

How does it comes together ?

ATO Technologies

Insights about fonctionnalities and their development ?

Automated driving and operational live decision-making, being interoperable, and for all application and segments, including urban light rail and freight.

Which WP are concerned by this topic ?

WP5 WP6 WP8 WP10

Which TE ?

TE4

Which demonstrators ?



Perception

Insights about fonctionnalities and their development ?

Safe environment perception, including signal reading and obstacle detection, among other use cases, supported by a data factory enabling AI training and certification.

Which WP are concerned by this topic ?

WP5 WP6 WP8 WP11

Which TE ?

TE6

Which demonstrators ?



Remote driving

Insights about fonctionnalities and their development ?

Remote driving and command, as standalone function for depots and controlled areas, for lines with low traffic, and as fall-back functions for GoA4 operations as well as for automatic shunting.

Which WP are concerned by this topic ?

WP5 WP6 WP8 WP12

Which TE ?

TE7

Which demonstrators ?



Automating Functions

Insights about fonctionnalities and their development ?

Automated functions, such as train preparation for both passenger and freight trains, testing of subsystems, incident detection and handling and other ATO GoA4 supporting functionalities.

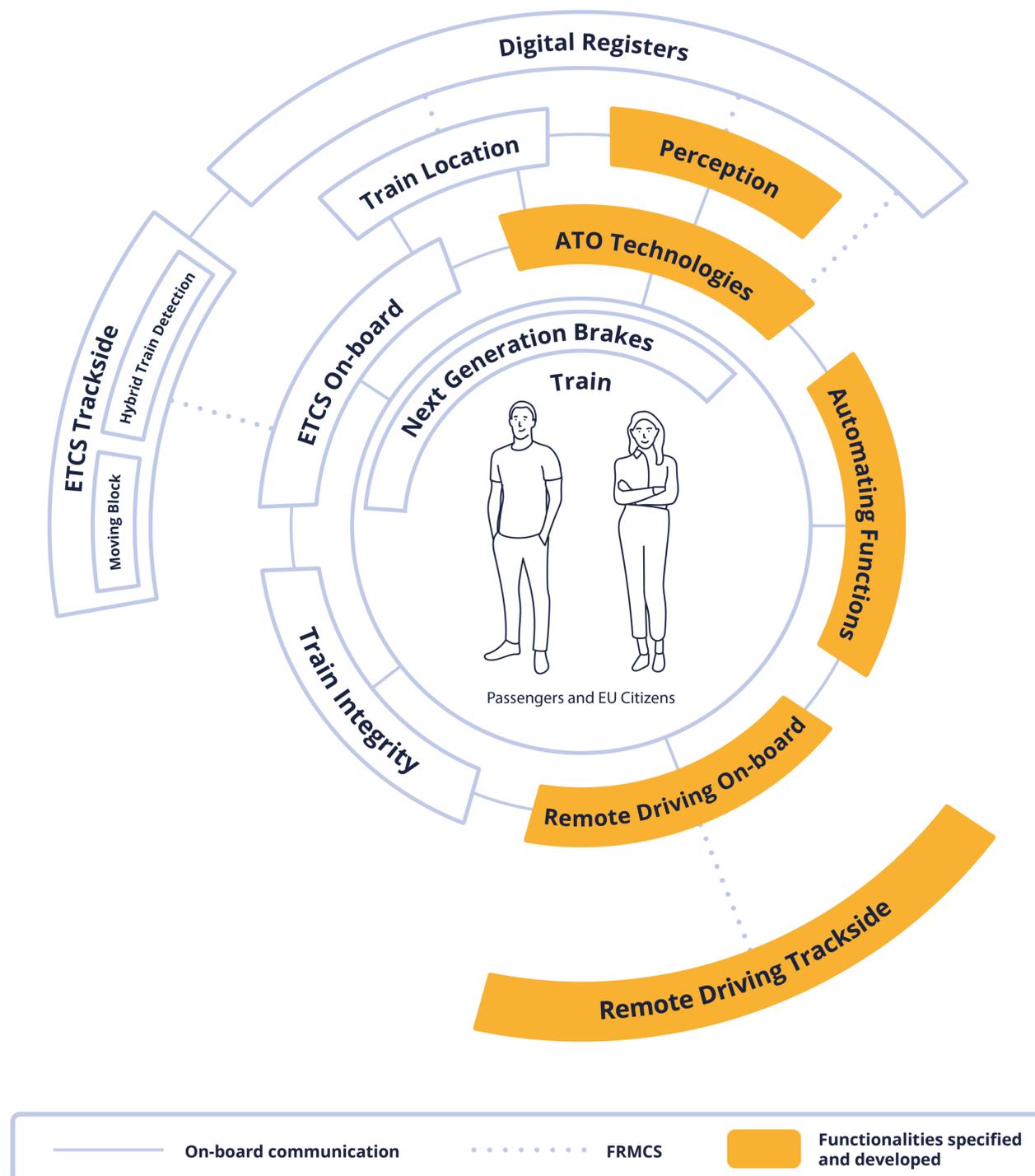
Which WP are concerned by this topic ?

WP5 WP6 WP8 WP9

Which TE ?

TE1

Which demonstrators ?



How does it comes together ?

Moving Block and Hybride Niv3

Insights about fonctionnalities and their development ?

Use of the information of train integrity and train length provided by the train to increase the capacity of the railway line.

Which WP are concerned by this topic ?

WP13 WP14 WP15 WP16

Which TE ?

Which demonstrators ?

TE10



NG Brake

Insights about fonctionnalities and their development ?

Improvement of braking performance in low adhesion conditions, facilitated by means to determine the actual wheel/rail adhesion condition, to improve it and to allow for an improved brake system performance.

Which WP are concerned by this topic ?

