Shift2Rail: Moving together to 2030. Achievements and ongoing activities

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Head of Research & Innovation

S2R Joint Undertaking

@Shift2Rail_JU
#Horizon2020

28
MEMBERS

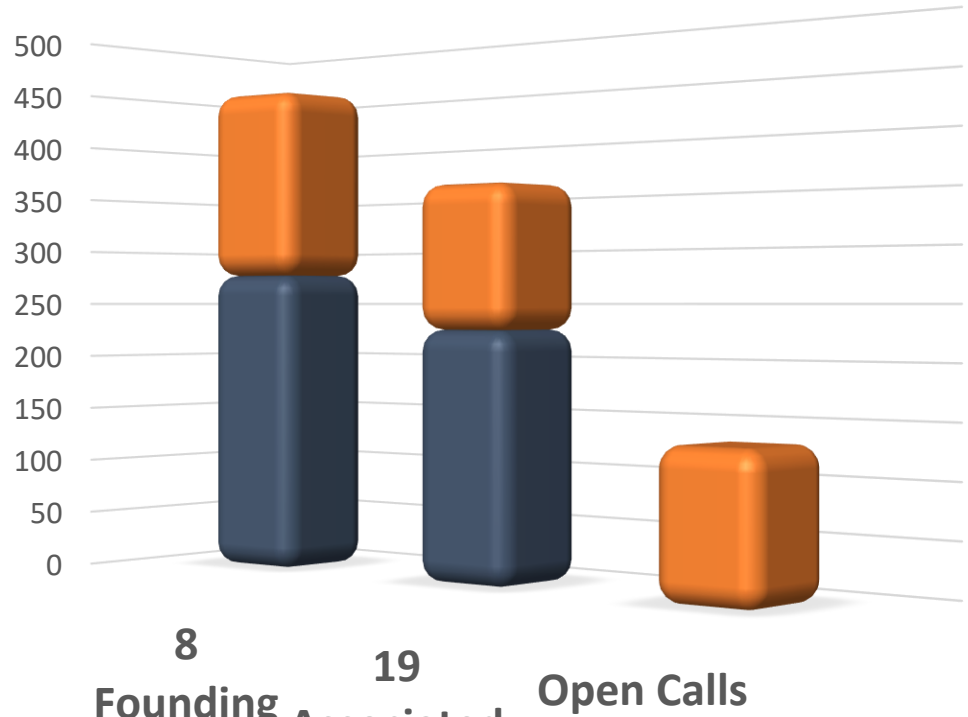
375
PARTICIPANTS INVOLVED FROM **28** COUNTRIES

