Alternative Bearers for Rail

WP3 overview

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RadioLabs

Kick off meeting

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Highlights

- **WP3 description**
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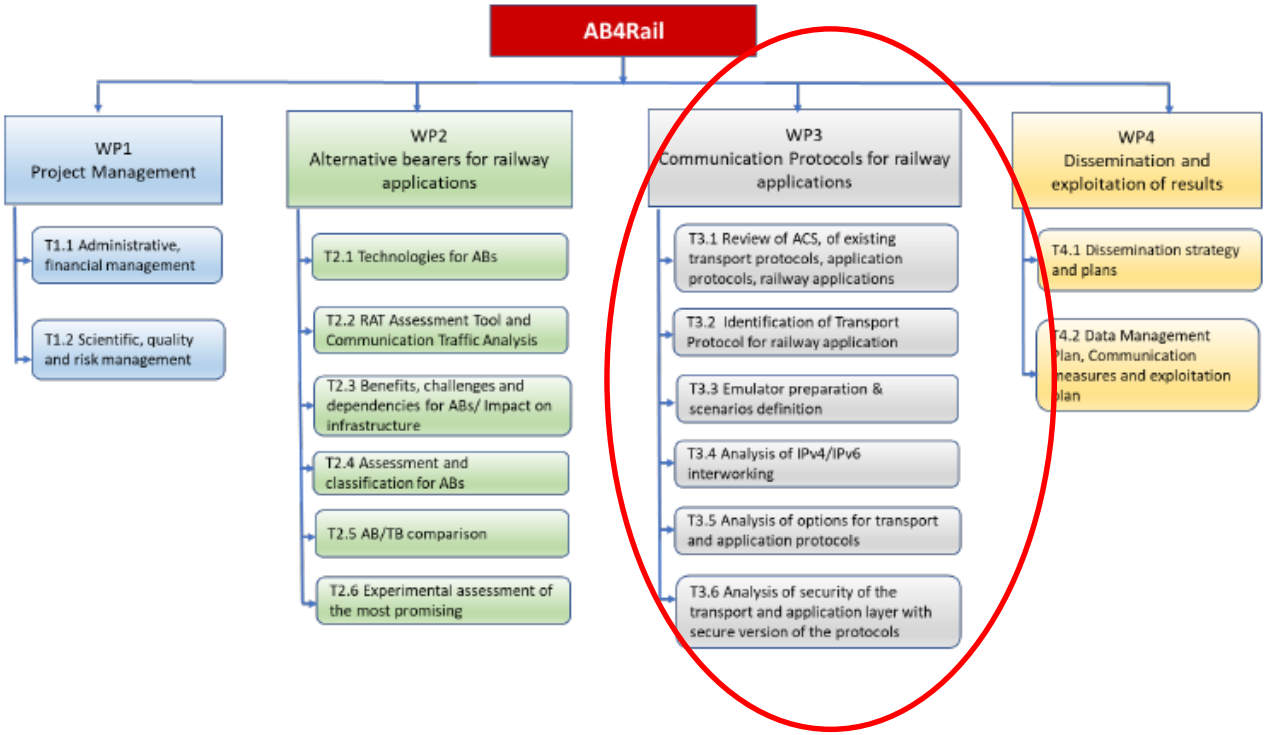
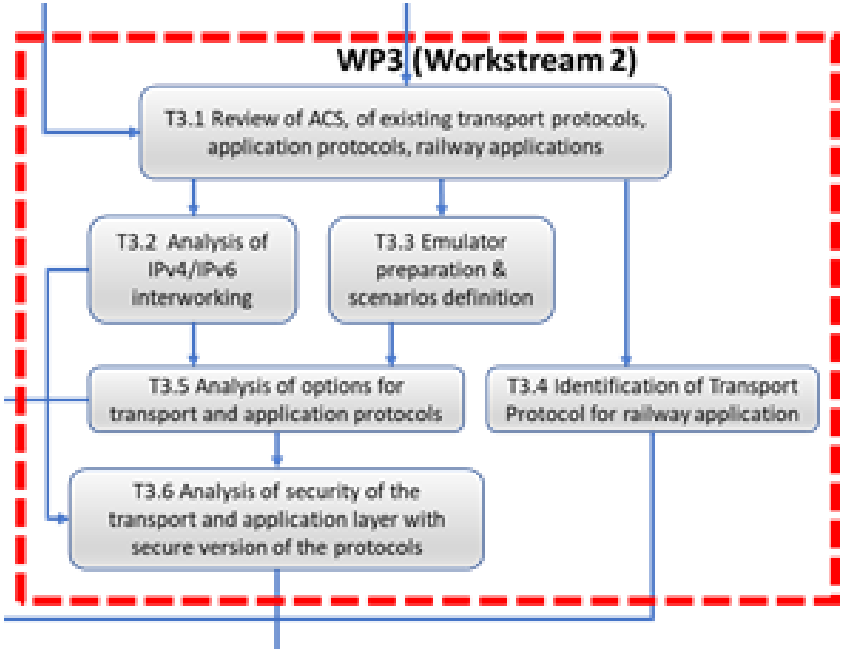
- **Timing**
- **Deliverables**



