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Safe4RAIL2

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Message from coordinator

It is our pleasure to welcome you to the first issue of the Safe4RAIL-2 project newsletter. In this issue we are detailing the activities carried out during the first months of the project, when most of the technical work has been focused on requirement definition for the different devices to be developed in the project.

This process has been done in close collaboration with CONNECTA-2 project. In order to illustrate the obtained results, specific details of the Next-Generation Train Communication Network (NG-TCN) devices based on Drive-by-Data technology are provided in this newsletter.

In the next period, these requirements will translate into specific design activities which will eventually lead to prototype development and integration into railway demonstrators.

Please keep an eye on future Safe4RAIL-2 newsletters for further information and updates on these activities.

Consortium

Safe4RAIL-2 is driven by a well-balanced, European consortium composed of six industrial partners (including SMEs and large companies), one research institution and one academic partner providing expertise from the automotive, aerospace, and railway sector in order to create synergies with existing and emerging concepts and technologies.

About Safe4RAIL-2

In today's train systems, interconnections and appropriate interoperability are not efficiently optimized. Many times, the braking, climate, door and electrical systems are designed by different companies without concerted efforts towards interoperability.

As a result, we see a huge potential to improve train systems and focus on efficient interconnections, standardized interfaces and enhanced safety level of distributed train systems and applications.

Our research and innovation action project Safe4RAIL-2 (Safe architecture for Robust distributed Application Integration in roLling stock 2) will look at ways of utilizing wireless (5G), interoperable, on-board communication as well as universal integration of the Train Control and Monitoring System (TCMS). In collaboration with its complementary action project, CONNECTA-2 (826098), Safe4RAIL-2 aims to develop railway demonstrators where next-generation architectures and components for TCMS will be integrated.

Another aspect of the project is to perform testing of the TCMS functions in a simulated environment. These test methods alleviate field-testing which would be costly to undertake.

Drive by Data – what is it and why do we need it?

The overall goal of the Drive-by-Data activities is to increase the capability of the Train Communication Network (TCN) whilst at the same time reducing the complexity and cost of the overall electronic architecture for the control systems (Train Control and Monitoring System, TCMS) in the train.

Drive-by-Data translates into predictable and safe Ethernet networking technology enabling full electronic control, without hydraulic, pneumatic or mechanical backup functions. Ethernet networking technology is a core technology for the design of an integrated architecture and enables the convergence of functional integration on one network.

The network in an advanced integrated architecture hosts all system function traffic with different timing and safety requirements. It will support the partitioning of network bandwidth for time-critical & safety-critical functions (up to SIL4) and to integrate other, less critical traffic. This is a necessary requirement for the design of integrated TCMS architectures with mixed-criticality requirements.

In the drive-by-data concept, the network is an enabler for functions to reside anywhere in the system; an "embedded cloud" so to speak. Hosted functions can have strictly deterministic access to any sensor, actuator and other resources in the system, unaffected by other network traffic. This capability is relevant for less complex redundant system (re)configuration, higher availability, as functions can be hosted on different computers to extend the mean-time between failures and meet the scheduled maintenance intervals.

What needs to change to achieve it?

In order to achieve the Drive-by-Data goals, the current Train Communication Network will be superseded by the Next-Generation TCN (NG-TCN). The main achievements are:

- Develop new train network topology and architecture
- Introduce Mixed-criticality Ethernet for converged real-time Ethernet
- Robustly handle coupling and uncoupling of trains (inauguration)
- Achieve the same level of safety as the current TCN

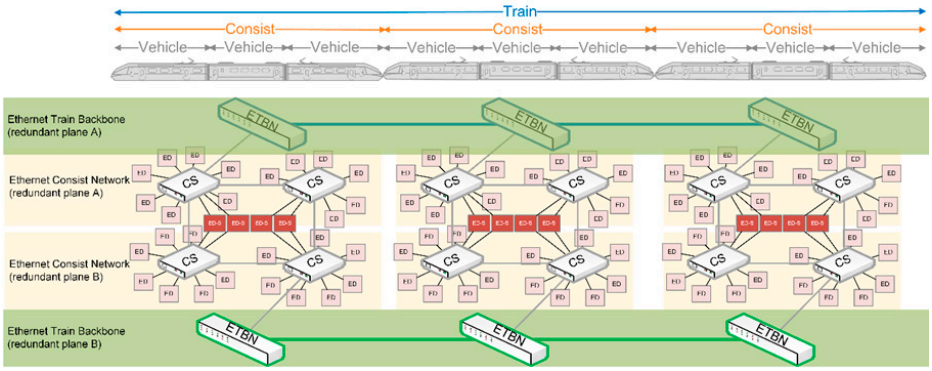
In order to achieve the desired behaviour in train communication, the Drive-by-Data (DbD) concept is implemented in all the network levels: at backbone level, at consist level, and at end-device level. This implies modifying all the network elements that currently deploy the wired communications inside the train, namely the Ethernet Train Backbone Nodes (ETBNs), the Consist Switches (CSs), as well as the End Devices (EDs).

A new train network topology and architecture

The proposed new train network topology is based on a redundant line architecture for the backbone network. Within each fixed consist, the local network is virtually split into the same redundant line architecture. Physically, the local network is connected in a ring.
The figure below depicts the different units that make up a train (i.e. vehicles and consists), and the two main network domains inside the train:

a) the Train Backbone, which deploys the consist-to-consist communication via Ethernet Train Backbone Nodes (ETBNs), connected in the redundant planes A and B.

b) the Consist Network, which includes Consist Switches (CS) as well as the Safety and Non-Safety End Devices (ED-S and ED, respectively) connected in the virtual planes A and B.



