Alternative Bearers for Rail

The AB4Rail project

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Kick off meeting

4th February 2021

Co-funded by the Horizon 2020 programme of the European Union

This project has received funding from the Shift2Rail Joint Undertaking (JU) under grant agreement No 101014517. The JU receives support from the European Union's Horizon 2020 research and innovation programme and the Shift2Rail JU members other than the Union.

Summary

- Agenda of the Kick Off Meeting
- Rail vision 2050
- The AB4Rail project
  - Motivations
  - Related projects
  - Relation to the work programme

Kick Off Meeting Agenda

- Agenda of the Kick Off Meeting

Thursday, February 4th 2021, Online Meeting (Zoom)

Start	End	Topic	Partner	Duration
9:30	9:45	**Welcome to the meeting**	Alessandro Neri (President of RDL)	15 mn
9:45	10:00	**Introduction to the meeting: AB4Rail project**	Franco Mazzenga (PC of AB4Rail, RDL)	15 mn
10:00	10:15	**Welcome and introduction from ERA**	Thomas CHATELET (ERA)	15 mn
10:15	10:30	**Welcome and introduction from Shift2rail**	Gorazd Marinic (S2R)	15 mn
10:30	10:45	**S2R X2Rail-5 and synergies with AB4Rail project**	Ulrich Geier (X2Rail-5, Kontron)	15 mn
10:45	11:10	**AB4Rail Project Overview** ● Partner introduction ● Project objectives ● Project Timing ● Work plan	Franco Mazzenga (RDL)	25 mn
11:10	11:20	**Break**		10 mn
11:20	11:30	**WP1 overview** ● WP description ● Timing and organization ● Deliverables	Maurizio Salvitti (RDL)	10 mn
11:30	11:45	**WP2 overview** ● WP description ● State of art, trends, and challenges ● Timing and organization ● Deliverables	Anna Maria Vegni (RDL)	15 mn
11:45	12:00	**WP3 overview** ● WP description ● State of art, trends, and challenges ● Timing and organization ● Deliverables	Alessandro Vizzarri (RDL)	15 mn
12:00	12:15	**WP4 overview** ● WP description ● Timing and organization ● Deliverables	Romeo Giuliano (USGM)	15 mn
12:15	12:50	**Discussion on interactions between partners (Question & Answer)**	All	35 mn
12:50	13:00	**Planning for next meetings**	Franco Mazzenga (RDL)	10 mn
13:00		**End of meeting**		

Rail Vision 2050 (from ERRAC)

- Europe's railway network is the heart of its mobility, serving the travel needs of its citizens and playing a key role in the distribution of the goods which they buy and use. By linking towns, cities, regions and states-whether through commuter travel in the growing urban centres or through regional, long-distance and international travel-rail delivers **a seamless web of connectivity which accounts for 9 billion individual trips annually** (2012) within the EU.
- With these numbers, Rail is in a privileged position to become the backbone of an intermodal "**Mobility as a Service**" for passengers and "**Delivery as a Service**" for goods.

In 2050, rail transport in Europe is the backbone of an intermodal **"Mobility as a Service"** within cities and beyond, for both passengers and goods, meeting the needs of customers, EU citizens and society. The suppliers and service organisations of the **European rail industry are recognised as the world's thought leaders** for railway products and services.

ERRAC: European Rail Research Advisory Council

Innovations to deliver the vision

- To deliver the 2050 vision the rail industry is underpinned by *technical and scientific research in Europe and around the world*. The development and widespread deployment of a host of related technologies include some that represent the evolution of current developments
- **Digitalisation:** (discussed in the next slide);
- **Distributed cognitive computing:**
  - endowing machines with the ability to become aware of and understand their surroundings, to recognize patterns, to generate meaningful insights from large amounts of distributed data, and to learn;
- **Robotics:**
  - endowing machines with the ability to perform goal-oriented tasks autonomously;
- **Distributed immutable shared ledgers:**
  - e.g. "blockchain" technology, allowing the secure recording of transactions without centralized control or coordination;
- New **"intelligent" materials** with self-healing properties and the ability to shape themselves in response to external stimuli.
- **These technology trends are based on the current state of technology.**