WP3 – Objectives

Communication protocols (workstream 2)

- To identify the appropriate transport protocol for ensuring communication characteristics and capabilities during application development;
- To study the interworking between Internet Protocol v4 (IPv4) and Internet Protocol v6 (IPv6);
- To analyse options for transport layer and the application layer protocols for specific rail applications;
- To analyse the security of transport and application layer using secure version of application protocols;
- To conduct IP-based emulation/simulation to support the protocol investigation activities.



WP3 – Communication Protocols

Considered Communication protocols

a) **TCP/UDP and other transport protocols** currently under study and/or development and/or testing in **IETF for data transfer over IP networks**. **The analysis accounts for the main novelties introduced into the recently proposed transport protocols.** The **following alternatives to TCP** will be reviewed and included in the successive AB4Rail investigation activities: **Stream Control Transmission Protocol (SCTP), Quick UDP Internet Connections (QUIC), Bottleneck Bandwidth and Round-trip propagation time (BBR). The Rail Safe Transport Application (RaSTA) protocol specifically designed for rail signalling and related requirements completes the review**.

b) the **application protocols to be layered on top of the transport protocol**. In principle, any application could craft its own network protocol. However, many applications are standardized, and they work with well-known and widely accepted application protocols. **The most important protocols** that will be considered in AB4Rail that are applicable to railway applications will be: **HTTP, FTP, RTP and their secure counterparts (if any) such as HTTPS and SFTP. The applicability of RaSTA as a user-plane protocol is also reviewed.**