101
SMEs

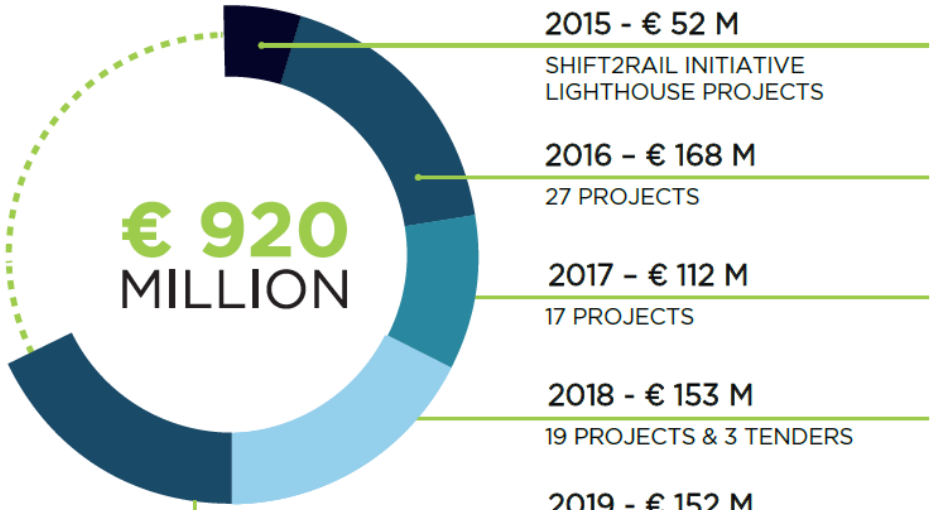
103
RESEARCH CENTRES AND UNIVERSITIES

[1]Data extracted from CORDA database in February, 2019

AN OPEN and ACTIVE ORGANISATION



Values as at 1 Sept 2016 in Million EUR



2015 - € 52 M
SHIFT2RAIL INITIATIVE
LIGHTHOUSE PROJECTS

2016 – € 168 M
27 PROJECTS

2017 – € 112 M
17 PROJECTS

2018 - € 153 M
19 PROJECTS & 3 TENDERS

2019 - € 152 M
18 TOPICS & 4 TENDERS

*incl. at least 120M€
of additional activities

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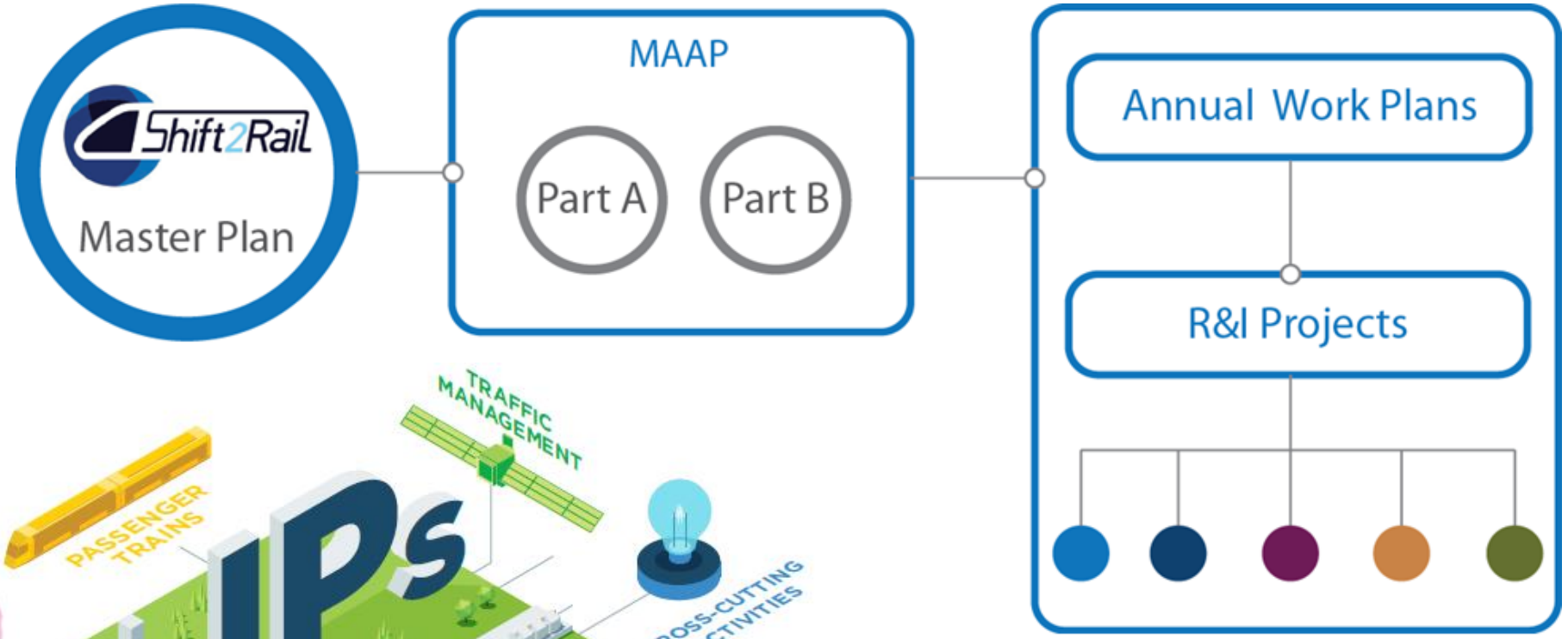
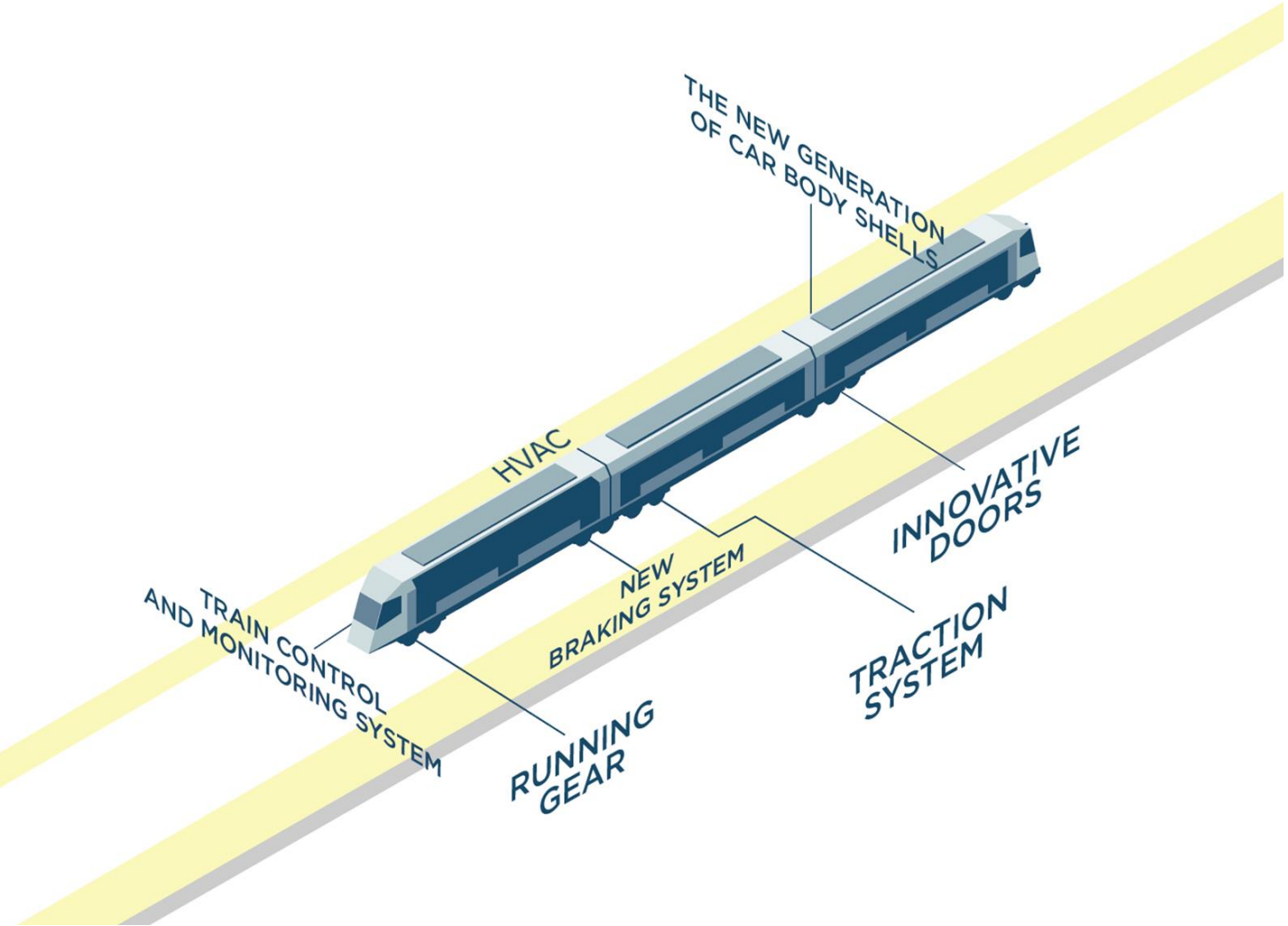
USER FIRST

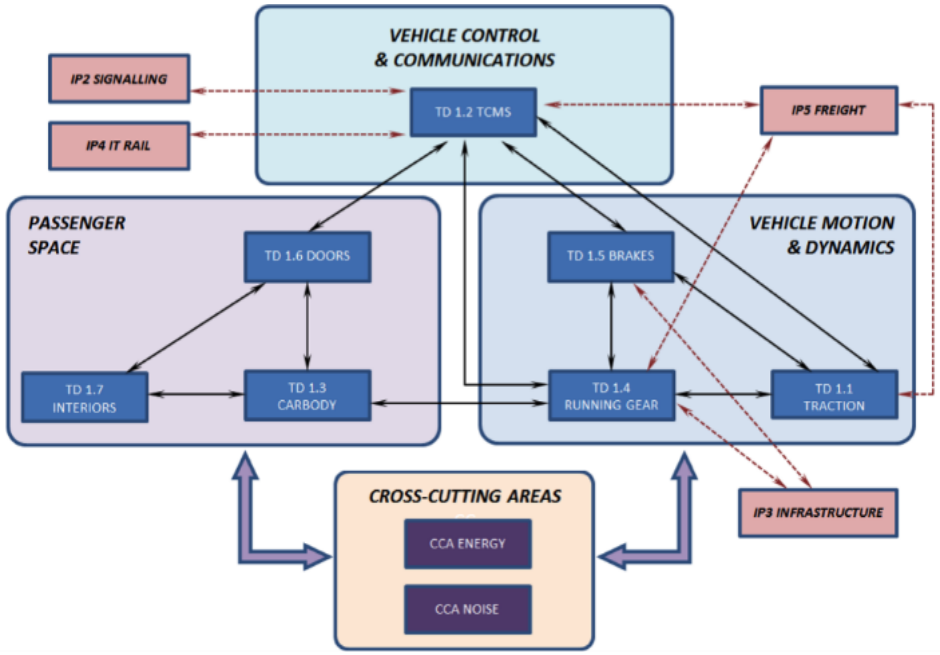
…opening up new Capabilities coming from emerging technologies or concepts!

