



The logo for Safe4RAIL, featuring the text "Safe4RAIL" in a green and blue font, with a blue and white checkered pattern below it, all set against a background of a blue and white perspective view of a train tunnel.

Train to Ground

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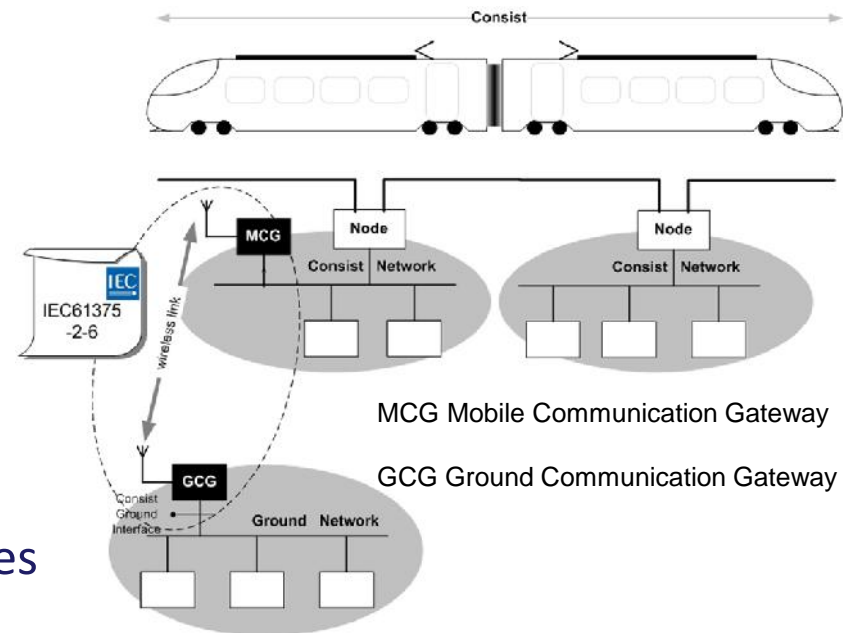
CONNECTA has received funding from the European Union's Horizon 2020 research and innovation programme under agreement No: 730539. Safe4RAIL has received funding from the Shift2Rail Joint Undertaking under grant agreement No: 730830. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme.

Safe4RAIL – SAFE architecture for Robust distributed Application Integration in rolling stock (730830)

CONNECTA – CONTRIBUTING TO SHIFT2RAIL'S NEXT GENERATION OF HIGH CAPABLE AND SAFE TCMS AND BRAKES (730539)

What is Train to Ground Communication ?

- Integration of the train on-board communication network in the operator on-ground network infrastructure
- Definition of a set of communication protocols
- Provisioning a set of services
- Communication partners shall understand each other, therefore communication protocols and services need to be clearly defined

