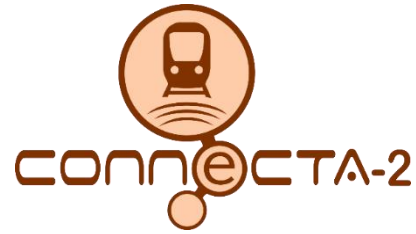
© CONNECTA-2 & Safe4RAIL-2

The projects CONNECTA-2 and Safe4RAIL-2 have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 826098 (CONNECTA-2) and No. 826073 (Safe4RAIL-2) respectively. The information and views set out in this document are those of the author(s) and do not necessarily reflect the official opinion of Shift2Rail Joint Undertaking. The JU does not guarantee the accuracy of the data included in this article. Neither the JU nor any person acting on the JU's behalf may be held responsible for the use which may be made of the information contained therein.



CONtributing to Shift2Rail's NExt generation of high Capable and safe TCMS. Phase 2

SAFE architecture for Robust distributed Application Integration in roLling Stock 2

Drive-by-Data

Mohammed Abuteir, TTTech mohammed.abuteir@tttech.com

Gernot Hans, Bombardier gernot.hans@rail.bombardier.com

Technical Seminar on Advanced Architectures and Components for Next-Generation TCMS

January 21st 2020, Brussels

Content

1. Why Drive-by-Data ?
2. DbD Key Innovations
3. DbD Technology Demonstrators
4. Upcoming activities for the rest of the project

© CONNECTA-2 & Safe4RAIL-2

Why Drive-by-Data ?

The future train will be full electronic control, without hydraulic, pneumatic or mechanical backup function. Therefore the Next-Generation TCN (NG-TCN) solution is intended to:

- Provide a robust train network topology and architecture
- Support mixed-criticality data traffic from different user domains (TCMS and Operator/Customer oriented services)
- Handle the coupling and uncoupling of trains robustly and safe (inauguration)
- Support data communication between safety functions up to SIL4

© CONNECTA-2 & Safe4RAIL-2

What is new (in a nutshell)?

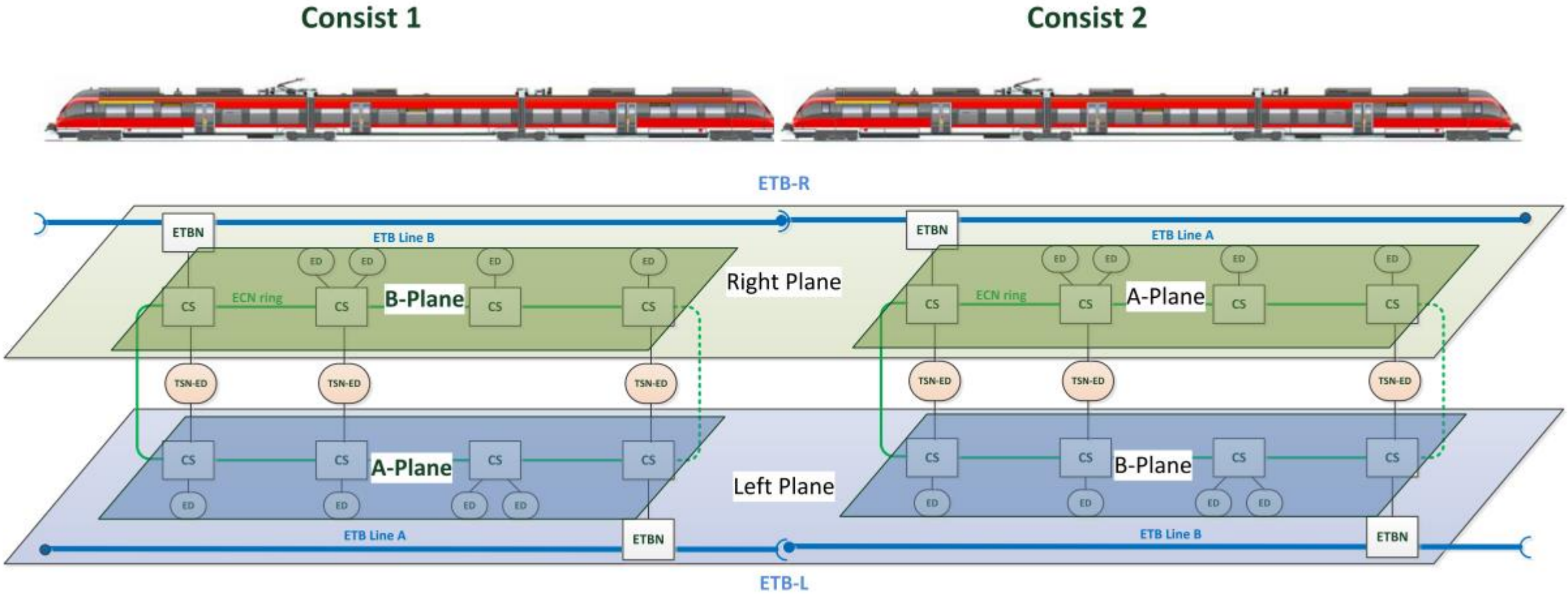
- Network topology with **2 independent data transmission planes** for time and mission critical data
- **TSN technology** for time and mission critical data transmission
- **Safe Train Inauguration** (up to SIL4)
- **Safe Data Transmission** (SDTv4, up to SIL4)