The S2R Programme implementation



IP1: Cost-efficient and reliable trains, including high-capacity trains and high-speed trains





IP1: key achievements and ongoing activities

- **Traction:** Technical Demonstrator with innovative components for energy saving, weight and size reduction, using mainly SiC technology
  - → up to 20% of Energy saving for Traction chain on Regional Platform
- **TCMS:** Wireless Technology for train communication network, Drive by Data and Functional Open Coupling concept.
  - → Prove of concept for integration of SIL4 functions in TCMS, significant reduction of wires (Installation and Maintenance Costs)

InnoTrans 18 – Virtual Coupling Demo

- **Doors**: next gen doors, PRM access, noise attenuation and increased accessibility
- **Interiors**: new modularity concepts, easier upgrades

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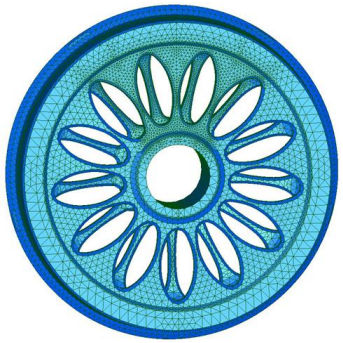
IP1: key achievements and ongoing activities

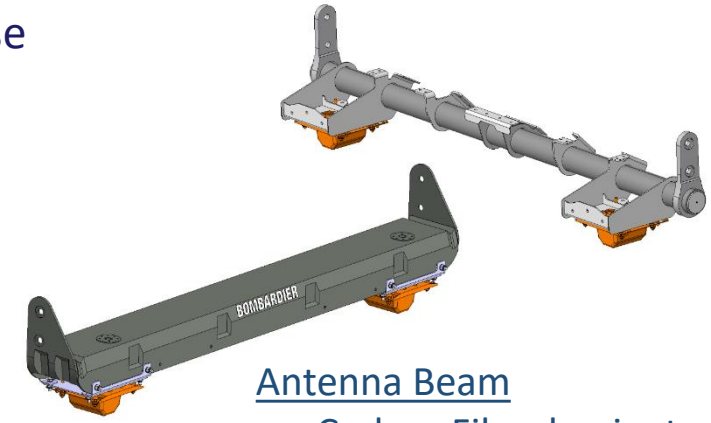
✔ **Carbody Shell and Running Gear:** Introduction of composite material for hybrid consist's structure.

→ Weight reduction - impact on vehicle's payload -> capacity increase



Spoke Wheel for Metro Bogie

- Wheel wear (use of new materials) and rail wear
- Weight (by 10%)
- Noise emission



Antenna Beam

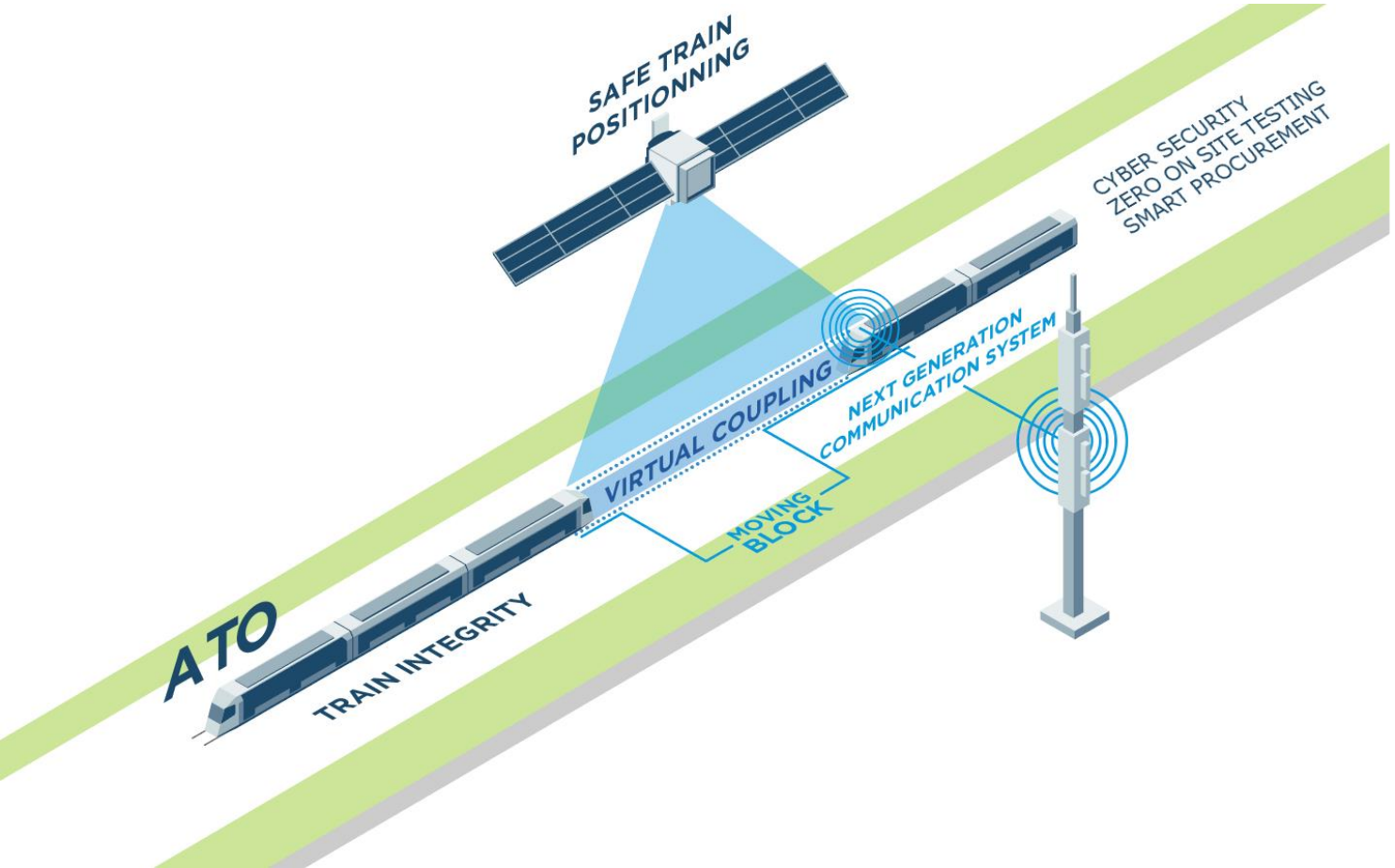
- Carbon Fibre laminate
- 13 kg vs 60 kg for conventional solution

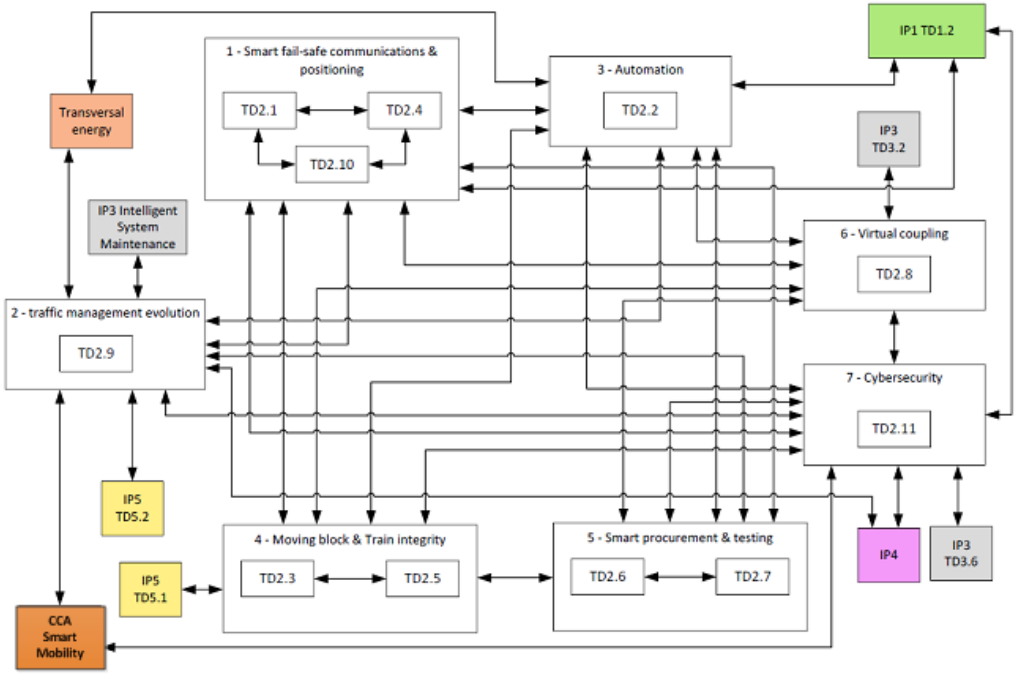
✔ **Brakes :** Design of Electro-Mechanical Brakes, High SIL Electronics and wheelset slide protection.