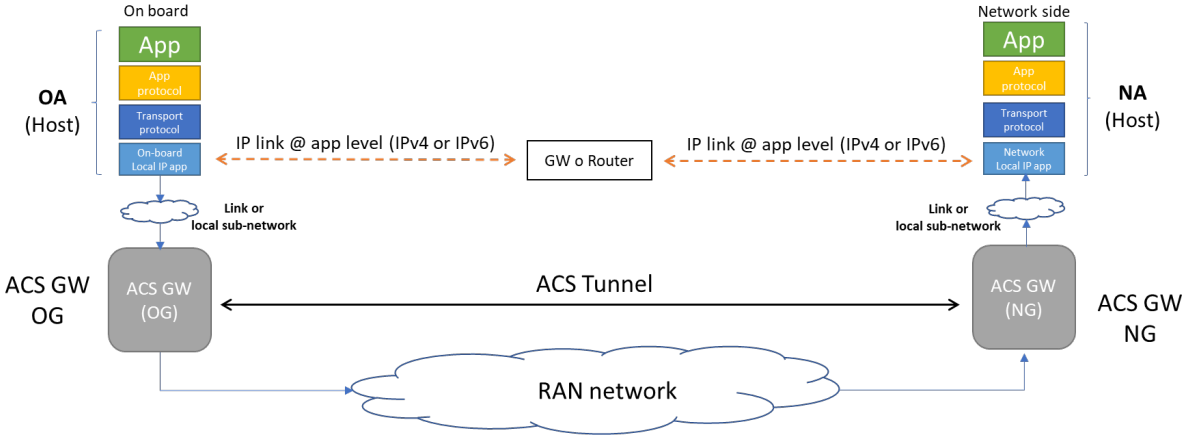
WP3 Impact

Operational flexibility aspects	The role of the AB4Rail project
Improved communications capabilities	• AB4Rail is in line with the communication paradigm envisaged in ACS by identifying, assessing and testing new bearers that are technical and economical sustainable for the rail applications. • We will investigate the possibility for some specific rail application (*e.g.* ETCS/ERTMS) to (flexibly) select/adapt its (secure/un-secure) transport and application protocols so to improve achievable end-to-end performance in terms of latency and overhead. This allows application to better interface with the ACS data transport infrastructure. • Optical communications, LEO satcom and HAPS are expected to boost actual communication performance
Radio Resource Management	• AB4Rail is expected to trigger research and development activities on ACS toward the study, analysis and development of new efficient algorithms for radio resource management. This will allow ACS to intelligently manage radio resources in a certain place and at a certain time with QoS/QoE.
Improved spectrum availability for the support of new services	• In principle, the support for the rail communication infrastructure for the new control services such as ATO, remote driving, predictive maintenance of the rail infrastructure etc. inevitably requires more radio spectrum. The possibility of integrating the alternative bearers emerged from AB4Rail studies into the ACS together with multi-path transport capability at application level (*i.e.* MP-TCP, MP-UDP etc.) can improve the aggregate transmission capacity available for rail applications. This is helpful to mitigate spectrum needs at least in those areas where traditional bearers and ABs are both available.
Improved/extended radio coverage	• Even though not yet fully standardized at institutional level (*e.g.* ETSI, 3GPP etc.) the possibility for ACS to seamlessly include satellite LEO/MEO HTS technologies and HAPS allows the same ACS system to be used over geographical areas.
Exportability of the ACS outside Europe	• The new bearers selected in AB4Rail are usable everywhere. This adds flexibility to the ACS to seamlessly include traditional and alternative radio technologies even for the market outside Europe and even in those countries where 4G/5G 3GPP and 802.11 radio access technologies could not be present at all or not fully developed, yet.

WP3 – Concept

- The **ACS provides the single/multi bearer underlying communication infrastructure** to be used by railway applications to **exchange voice/data-based services**.
- The workstream 2 activities (WP3) deals with **communications protocols on the "application side"** of the ACS-GW focusing, in particular, on the "**best" selection of (secure/un-secure) transport and application protocols layer**.
- The ACS GW allow to:
  - **inter-connect (on-board) applications (OA)** with the **corresponding applications running on the network side (NA)**
  - **interconnect hosts** residing **on sub-networks with different IP addressing schemes** *e.g.* one sub-network using IPv4 and the other IPv6.

ACS functionalities and protocol stack



- **Transport and application protocol layers** can severely **influence the end-to-end link performance** as perceived by the railway application which run on top of the protocol stack
- Main **transport mechanisms influencing end-to-end performance** can be **related to congestion and flow control procedures** which are **specific of the selected transport protocol layer**.

WP3 – Methodology

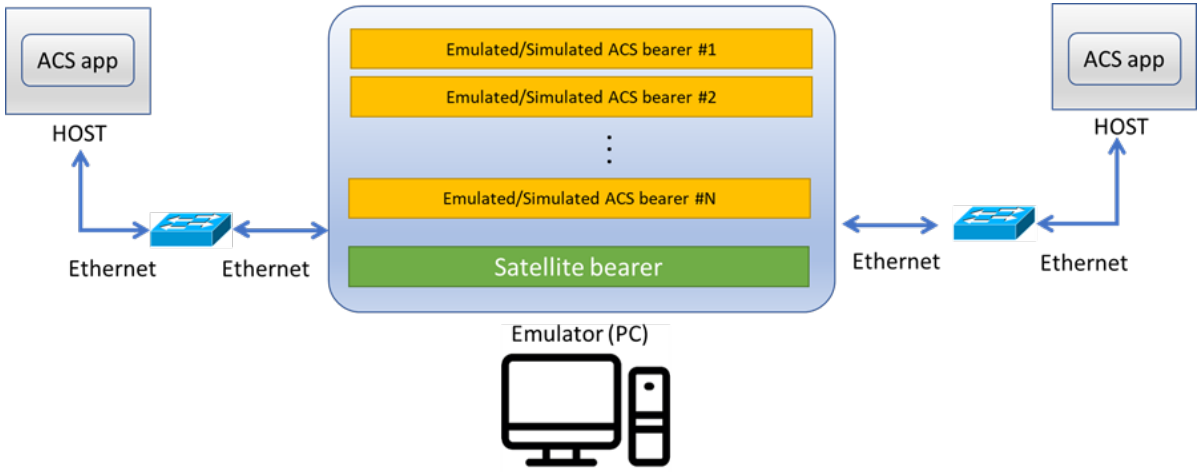
- **a** • Review of ACS, of existing transport protocols, application protocols, railway applications
- **b** • Analysis of IPv4/IPv6 interworking
- **c** • Emulator preparation & scenarios definition
- **d** • Identification of Transport Protocol for railway application
- **e** • Analysis of options for transport and application protocols
- **f** • Analysis of security of the transport and application layer with secure version of the protocols

The investigation methodology based on:

1. analytical and theoretical results available in the literature
2. software platform supporting network emulation and/or simulation at IP level.

The software platform:

1. Reproduces the behavior of the end-to-end IP-based communication through ACS
2. Provides the following features:
   - Emulation/simulation of the IP link in the case of terrestrial access radio technologies;
   - Assessment of degrading effects due to IPv4 to IPv6 (and vice versa) interworking;
   - Interfacing data traffic generators with variable (secure/un-secure) application and transport protocol
   - Embedding software tools for monitoring packet performance.