© CONNECTA-2 & Safe4RAIL-2

DbD Key Innovations

© CONNECTA-2 & Safe4RAIL-2

New Train Network Architecture



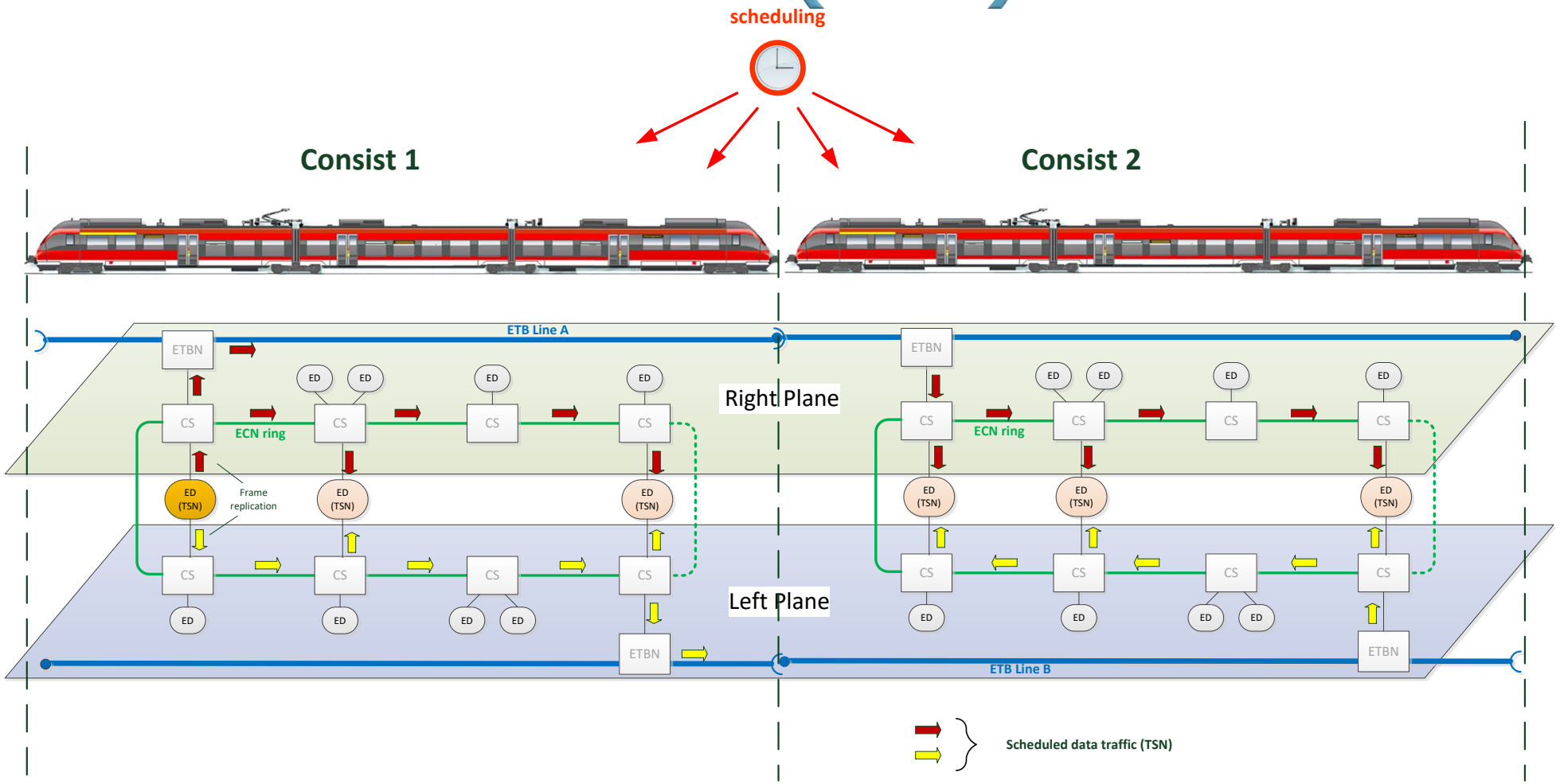
© CONNECTA-2 & Safe4RAIL-2

New Train Network Architecture

Key benefits	Restrictions
Support of TSN (Time Sensitive Networking) for deterministic data exchange	No communication continuation over powerless consists
Seamless redundancy of time critical data traffic	
Elimination of train lines / reduction of cabling	
High reliability (independency of transmission channels)	
Compliance to existing network architecture	
Intrinsic consist orientation detection (safety)	
No bypass function	
Fire protection support (EN 50553 type 2 fires)	

© CONNECTA-2 & Safe4RAIL-2

Scheduled Data Traffic (TSN)