Mixed-criticality Ethernet for converged real-time Ethernet

The reduction of cabling can be achieved by technology that is able to partition the network robustly enough so that critical and non-critical traffic streams do not interfere with each other. This is achieved by converged real-time Ethernet based on Time-Sensitive Networking (TSN) concept.
Scheduled communication ensures that the network is available when critical/high-priority data is sent even under high load situations.

Major contributions here are the correct scheduling of the (cyclic) communication for the control systems, as well as the underlying clock synchronisation between all nodes connected to the network.
Finally, robustness is ensured by traffic policing functions in the network devices and tolerance for link loss or component failure through the redundant, fail-operational architecture.

Robustly couple and uncouple trains

Trains, as opposed to other modes of transportations such as cars or airplanes, are more dynamic in nature in their composition. This is due to the flexibility of coupling two trainsets together which is commonly performed to improve the service to the customers and reduce cost.
However, it poses a challenge to the network which must safely handle such a recomposition of the train, manoeuvre certain functions to the right part of the train and ensure that the new configuration is correctly recognized, stored and handled by all cars in the trains, even under adverse situations such as the presence of a malfunctioning component in the network. This so-called Inauguration concept has been defined for the traditional TCN.
With the next-generation TCN, since the topology and architecture of the train is fundamentally different, also the inauguration function is changed. This is a major part of the Drive-by-Data activities.

Achieving Safety

Trains are already the safest form of transportation and maintaining current levels of safety is of paramount importance to any new development in the area of railway. For this reason, an update to the communication architecture of the train can only be performed by maintaining the same safety requirements.
In Safe4RAIL-1, safety analyses were performed to ensure that the newly introduced concepts are compatible with the safety requirements. In Safe4RAIL-2, even more emphasis is placed on the safety, by designing and implementing safe Ethernet-based train inauguration as well as incorporating safety data transmission layer (SDT) into the network components responsible for the inauguration.

Ongoing Activities

Latest news from the WPs

WP1 TSN-based Drive-by-Data
A decision was made about which FDF-DbD interface requirements belong to end-devices (WP3) and which ones will be implemented by the network devices (WP1). Furthermore, the requirements definition phase for the integration of TSN into end-devices has passed and a first set of requirements is proposed.

WP2 Future Wireless TCMS
The requirements for the WireLess Train Backbone (WLTB) and WireLess Consist Network (WLCN) devices were defined. In addition, scenarios and required models for challenging wireless situations were identified.

WP3 Functional Distribution Framework (FDF) and Simulation Framework (SF)
In the first six months of the project, partners concentrated on the collection of requirements. This resulted in the deliverable D3.1. Based on a set of high-level integration requirements for the FDF and SF, detailed requirements for the Regional and Urban demonstrator were identified. WP3 has organised two successful inter-consortia technical meetings to clarify doubts and identify needs and collaboration points

WP4 Dissemination, Communication, Exploitation and Standardisation
The project website, networking platforms (Twitter, LinkedIn, etc.), project logo, project leaflets, and design for upcoming dissemination activities were established.

WP5 Project, Risk, and Innovation Management
A successful Kick-Off meeting took place immediately after the start of the project. The main coordination result in this first period has been the completion of the Consortium Agreement, the Grant Agreement, and the Collaboration Agreement (COLA) with CONNECTA-2, which led to a smooth collaboration.

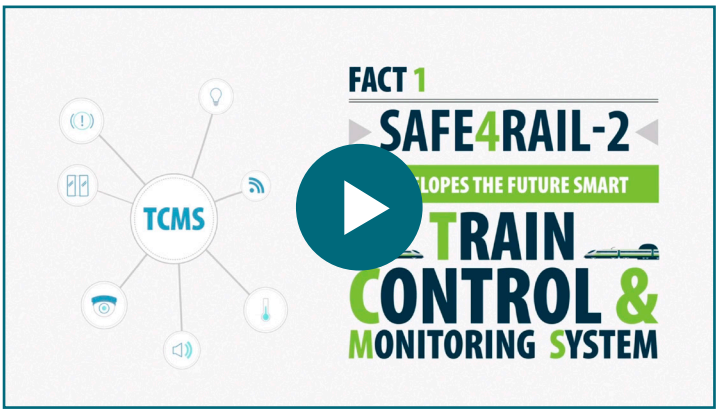
Public Deliverables Submitted

From **M01 to M06** two public deliverables have been submitted to the European Commission.

D4.1: "Internal and external IT communication infrastructure and project website" [February 2019] constitutes a guideline for communication of the Safe4RAIL-2 project to external target groups including conferences, marketing measures and communication channels.

D5.1: "Project quality plan" [February 2019] constitutes a set of project templates, explanations on the project management process, review process, quality checks, meeting organisation, which is communicated to all partners.

Video & Leaflet



We invite you to watch our new video about improving trains in Europe.
Watch on Vimeo

You want to know more about Safe4RAIL-2? Take a look at the brand-new leaflet.
Check out the Safe4RAIL-2 Leaflet

Past Meetings

Kick-Off Meeting
Munich, Germany
21st - 22nd November 2018

Safe4RAIL-2 & CONNECTA-2 Planing Meeting
Hennigsdorf, Germany
3rd - 4th December 2018

AUTOSAR Adaptive Platform Training
Munich, Germany
11th - 12th December 2018

AUTOSAR Adaptive Platform Training
Munich, Germany
10th - 11th January 2019

AUTOSAR Adaptive Platform Training
Stuttgart, Germany
07th Feburary 2019

EndPoint Integration Meeting
Korneuburg, Austria
05th - 06th March 2019

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