→ No pneumatic pipes for brakes management -> LCC

→ Braking distance reduction in poor adherence, from +25% to 15%

IP2: Advanced Traffic Management and Control System





IP2: key achievements and ongoing activities

- **ATO for mainline railways**; GoA4 will reduce human error and increase service availability
  - GoA2 draft specifications available (reviewed by sector + ERA);
  - Pilot tests in first half of 2019;
  - Use cases/specifications for GoA4 are ongoing.

- **Moving Block** based on ERTMS/ETCS specifications and opportunity to remove trackside fixed signalling systems

InnoTrans 18 – Moving Block demonstration in urban, suburban, high speed and freight traffic management

IP2: key achievements and ongoing activities

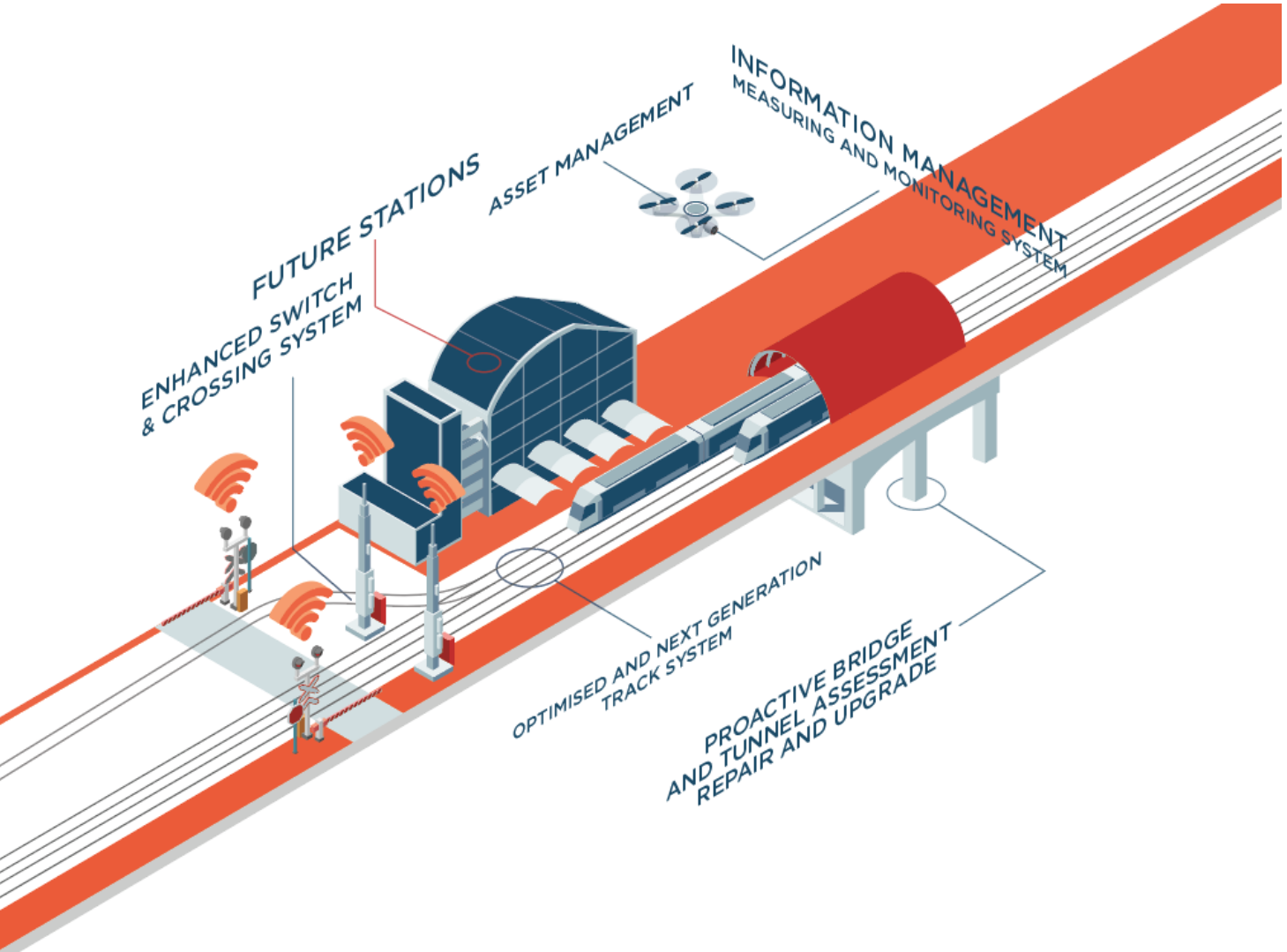
- **GNSS/positioning systems** applied to rail to remove physical balises and facilitating the application of moving block
  - System Requirements Specification and system architecture to be delivered

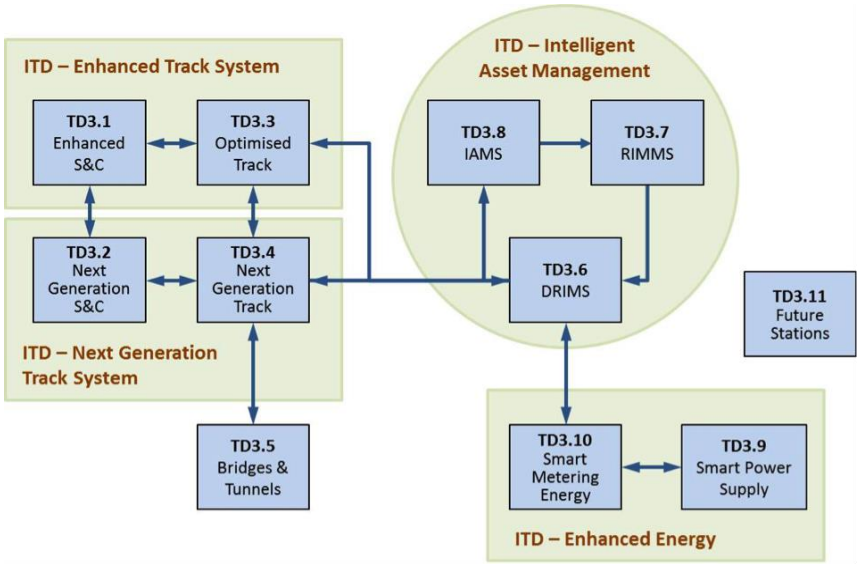
- **Adaptable communication for railways,** technology and bearer independent
  - Cooperation UIC FRMCS (+ ERA) on use cases;
  - Specifications development and prototypes preparation

- **New and dynamic control of train management** – based on Virtual Coupling and On-board intelligence

- **A new Railway System Architecture under preparation**.

