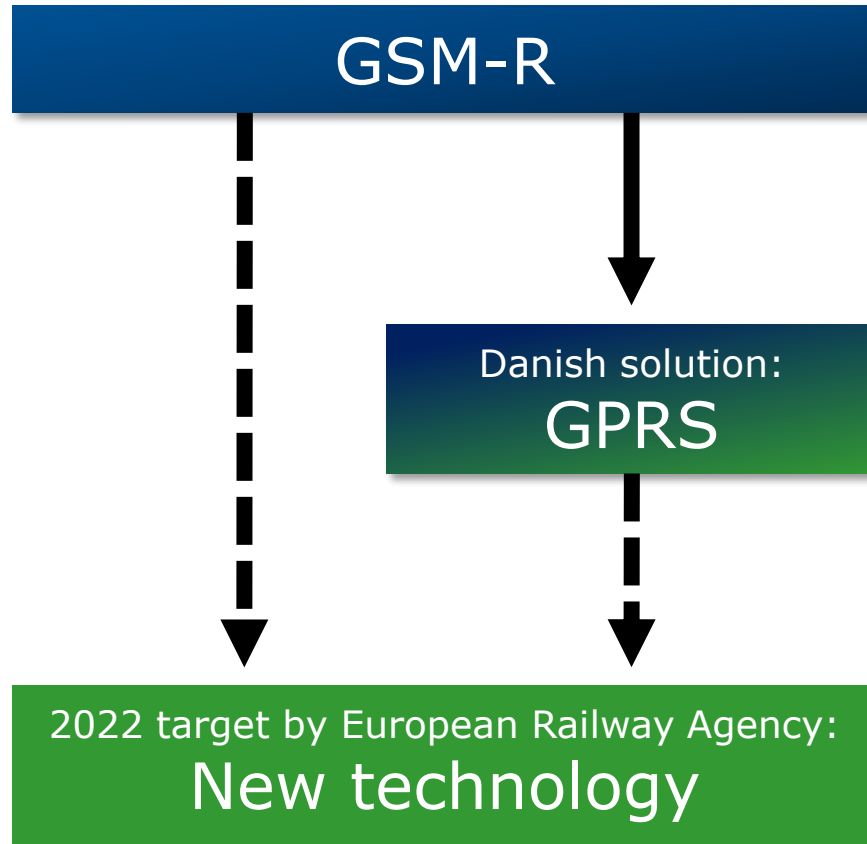


Voice communication



GSM-Railways (GSM-R)