© CONNECTA-2 & Safe4RAIL-2

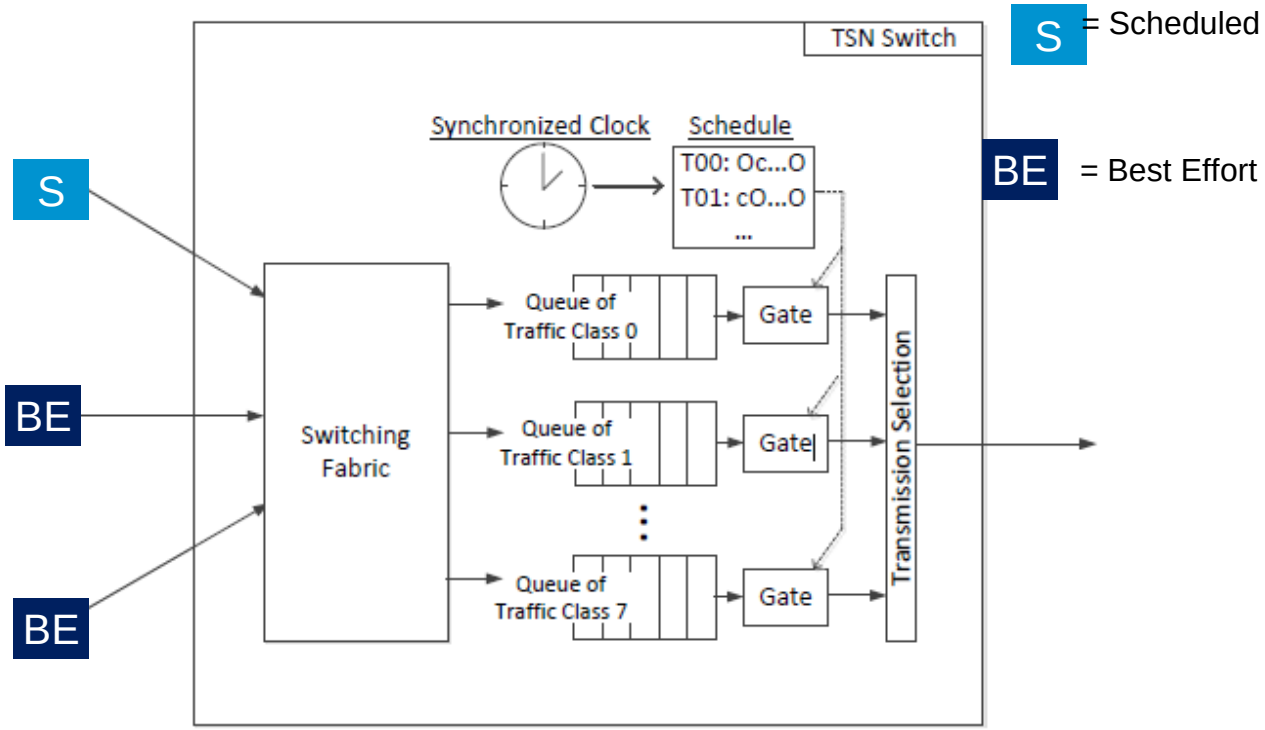
TSN Technologies

- IEEE802.1AS-Rev – Precise time synchronization
- IEEE802.1Qbv – scheduled traffic
- IEEE802.1CB – frame replication and elimination

© CONNECTA-2 & Safe4RAIL-2

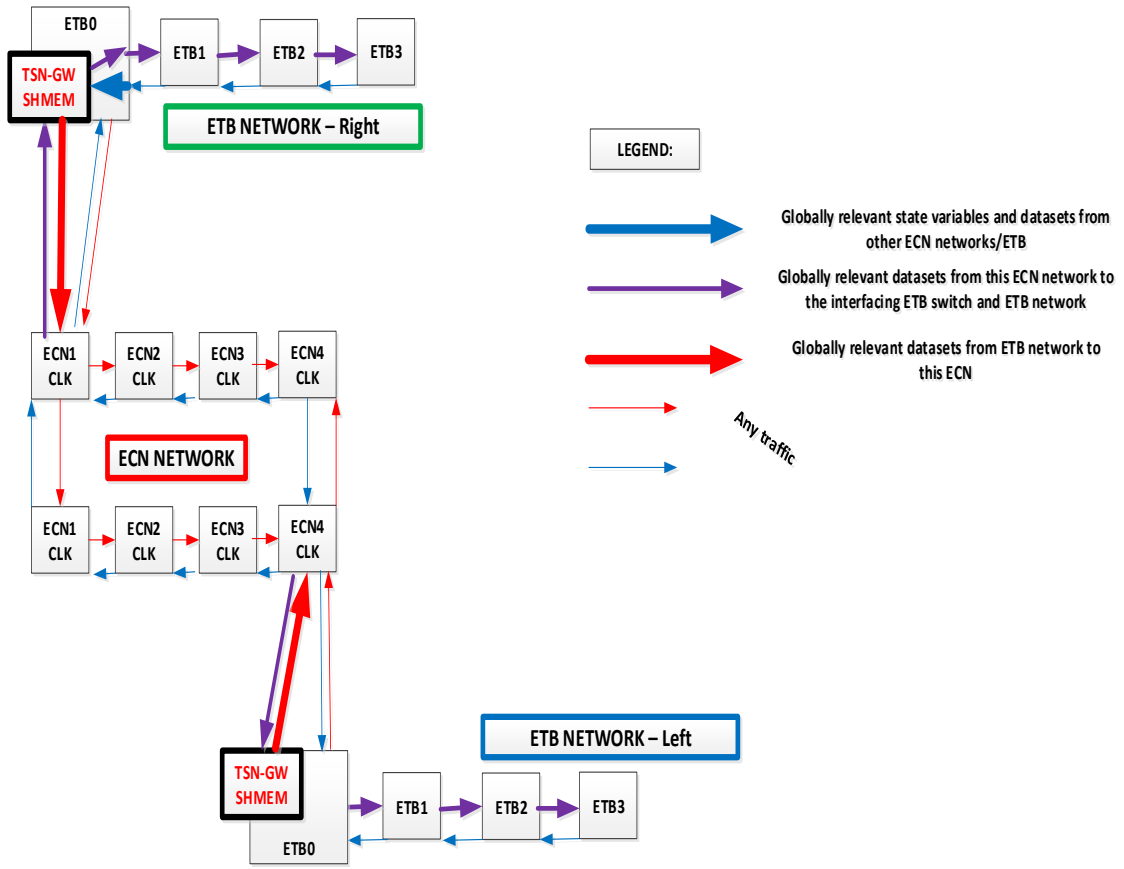
802.1Qbv Time-Aware Shaper

- A schedule determines which traffic queue will be forwarded from the switch at any given point in time.
- Qbv specifies the so called "*gate open*" and "*gate close"* events for each queue