Digitalisaton and ACS for Rail Vision 2050

- **Digitalisation:** the instrumentation of assets, processes and personnel with powerful Information and Communications Technology (ICT) capabilities, able to sense, detect, process, receive, transmit and analyse digital information **across secure, reliable and ubiquitous networks**, making them all participants of a global ‘’internet of things”;
- **FRMCS** and **ACS** are the future of the ICT infrastructures for rail communications.
- Both move in the right direction in accordance with Telcos and OTT visions, respectively
  - Objectives: one relevant example: ERTMS in 2030 –> 50000 km at least, no GSMR !
- ACS enables the fast deployment of the **interoperable, reliable, safe/secure communication** network infrastructure
- ACS allows to accelerate the creation of the data enabled railway (Single European Railway Area)
- AB4Rail tries to improve ACS to incorporate (possibly) ‘’*any*’’ other communication technology so to render ACS even more **ubiquitous**

A jump in the far ‘’future’’: what **IP** (**I**nterconnecting **P**eople) protocol version we will use in **2050** ?

IPv4 !!!?? 😄 😄 (and **IPvX** with **X≥6** will replace shortly)

The AB4Rail Project

- The AB4Rail project contributes to the work programme S2R-OC-IP2-02-2020
- It is a complementary project in X2Rail-5

Objectives

- identifying alternative communication bearers (ABs) for the Adaptable Communication System (ACS)

- Study of communication protocols: transport and application level

Project's Partners

- *Consorzio Università Industria – Laboratori di Radiocomunicazioni* (Radiolabs) – (Coordinator)
- *Università degli studi Guglielmo Marconi* – (Partner)

Motivations

- The foreseen evolution of the ERTMS platform towards a more efficient and **competitive train management systems will largely depend on the telecommunication infrastructure performance impacting on cost, capacity and energy consumption**.
  - These elements are also contributing to the emission of CO_2 and even though the railways transport is the greenest transport means a greater effort is needed to preserve the environment.

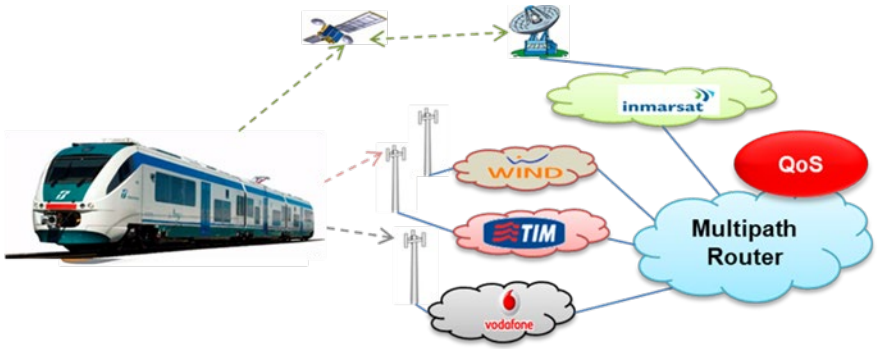
- AB4Rail will be targeting an improvement of the ACS performance

  - manage **multi communication bearers** and heterogeneous connection link (**bearer independence concept**) to guarantee the best performance of a single (multiple) specific rail application(s), by complementing communication bearers;

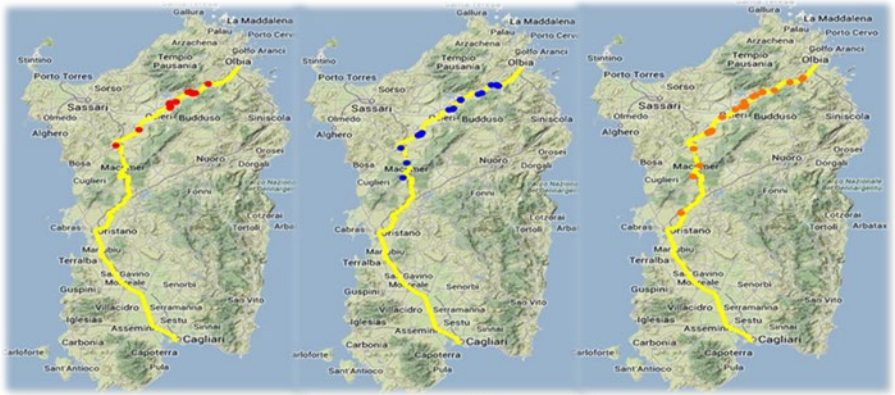
  - adopt a top-down approach for developing and managing rail applications in an **end-to-end** way to guarantee appropriate levels of Quality of Service (QoS) and Quality of Experience (QoE).