Background and motivation: **GSM-R is obsolete**



Inefficient
Insufficient capacity
Poor performance
Declining industry support

Partial solution
Easy migration and compatibility
Ahead of standards

Full solution
New applications and services
Long-term solution

Background and motivation: **Future evolution**

Future ERTMS

Condition-based maintenance

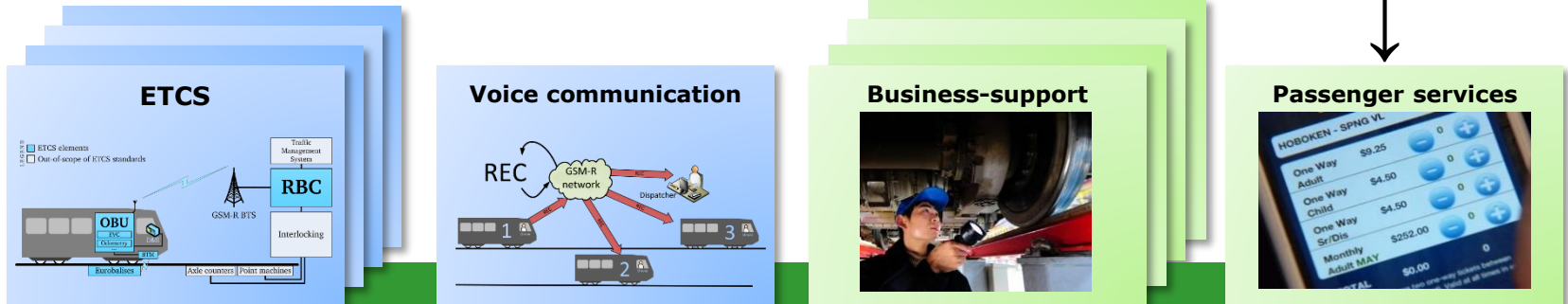
More capacity for ETCS

Optimized operations, e.g. real-time planning

Improved transmission

Improved security and safety

Customer satisfaction



New communication technology

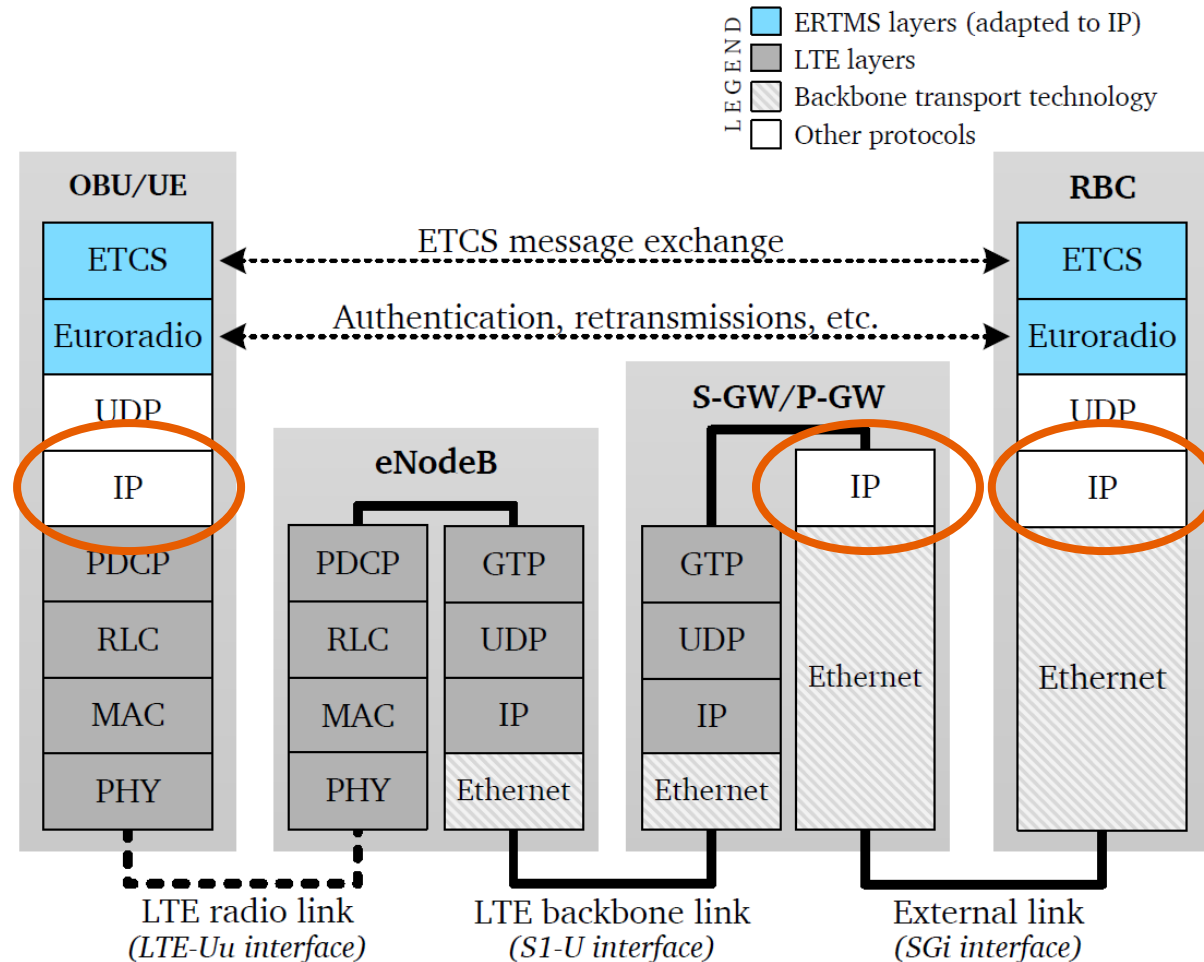
ERTMS over LTE:

LTE as an alternative to GSM-R

- + Packet-switched network, efficient radio interface
- + High capacity
- + Low-delay, high throughput
- + Migration from GSM
- + Low obsolescence risk
- Challenges:
 - Commercial technology
 - Not validated in railway scenarios
 - Never investigated as an ETCS supporting technology
 - Not confronted with railway requirements
 - Critical vs non-critical

ERTMS over LTE:

LTE is more “future-proof” than GSM-R



ERTMS over LTE: Simulation-based work

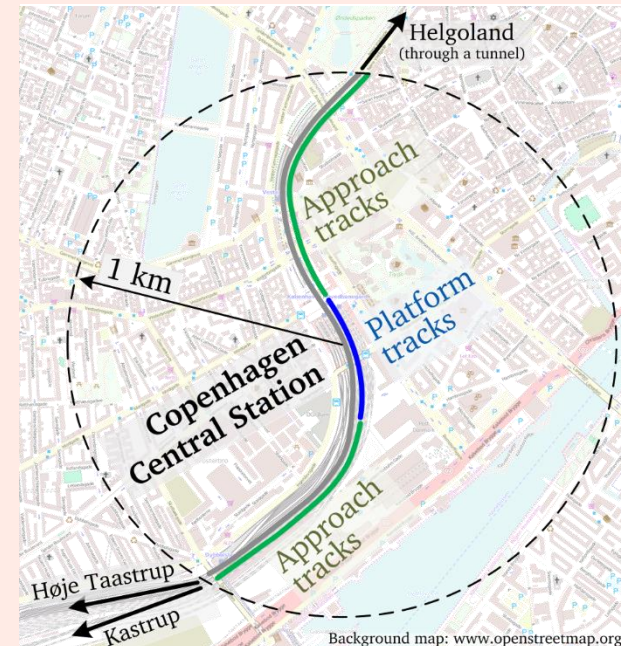
Snoghøj-Odense

- Coverage
- Radio base station density
- Handovers
- Speed