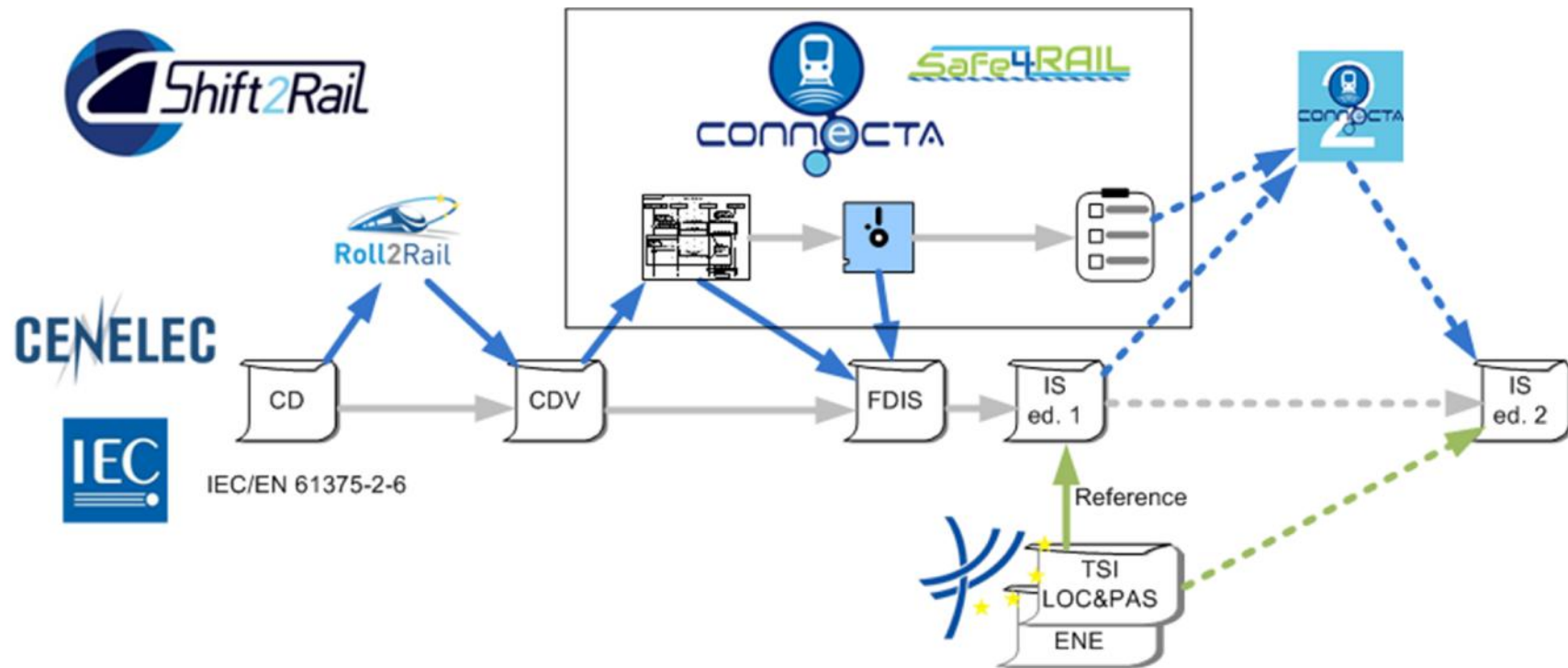




Why ?

| Today | With standard IEC/EN 61375-2-6 |
|---|--|
| Many different implementations of Train to Ground communications from different manufacturers for different railway operators are existing: | The standard defines a clear set of requirements for Train to Ground communication protocols and services |
| • using proprietary, non-interoperable communication protocols | Implementations according to the standard understand each other |
| • using different non-interoperable services | Common used services are available |
| • increasing efforts and costs in maintenance or operation with different railway operators | Only one solution (per manufacturer or operator) needs to be maintained, easier border crossing traffic possible |
| | |

Shift2Rail and Standardisation



Safe4RAIL – SAFE architecture for Robust distributed Application Integration in rolling stock (730830)