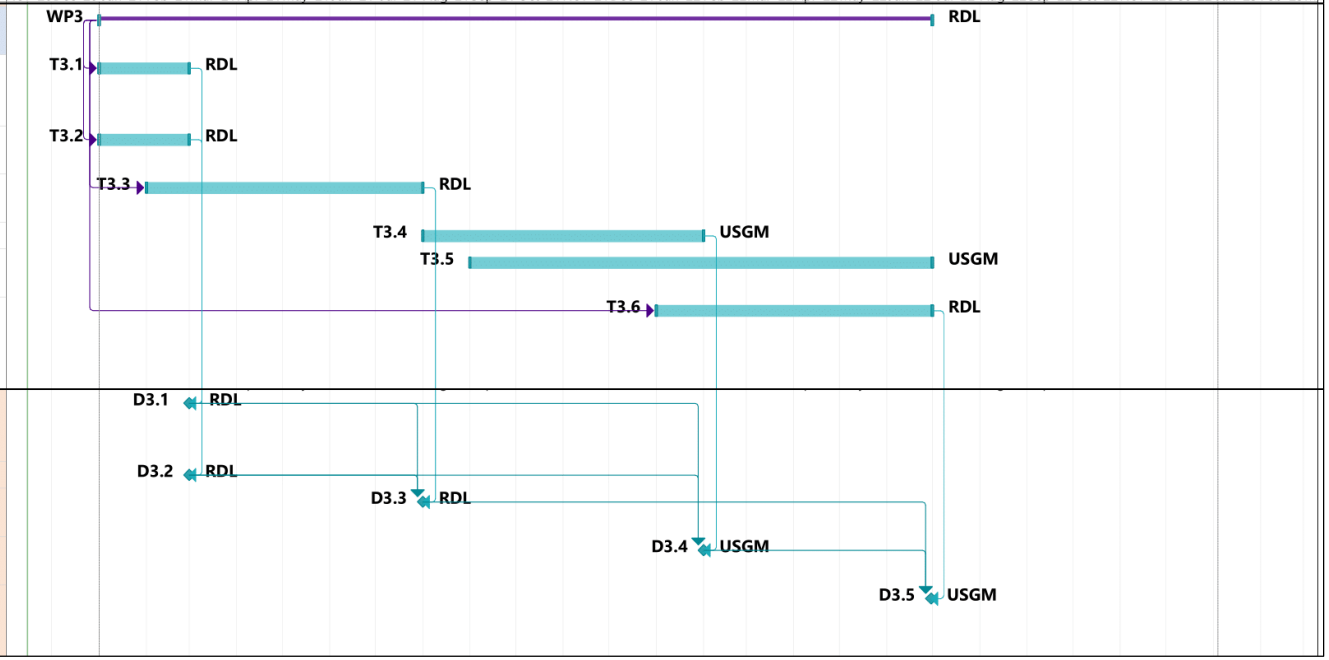


WP3 – Deliverables

Deliverable (number)	Deliverable name	Work package number	Short name of lead participant	Type	Dissemination level	Delivery date (in months)
D3.1	Review of ACS, of existing transport protocols, application protocols, railway applications	WP3	RDL	D	PU	T0+2
D3.2	Analysis of IPv4/IPv6 interworking	WP3	RDL	D	PU	T0+2
D3.3	IP Emulator and scenarios definition	WP3	RDL	D	CO	T0+7
D3.4	Identification of Transport Protocol for railway applications	WP3	USGM	D	PU	T0+13
D3.5	Analysis of options for transport and application protocols and of their secure versions	WP3	USGM	D	PU	T0+18

WP3 – Timing

ID	Activity Name	Leader
19	**Communication Protocols for railway applications**	**RDL**
20	Review of ACS, of existing transport protocols, application protocols, railway applications	RDL
21	Identification of Transport Protocol for railway application	RDL
22	Emulator preparation & scenarios definition	RDL
23	Analysis of IPv4/IPv6 interworking	USGM
24	Analysis of options for transport and application protocols	USGM
25	Analysis of security of the transport and application layer with secure version of the protocols	RDL
26	*Review of ACS, of existing transport protocols, application protocols, railway applications*	*RDL*
27	*Analysis of IPv4/IPv6 interworking*	*RDL*
28	*IP Emulator and scenarios definition*	*RDL*
29	*Identification of Transport Protocol for railway applications*	*USGM*
30	*Analysis of options for transport and application protocols and of their secure versions*	*USGM*



Thank you for your attention!

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