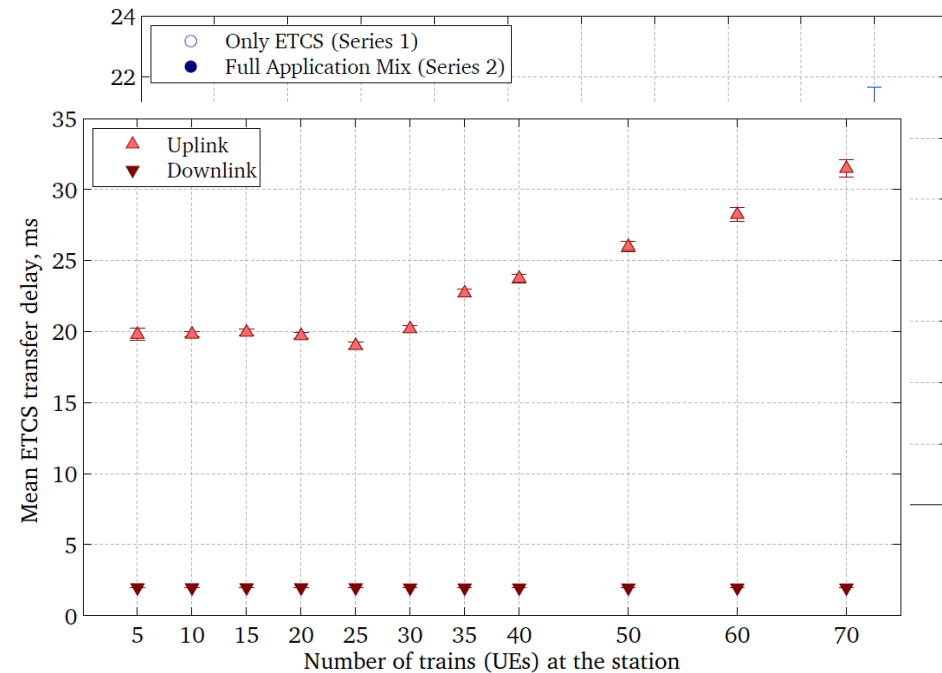
Copenhagen Central Station

- Capacity
- Number of users
- Traffic load



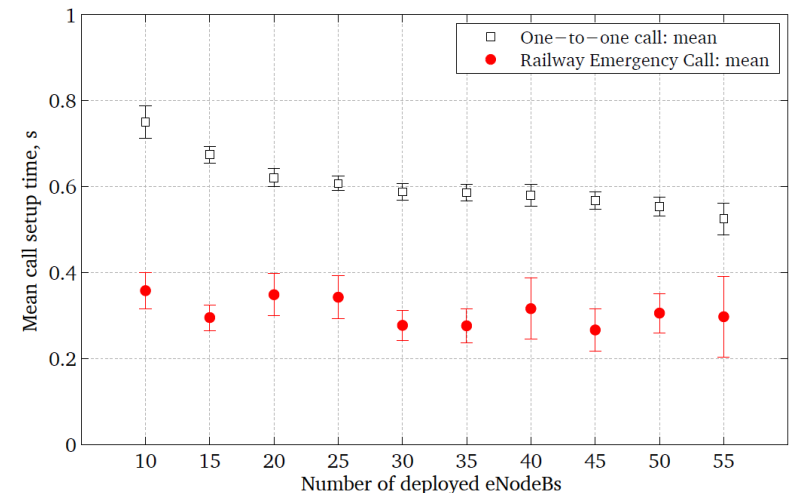
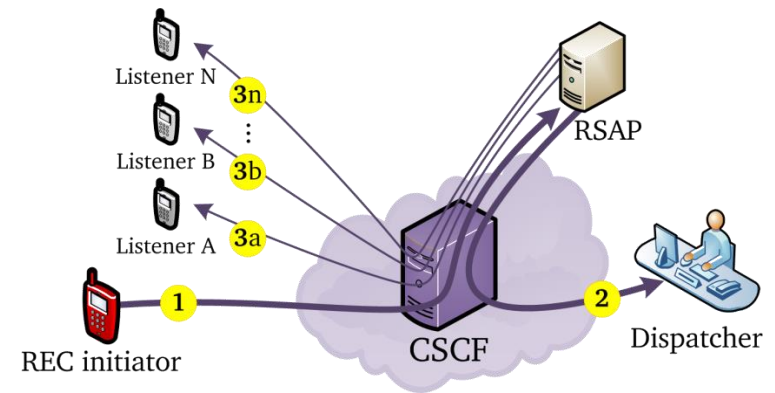
ERTMS over LTE: **ETCS performance in LTE**

- **ETCS requirements fulfilled:**
 - Despite network congestion, base station density, etc.
- Traffic prioritization
- LTE fully solves the capacity problems
- Considerable **improvements over GSM-R** in terms of:
 - Radio cell capacity
 - Message transfer delay
 - Transmission performance



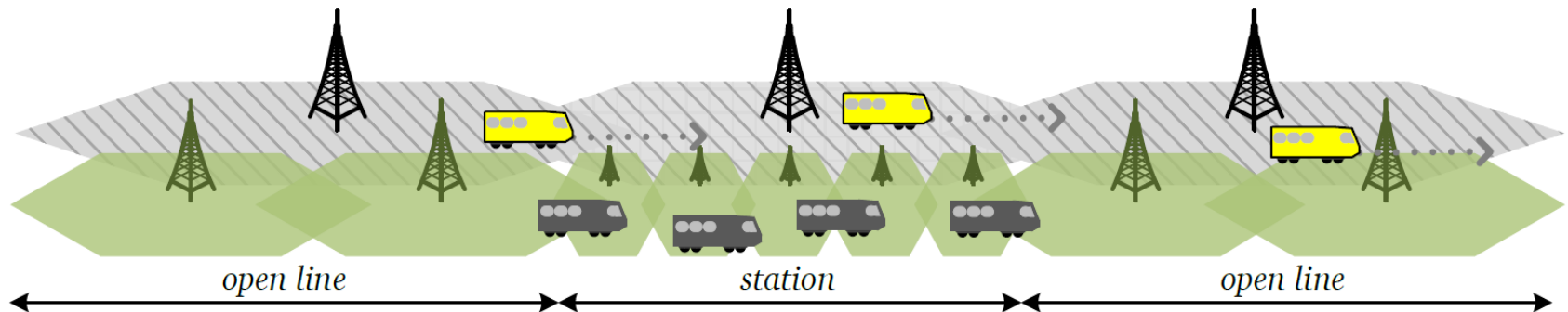
ERTMS over LTE: Voice communication in LTE