Radiolabs expertise

Radiolabs has been the first in Europe with RFI to introduce and test (in Sardinia, Italy) in 2015 a new telecom architecture (Figure) for railway **multi-bearer communications**, based on public mobile networks, to replace legacy telecom infrastructure, such as the GSM-R.



(a)



(b)

AB4Rail and relation with other Radiolabs' projects

- AB4Rail is strongly linked with other ongoing projects managed by Radiolabs.
- These projects mostly assigned by the EC and ESA form a set of activities focused on the exploitation of new telecom bearers.
- These projects aim to study and develop innovative communication platform for rail sector adopting multi-bearer transmission approach using both private and public radio technologies.

Projects	Financing Organization	Inputs, show as well how this project will go beyond the state of the art
EMULRADIO 4RAIL (2018-20). Grant Agreement No 826152).20	Shift2Rail Open Call http://www.emulradio4rail.eu/	The Emulradio4Rail Project aims to provide an innovative platform for tests and validation of various radio access technologies (Wi-Fi, GSM-R, LTE, LTE-A, 5G and satellites) that combines very new approaches for testing so called System in the loop (SITL) and Hardware in the loop (HITL). The IP-based satellite emulator developed by Radiolabs in Emulradio4Rail will be extended in AB4Rail to include terrestrial bearers as well to account for the ACS specific features. The AB4Rail IP software platform will also include the possibility of interface the generated application traffic with different transport and application protocols layers.
SBS phase 2 (2019-2021)	ESA https://business.esa.int/projects/sbs-rails-phase-21	SBS aims to design, develop and test, both on laboratory and on field, a demonstrator for the certification of an ERTMS L2 with GNSS positioning and public telecoms with a Multi-bearer (GSM-R, 3G/4G, Satcom, WiFi) solution coherent with the ACS. The results of SBS Phase2 can be integrated with the analysis results of Alternative Bearer in specific scenarios already tested both in Lab and in field (Novara-to-Rho pilot line), together with transport protocol/Application protocols. AB4Rail benefits of SBS phase 2 results providing important indications on the concepts and practical implementation of the multi-bearer approach to be extended to ABs in place of traditional bearers as in SBS phase 2.
EMERGE project (2019 – 2021)	**Ministry of Economic Development MISE** http://www.radiolabs.it/en/enabling-technologies-for-the-connected-cars/	The national EMERGE project coordinated by Radiolabs aims to the development, prototyping and test of innovative solutions to allow connected vehicles to operate in daily or emergency scenarios, acting on: • Geo-localization with satellite multi-constellation (GPS+Galileo), augmentation algorithms and data-fusion with on board sensors; • Communication inter and intra vehicles by integrating cellular, satellite public networks and 5G; • Cybersecurity for enhancing security on intra and inter vehicular communications and ensuring integrity on data for vehicle positioning; • Cloud/Edge computing by developing and implementing algorithms to identify and avoid potential hazards. EMERGE provides a first implementation of the multi-bearer platform in the automotive case. The concepts and results developed in EMERGE will support AB4Rail activities concerning the possible integration of ABs and traditional bearers in the rail ecosystem. In turn, AB4Rail results could influence EMERGE by providing information on alternative communication technologies that can enlarge the pool of communication bearers (Traditional/ Alternative Bearers) to be used even in the automotive scenarios.
SAT4TRAIN (2017-2020)	ESA https://artes.esa.int/projects/sat4train	Sat4Train is a project focused on the design, development and prototyping of dedicated Multi Link satellite-based Communication Platform (MLCP), as a candidate solution for providing an alternative solution to the standard GSM-R technology adopted by the ERTMS system that is approaching its obsolescence. Sat4Train will exploit innovative features such as the use of multiple public networks (SatCom and cellular) and intelligent routing with cognitive algorithms to allow an ERTMS Quality of Service, suitable for the specific railway application domain without deploying a dedicated telecommunication infrastructure.