© CONNECTA-2 & Safe4RAIL-2

Bridging across ECN and ETB

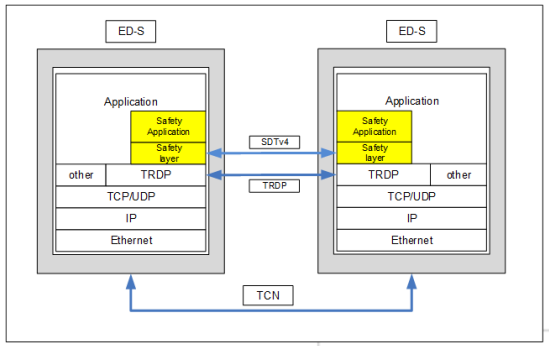


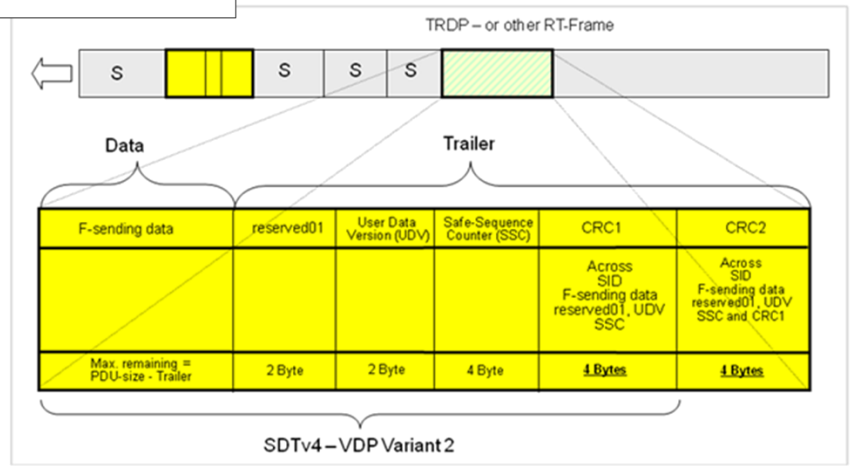
- Decouples ECN from the actual ETB
- It will receive process data and critical messages from ECN data sources and pass to ETB (and vice versa)
- ETB-TSN is a programmable message store
  - Can transfer specific data in defined periods
  - Can assemble several small messages into datasets
- ETBN message store holds the TSN traffic for all consists
  - Each consist publishes its own ‚outgoing' datasets on ETB sync-time
  - Each consist updates all ‚incoming' datasets on ETB sync-time