- LTE can provide advanced railway voice features, such as:
Railway Emergency Call (REC)
- **Fast call setup**
- **Effective call prioritization**
- Short transfer delay and low packet loss
→ **good voice quality**



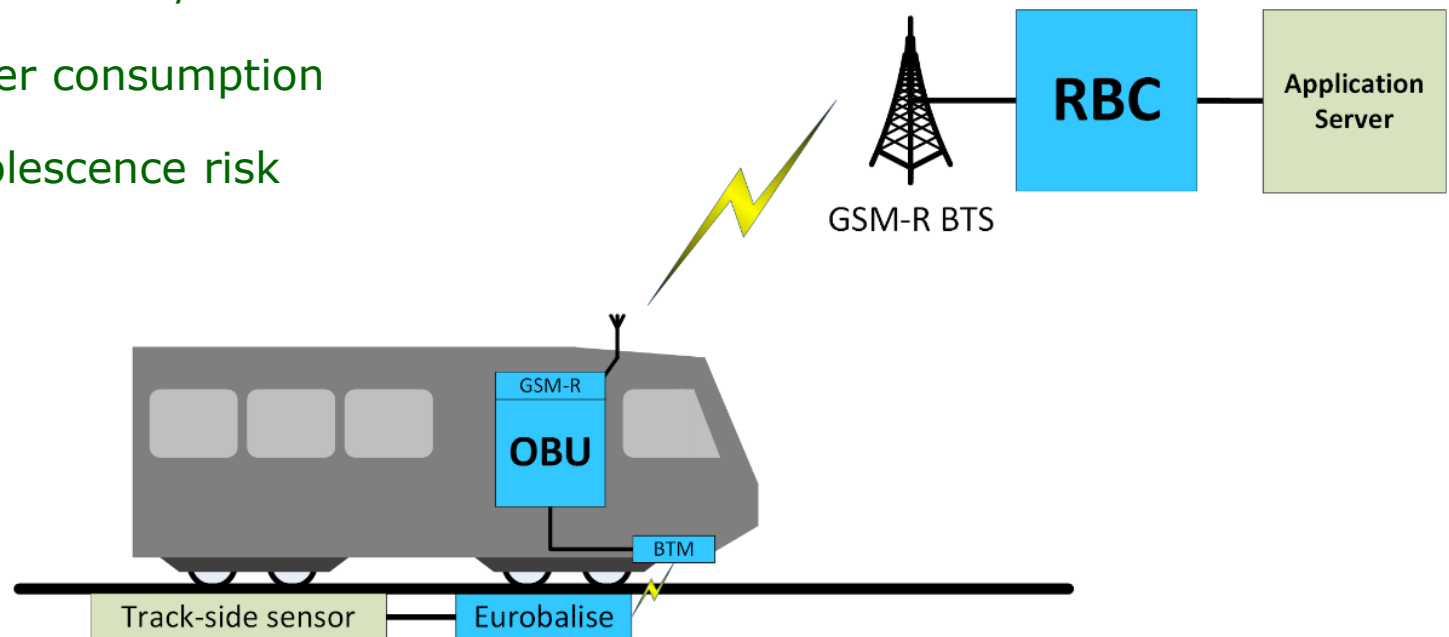
More communication in railways: **Macro/micro architecture**

- + High network availability
- + Increased network capacity
- + Optimized for train speed
- + Multi-technology networks: GSM-R/LTE/WiFi...
→ convergence with CBTC?



More communication in railways: **Sensor networks for ERTMS railways**

- Condition-based maintenance for improved robustness
- + Taking advantage of the available ERTMS standards
- + Supports 500 km/h
- + Low power consumption
- + Low obsolescence risk



Conclusions

- **GSM-R**: revolution → **obstacle**
 - LTE is a feasible alternative for railways:
 - + Addresses GSM-R shortcomings
 - + Fulfills requirements
 - + Significant **improvements for ETCS**

 - + **Effective traffic prioritization**
 - + New railway applications
 - Importance of communication technologies in railways will increase
- Thesis is available now at DTU Orbit:
– <http://l.dtu.dk/as71>