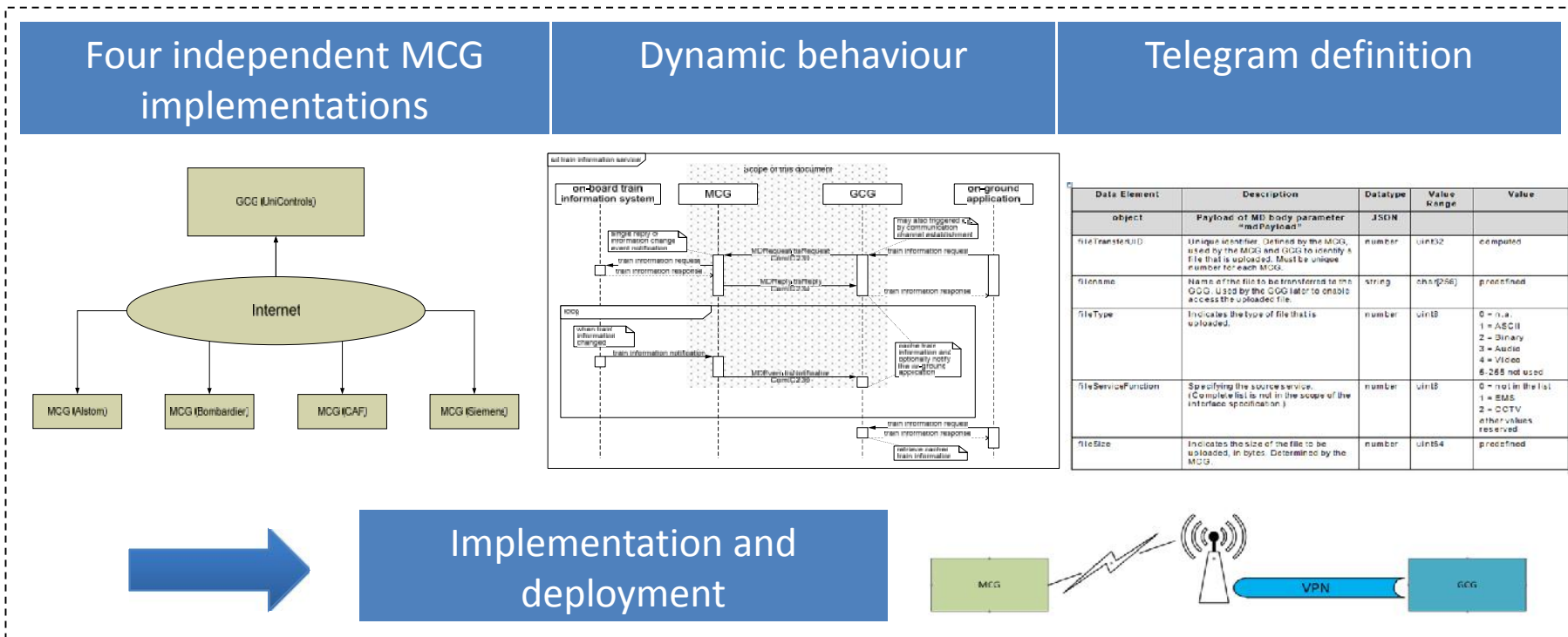
CONNECTA – CONTRIBUTING TO Shift2Rail'S Next generation of high Capable and safe TCMS and brAkes (730539)



Verification of IEC/EN 61375-2-6

- Analysis of the requirements of the draft versions of the standard
- Selection of three use cases for implementation (Train identification, Train location, File transfer)
- Detailed specification of communication protocols between MCG and GCG
- MCG implementation by four CONNECTA partners (ALS, BTG, CAF, SIE)
- Test Environment & GCG implementation by Safe4RAIL (UC, IKL, IFS)
- Cooperative test by CONNECTA and Safe4Rail
- Feedback of experiences to IEC TC9 WG43

MCG & GCG Implementation

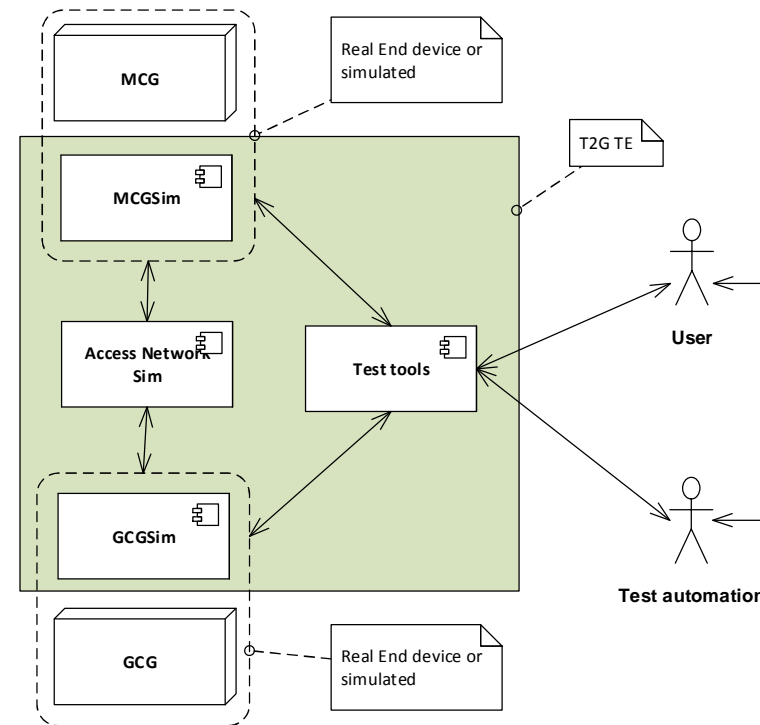


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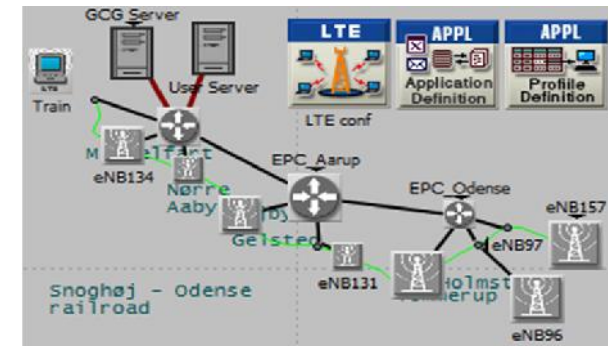
Train2Ground Test Environment