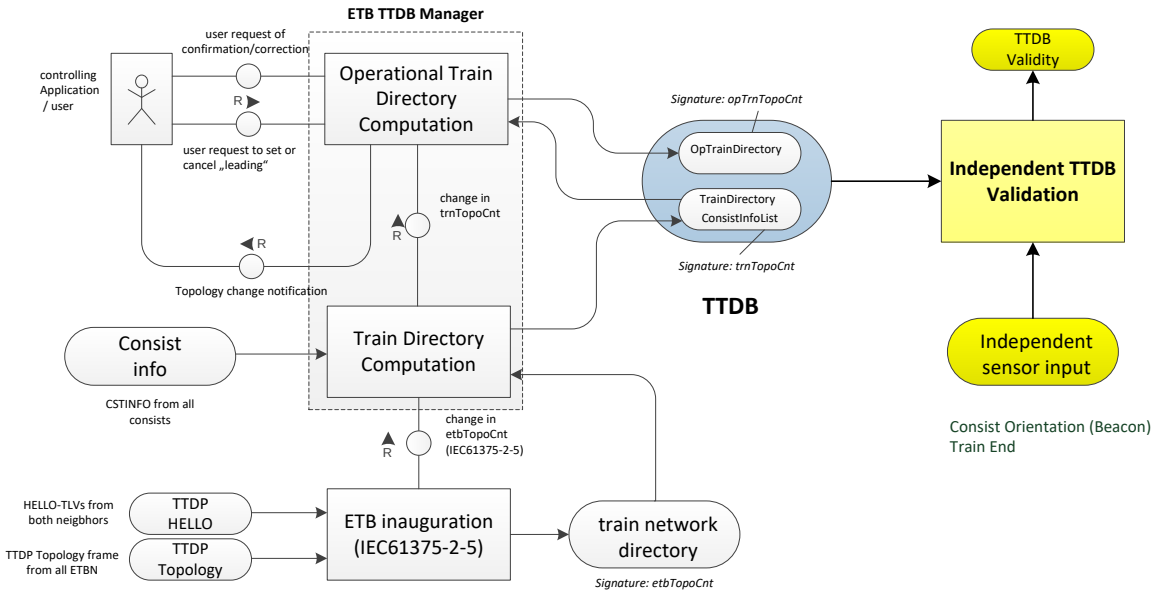
© CONNECTA-2 & Safe4RAIL-2

SAFE architecture for Robust distributed Application Integration in roLling stock 2

DbD Safety Functions







Safe Data Transmission (SDTv4)