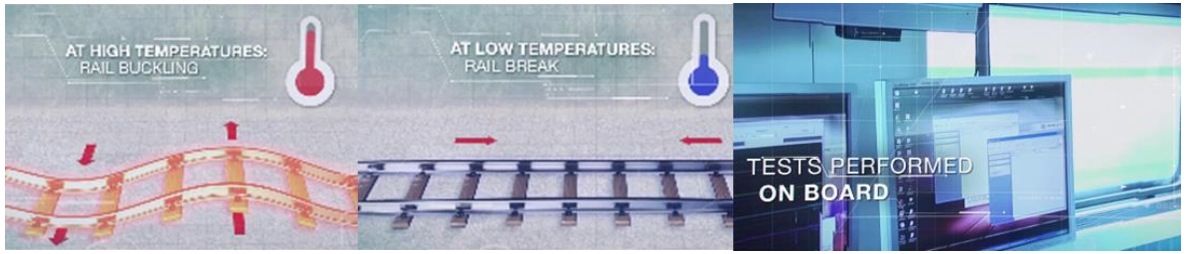
IP3: Cost Efficient and Reliable High Capacity Infrastructure





IP3: key achievements and ongoing activities

- **Intelligent Asset Management:** Shift from reactive to proactive maintenance based on innovative monitoring/ measuring & processing technologies
  - Innovative technologies in asset measuring & monitoring (satellite, drones, robotics), data processing & decision support (IoT, Artificial Intelligence)
  - Demonstration & evaluation of asset management, maintenance strategies: Thermal Stress Monitoring, and Lean Tamping



- **Intelligent Energy Management:** mapping of all energy flows in railway system for management strategies. Future traction power supply system in integration with public grid
  - Proof-of-Concept in light-train environment (tramway)
  - Design of an intelligent substation, 66% savings on transmission losses, 25% reduction on dimensioning

IP3: key achievements and ongoing activities

✔ **Optimized & Future Infrastructure Design:**

✓**Track and S&C System:** Analysis of deformation mechanisms & introduction of advanced capabilities to existing systems. Design of radically new designs & systems

- Novel concept for locking & detection capabilities
- Conceptual designs for radical switch actuation, locking and detection

✓**Bridges & Tunnels:** Improved inspection & repair methods → service life extension, disruption time reduction, N&V reduction

- Digital Imaging for asset monitoring + BIM-based asset management for remaining life estimation & bridge prediction behavior
- Investigation of bridge-rolling stock interface & contribution to standards

✓**Stations:** New designs enhancing mobility, accessibility & crowd management

- Analysis of the passenger needs and expectations at railway stations
- Conceptual design of Platform-Train Interface (PTI) solution

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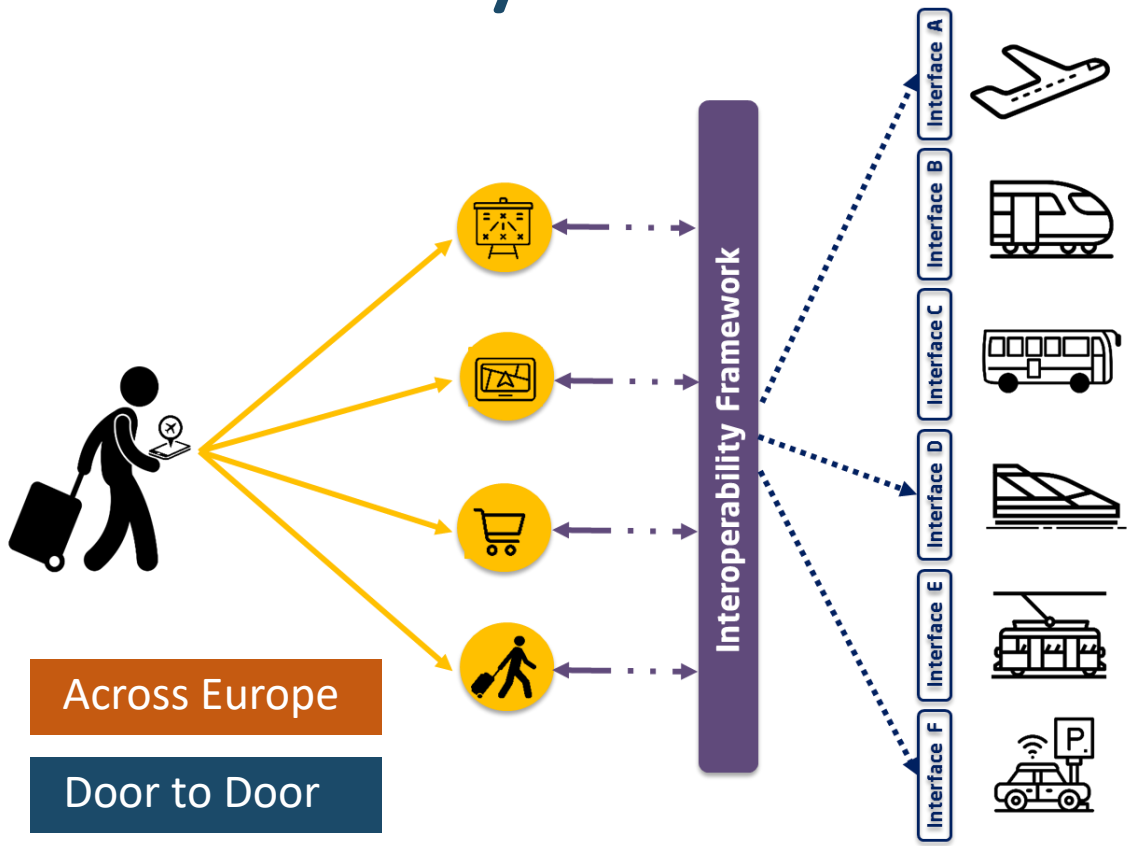
IP4: IT Solutions for Attractive Railways Services



Across Europe

Door to Door

Across Modes

Across Services

IP4: key achievements and ongoing activities

- **Interoperable framework:** semantic based IT solution capable of making interoperable different databases using different standards, without the need of changing the legacy systems – creating a multimodal framework
  - First converter demonstrating semantic interoperability using FSM and TAP-TSI
  - Enhance the Interoperability Framework with AI