AB4Rail and relation to the work programme (1/2)

- The AB4Rail project addresses topic number "**S2R-OC-IP2-02-2020**" on technology feasibility studies of the IP2 adaptable communication technology demonstrator.

- The AB4Rail project is positioned in the Shift2Rail work programme and specifically in the **IP2 X2Rail-5** WP03 TD2.1 activity concerning the development of the **Adaptable Communications System** (ACS) for all railways technological demonstrator.

- AB4Rail studies will be conducted using effective and well tested methodologies in X2Rail's projects allowing AB4Rail's results to be directly used in TD 2.1 development activities.

- The following Table summarizes the relation of AB4rail with the work programme and Q&A document (18 may 2020), Q. 36.

AB4Rail and relation to the work programme (2/2)

Work Programme S2R 2020 (S2R-OC-IP2-02-2020) and Q&A document, 18th May 2020, Q 36	Action in AB4Rail	Related WPs
Workstream 1		
a. Describe the alternative bearers from a technology perspective;	• A complete review prior state-of-the-art in the area of the selected alternative communication bearers, which are of interest for the railway ecosystem and for improving capabilities of ACS (Task 2.1).	WP2 "Alternative bearers for railway applications"
b. Qualify the benefits and challenges of the bearers, taking into account operational and economic considerations;	• This activity is devoted to the analysis of the considered ABs from a technical point of view. The objective is to evidence their benefits, challenges and dependencies on the basis of technical, operational and economic considerations mainly related to the maturity status of the considered technology (Task 2.3).	WP2 "Alternative bearers for railway applications"
c. Outline the dependencies to infrastructure or other environmental preconditions;	• Evaluation of selected ABs' impact on the existing infrastructures, highlighting their inter-connection and inter-working features (Task 2.3).	WP2 "Alternative bearers for railway applications"
d. Compare the expected communication characteristics with well-established wireless technologies in terms of (but not limited to) average/maximum/guaranteed throughput, packet delay, packet jitter and other attributes such as Quality of Service support, resource management, multi-user / multi-application capabilities;	• Evaluation of the technical features of ABs by means of both the Radio Access Technology tool and the Communication Traffic Analysis procedure (Task 2.2). • Alternative Bearer/Traditional Bearer comparison (Task 2.5)	WP2 "Alternative bearers for railway applications"
e. Provide a recommendation or classification of bearers related to certain railway environments and further work in terms of technology and business case development.	• Recommendation or classification of ABs related to certain railway environments, as well as further work in terms of technology and business case development (Task 2.4)	WP2 "Alternative bearers for railway applications"
Q&A document 18 may 2020, Q. 36		
Based on the topic description included in the AWP2020, although the topic is marked as a study, tests in lab and on site of the most promising technologies, followed by an evaluation, are required	• AB4Rail will assess the potentials of the most-promising ABs by means of in labs and/or on field trials (TRL 4/5) (Task 2.6).	WP2 "Alternative bearers for railway applications"

Workstream 2		
a. With the convergence of network protocol layer towards the Internet Protocols to identify the appropriate transport protocol for ensuring communication characteristics and capabilities during application development;	• Review of ACS, of existing transport and application protocols, for railway applications (Task 3.1)	WP3 "Communication Protocols for railway applications"
b. Analyse interworking between Internet Protocol v4 and Internet Protocol v6;	• The task activities will start with an extensive investigation of the current literature concerning the problem of IPv4 and IPv6 interworking (Task 3.2)	WP3 "Communication Protocols for railway applications"
c. Analyse the different options for the transport layer (UDP, TCP, SCTP , etc.) and the application layer protocols (HTTP, QUIC, SIP, etc.) with the aim to narrow the selection for certain application requirements, qualifying the protocols in terms of technology features like flexibility, latency and prioritization as well as operational considerations including engineering and implementation complexity, monitoring and debugging capabilities;	• Emulator preparation & scenarios definition (Task 3.3) • Identification of Transport Protocol for railway application (Task 3.4)	WP3 "Communication Protocols for railway applications"
d. Analyze the security of the transport and application layer with using the secure version of protocols, *e.g.* SFTP or SCP instead of FTP, or HTTPS instead of HTTP or combining the protocols with application security.	• Analysis of options transport with application protocols [RDL, USGM].	WP3 "Communication Protocols for railway applications"

Thank you for your attention!

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www.ab4rail.eu

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