- MCG Simulator
- GCG Simulator
- Access Network Simulator
 - LTE
 - Wi-Fi
- Test Tools
 - Test scripts



Train2Ground Test Environment

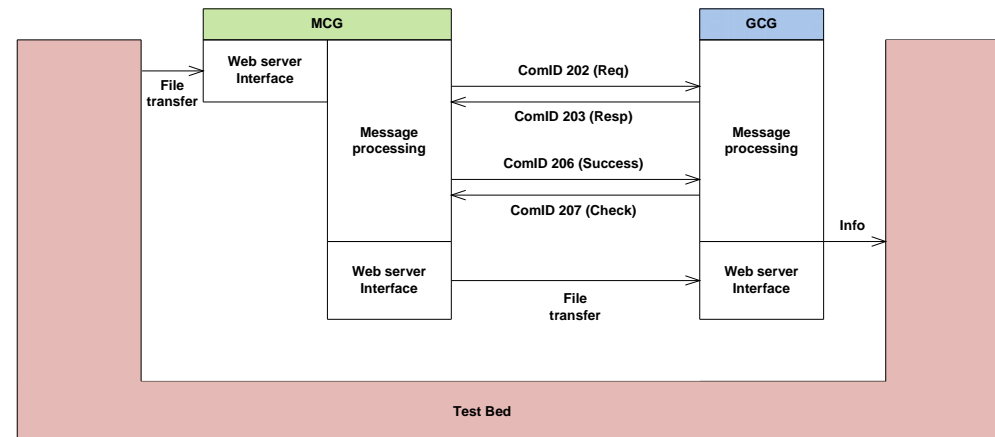
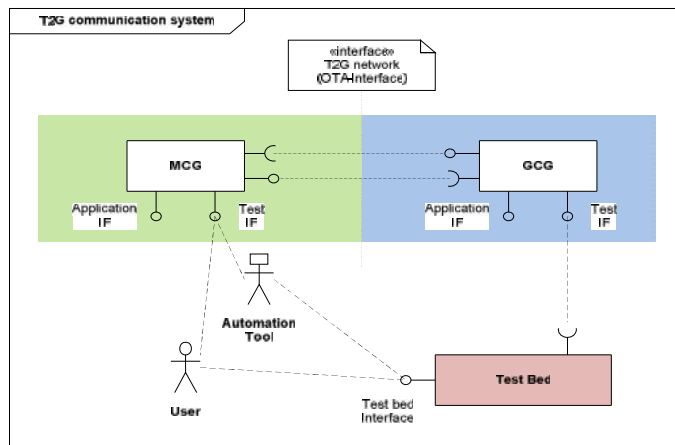
- LTE network simulator (Riverbed Modeler)
 - Pure simulations
 - Co-simulations
- Wi-Fi network simulator



- Simulations: handovers, signal fading, simultaneous usage by passengers, jamming

MCG-GCG-Test

- Test setup (MCG/GCG) and test case (example File transfer)



- → Test report with list of observations as input to IEC for improvement of the standard



Next station is

- We are on the way:
 - The time lines of IEC and CONNECTA were not in sync
 - First edition of IEC 61375-2-6 is already released, but some deficiencies were experienced by CONNECTA
- CONNECTA-2 will implement further use cases (e.g. telemetry)
- Experience from implementation and test will be provided to IEC TC9 WG43 for revision of the standard IEC 61375-2-6
- Evolution for co-existence and cooperation with Train to Ground communication of Shift2Rail IP2 (signalling application)



Conclusions

- The standard is a base for interoperable train to ground solutions
- The implementation is a way to verify the feasibility of the standard
- The experience from the implementation and test revealed opportunities to improve the existing standard