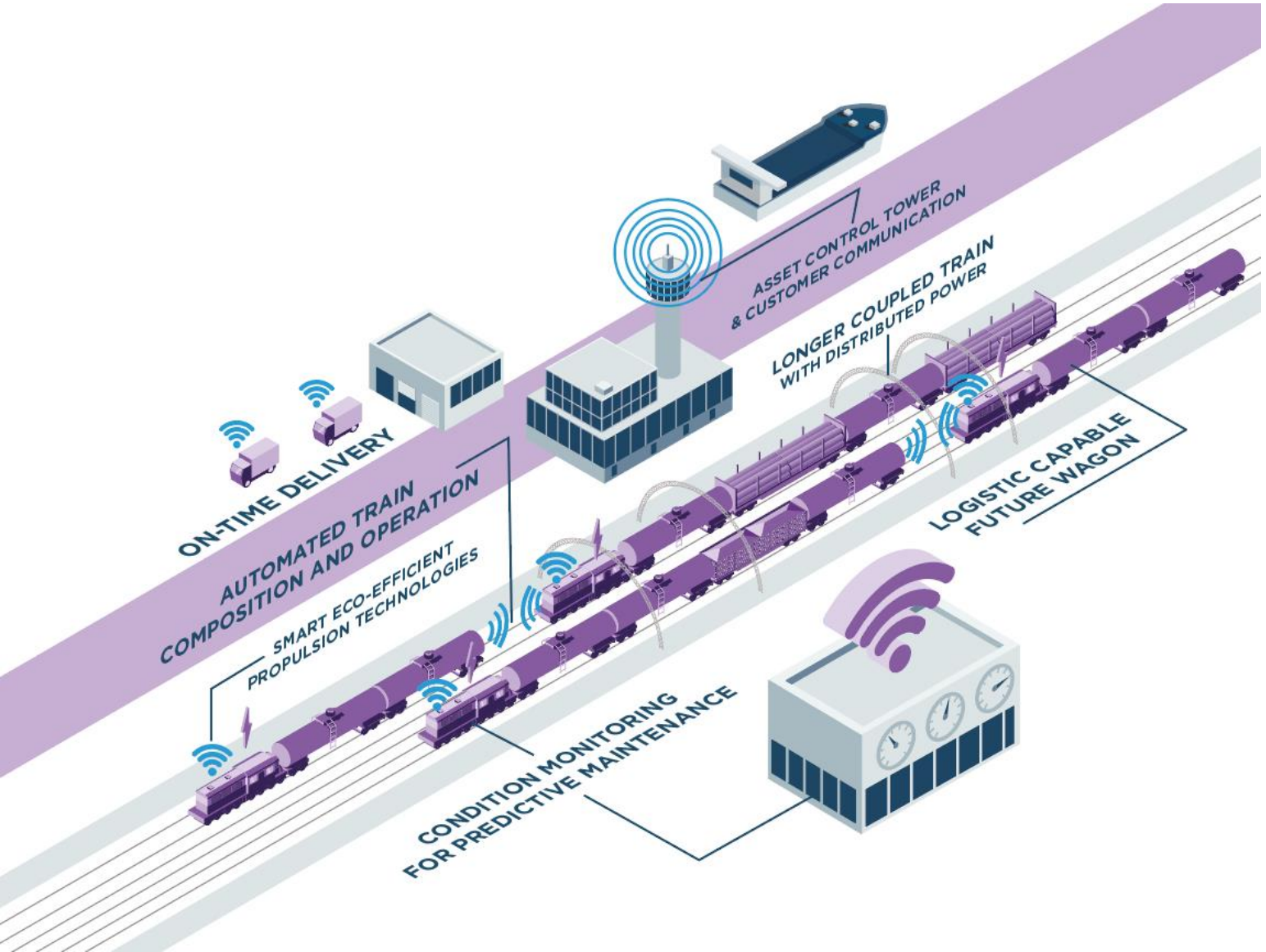
- **Multimodal travel services:** providing to the passenger the easy interface, masking the complexity of technical and financial interaction among the several services provider, for shopping, booking and retrieving their right to travel
  - **First demonstration of the IP4 ecosystem at Innotrans 2018**

IP4: key achievements and ongoing activities

- **Customer experience applications:** providing to the user the engine to search its travel accordingly to his/her specific needs/preferences + providing an useful companions guiding the user across the right platform or across a service disruption through an automatic re-routing, etc.
  - inclusion of new Mobility Services in the ecosystem
  - Starting on MaaS, for a European « roaming service »

- **Business analytics:** providing to the operating companies the means to understand and adapt their offer to a real time multi-modal demand

IP5: Technologies for Sustainable & Attractive European Rail Freight



Technical Demonstrators (TDs) – new structure

TD5.1_Fleet digitalization and automation	Improved services and reliable automated freight trains
TD5.2_Digital transport management	Optimised service planning, operation and capacity
TD5.3_Smart freight wagon concepts	Flexible and reliable high-capacity assets
TD5.4_New freight propulsion concepts	Smart and eco-efficient propulsion technologies
TD5.5_Business analytics and implementation strategies	Technologies in line with the market needs

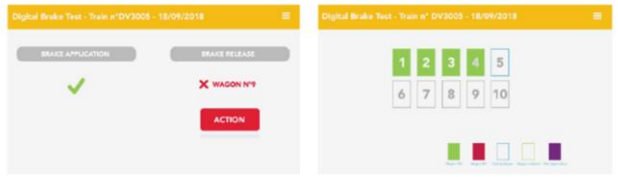
IP5: key achievements and ongoing activities

- **Fleet Digitalisation/Automation:** automatic coupling (flexible wagon composition), CBM (data handling, analytics and dashboards), ATO/DAS (testing of ATO developed in IP2)
  - Multi-sensor obstacle detection up to 1km

- **Transport Management:** IT solutions electronic communication technologies to maximise punctuality and capacity.
  - Intelligent Video Gate for high speed waggon scan and multi modal dispatching