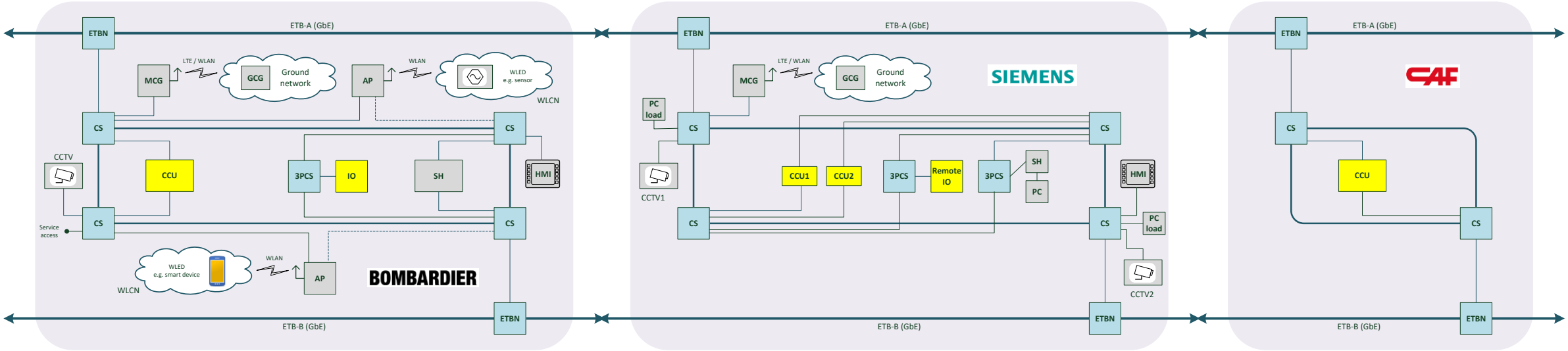
Safe Train Inauguration

© CONNECTA-2 & Safe4RAIL-2

DbD Technology Demonstrators

© CONNECTA-2 & Safe4RAIL-2

Example: Regional Demonstrator



© CONNECTA-2 & Safe4RAIL-2

DbD network components for demonstrators

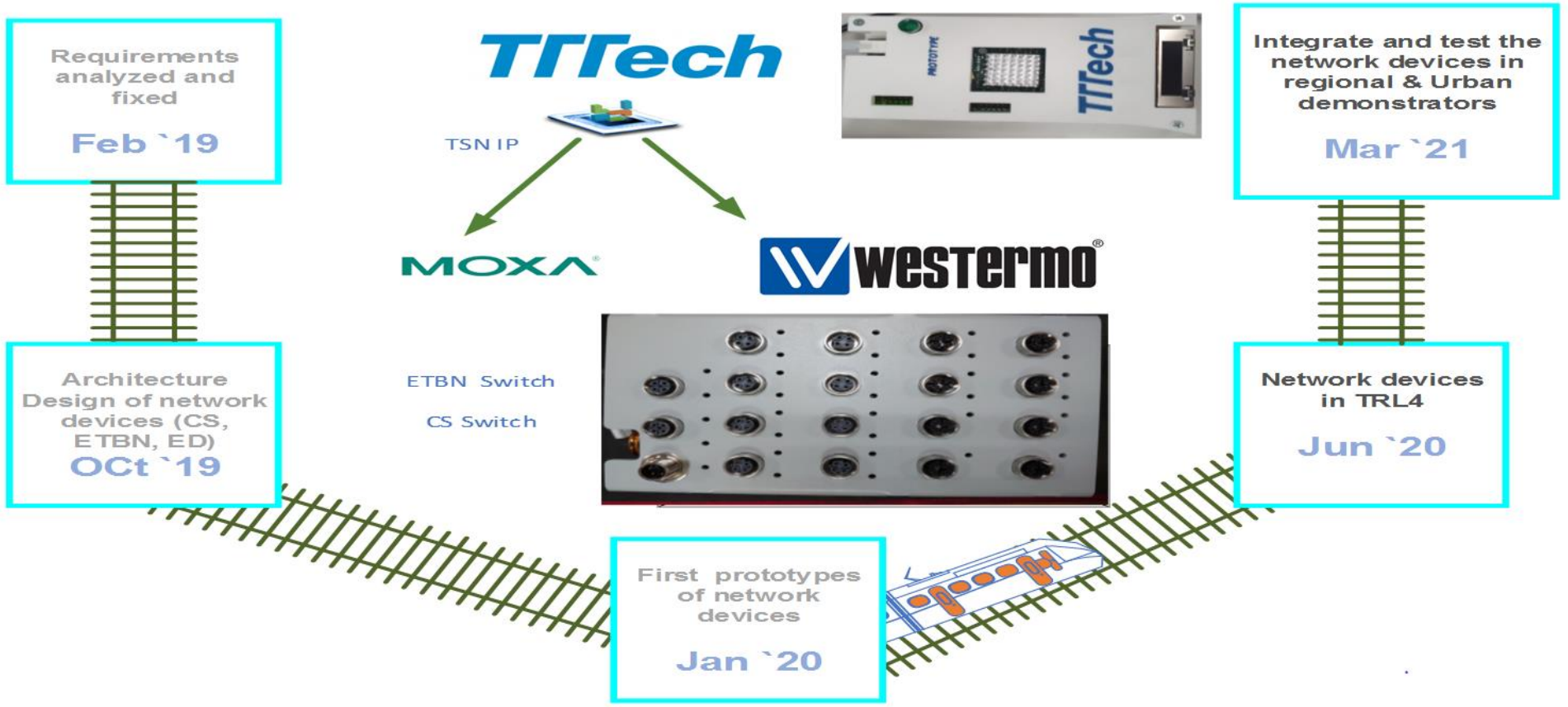
Network Component	Description
ETBN	Ethernet Train Backbone Node ▪ IEC61375 compliant *) ▪ GbE ETB ▪ 2 ETB ports ▪ (safe) train inauguration ▪ TSN Gateway ▪ IP router
CS	Consist Switch ▪ TSN enabled managed Ethernet switch ▪ 2 GbE ECN ring ports ▪ 4 end device ports
PCIe	TSN capable NIC for integration in end devices

*) except for changes related to the changed train backbone topology

© CONNECTA-2 & Safe4RAIL-2

Network Components & Roadmap

networking components that offer **deterministic communications,** as well as focus on the **interoperability** between two different equipment manufacturers.



© CONNECTA-2 & Safe4RAIL-2

Next Steps

- Preparation of test specifications for DbD proof-of-concept testing
- Several workshops and plug-fests for testing the individual DbD functions:
  - Train inauguration & ETB Control
  - Clock synchronization
  - Scheduled data traffic consist local and train-wide
- Launching standardization activities (IEC TC9 WG43)

© CONNECTA-2 & Safe4RAIL-2

Questions ?

© CONNECTA-2 & Safe4RAIL-2

© CONNECTA-2 & Safe4RAIL-2

The projects CONNECTA-2 and Safe4RAIL-2 have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 826098 (CONNECTA-2) and No. 826073 (Safe4RAIL-2) respectively. The information and views set out in this document are those of the author(s) and do not necessarily reflect the official opinion of Shift2Rail Joint Undertaking. The JU does not guarantee the accuracy of the data included in this article. Neither the JU nor any person acting on the JU's behalf may be held responsible for the use which may be made of the information contained therein.

Coordinator:

CAF, Igor López

✉ igor.lopez@caf.net

✆ +34 943 189 241

Coordinator:

IKERLAN, Aitor Arriola

✉ aarriola@ikerlan.es

✆ +34 943 712 400