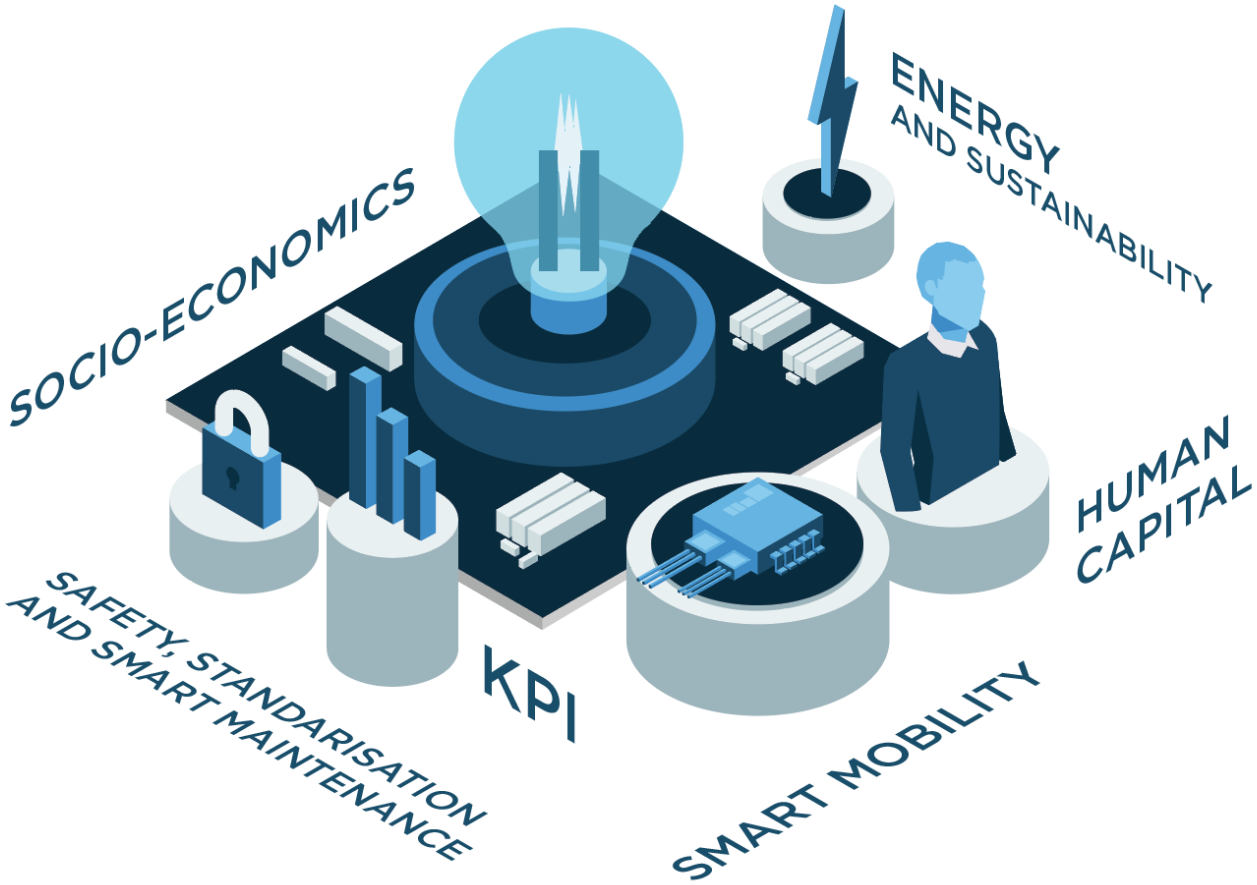
- **Freight waggon concepts:** Low-noise, lightweight, high speed & track friendly Freight Running Gear & Modular lightweight freight wagon design
  - Automatic brake test and a new silence wheelset

DIGITAL BREAK TEST presented at InnoTrans2018



- **Freight Propulsion systems:** New freight locomotives with network independent operation capabilities, supporting increased train lengths up to 1500m, energy reduction
  - Demo on 740m long train: 2 locos being remotely controlled by the leading one (next step: 4 locos and increased lenght)

CCA: Cross Cutting Activities



CCA: key achievements and ongoing activities

- **Long-term needs and socio-economic research:** to what extent rail can be a catalyst in transformational societal changes
  - Specifications for the 4 S2R System Platform Demonstrators (SPDs) high-speed, regional, urban passenger rail (metro) and rail freight

- **KPI method development:** based on the 3 quantitative KPIs of the S2R regulation and assessment of the S2R innovation technologies against those
  - High-level KPI architecture is completed and the first quantification is under assessment

- **Safety, Standardisation, Smart Maintenance, Smart Materials & Virtual certification**
  - Standardisation Rolling Development Plan lists the potential needs and opportunities of the S2R innovations those feeds into standardisation

CCA: key achievements and ongoing activities

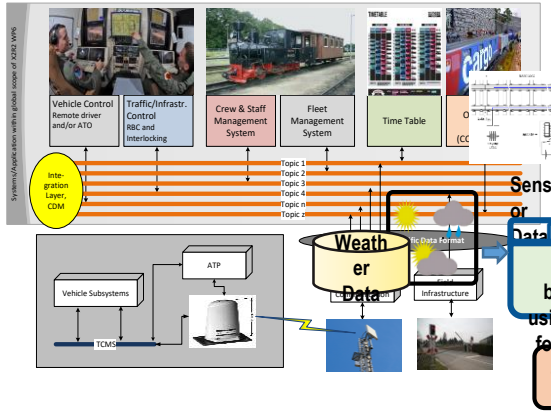
- **Noise & Vibration:** N&V management to be applied on an overall system approach and enable mitigation actions
  - Auralisation and visualisation technology InnoTrans
  - Tools and methods to improve prediction of noise from different sources on a system level and to rank railway noise mitigation options together with assessment of their cost-effectiveness

- **Human Capital:** management of technological & demographical Changes from the human factor's aspect
  - Impacts of the S2R innovations on rail employment and future skills
- **I2M:** Integration layer for data exchange between traffic management system, freight operations and asset management services
  - Use-cases and business rules for high-efficient freight operations

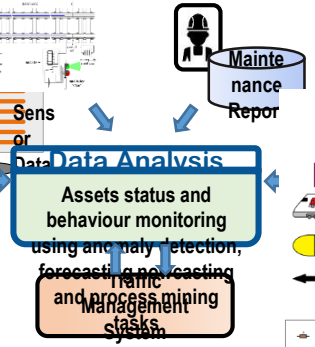
looking into the future: integration

Several S2R projects already working on different ways of harmonizing data exchange for each Systems/sub-systems

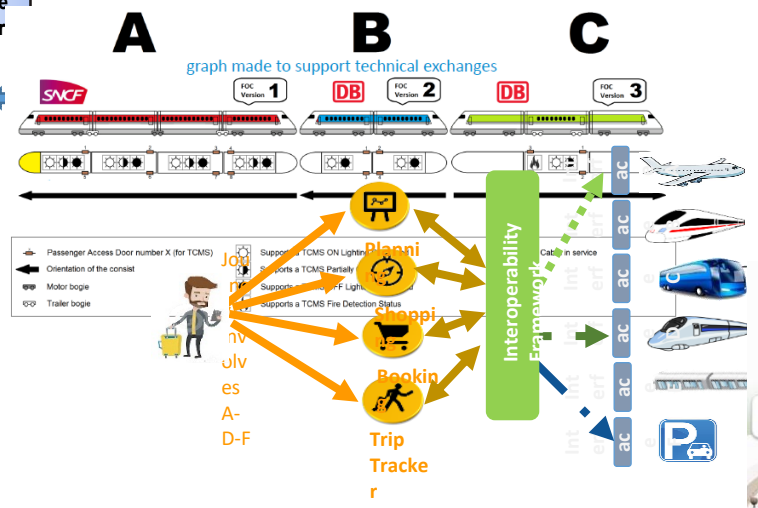
X2Rail2 (signalling and communication); S2R-CDM and Integration layer



IN2SMART (maintenance infrastructure); S2R-CDM Standardised interface for maintenance data

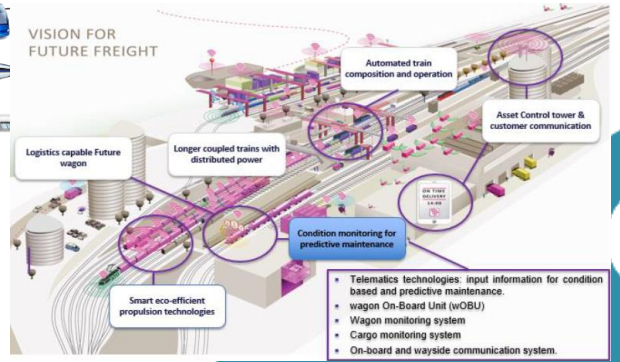


Connecta (Train Control and Management System); Functional communication Concept, SysML modelling

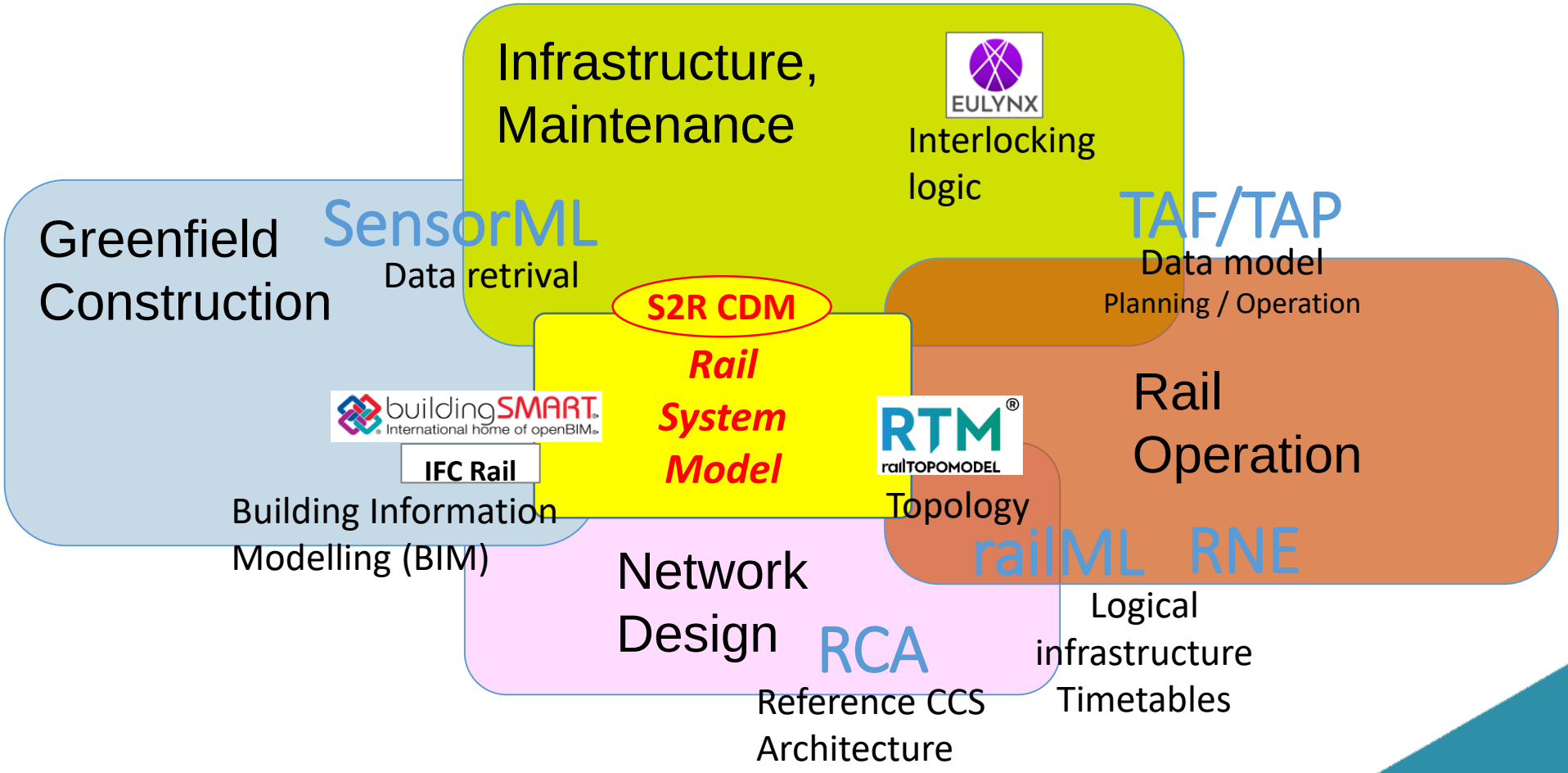


Connective (Multimodal Passenger information systems) ; Interoperability Framework, Semantic interoperability, not only rail applications

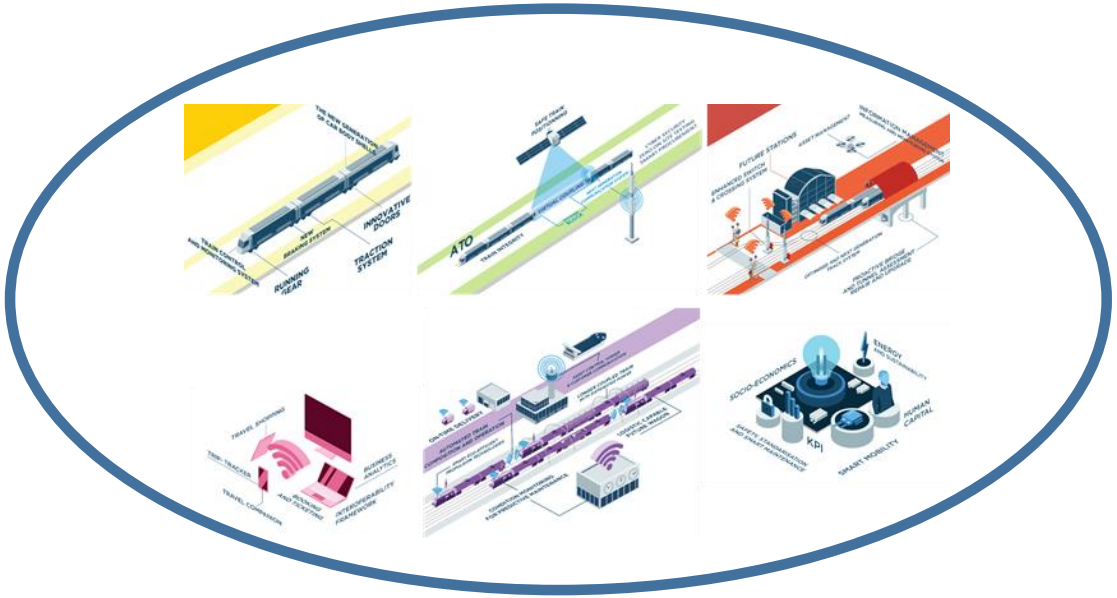
FR8RAIL (rail freight operations);Definition of a whole Rail Data Model, General Rail Ontology, Canonical Data Model, Data Standardization



Several digital information managed without a system approach, hence the entire sector digital initiatives are willing to work at the moment in the S2R Conceptual Data Model (CDM) for data integration



An overall optimization of railway performance will result from a global railway approach



e.g. future Autonomous Train is an integrated solution involving all subsystems: Train, Infrastructure, and Traffic Management.

- *Do we master the railway system as a whole (a system of systems), the interactions between its sub-systems?*
- *Are we able to anticipate its global behavior in view of optimising it?*

Going for global performance definitely requires to master, design and simulate the Railway System as a whole → definition of an overall architecture (*S2R-CFM-IPX and CCA-01-2019: S2R System Architecture and Conceptual Data Model***)**

FOUNDING MEMBERS

ASSOCIATED MEMBERS

Virtual Vehicle Austria consortium+ (VVAC+)

European Rail Operating community Consortium (EUROC)

Swi'Tracken consortium

Smart DeMain (SDM) consortium

AERFITEC

Competitive Freight Wagon Consortium (CFW)

Smart Rail Control (SmartRaCon) consortium