WP17 WP18

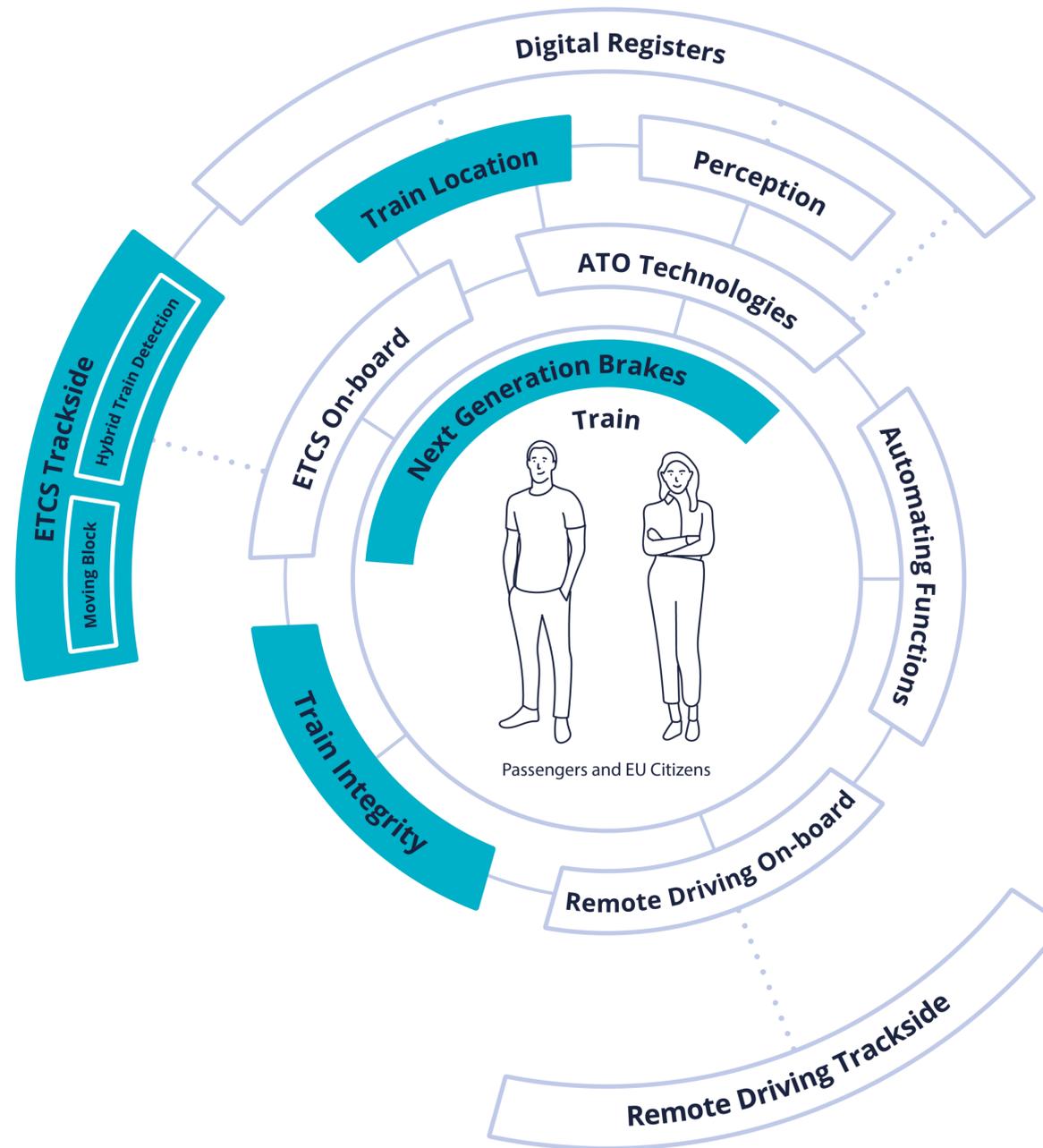
Which TE ?

Which demonstrator ?

TE13



Stabling



Train Integrity

Insights about fonctionnalities and their development ?

solutions for verifying train integrity and determining the train length to be provided to the ETCS on-board system.
Definition of requirements and use cases about them.

Which WP are concerned by this topic ?

WP19 WP20

Which TE ?

Which demonstrators ?

TE3



Train Localisation

Insights about fonctionnalities and their development ?

Definition of requirements and use cases about full ASTP
Development and testing of 8 ASTP demonstrators

Which WP are concerned by this topic ?

WP21 WP22

Which TE ?

Which demonstrator ?

TE2



Regional

How does it comes together ?

Onboard networks

Insights about fonctionnalities and their development ?

Focus on foundations for the onboard communication network and communication functionality.
Focus mainly on the network management functionality and the CCS/TCMS interoperability.

Which WP are concerned by this topic ?

WP 36 WP 45

Which TE ?

TE17+TE18

Which demonstrator ?



FRMCS

Insights about fonctionnalities and their development ?

FRMCS is the successor of GSM-R. This system will ensure the digitalization of the train and function as a driver for the transformation of predictive maintenance. FRMCS integrates the future European TSIs for CCS.

Which WP are concerned by this topic ?

WP36 WP 45

Which TE ?

TE 05

Which demonstrators ?



Digital Register

Insights about fonctionnalities and their development ?

This activity focuses on the specification, development, and implementation of the Digital Register in the sense of a database supporting assisted and automated train operations and optionally safe train positioning.

Which WP are concerned by this topic ?

WP 45

Which TE ?

TE 09

Which demonstrator ?



Computing Platform

Insights about fonctionnalities and their development ?

Focuses on developing the architecture and specifications for the testing and certification of modular and safe computing platforms for onboard and trackside systems which host safety-related and non-safety related functions.

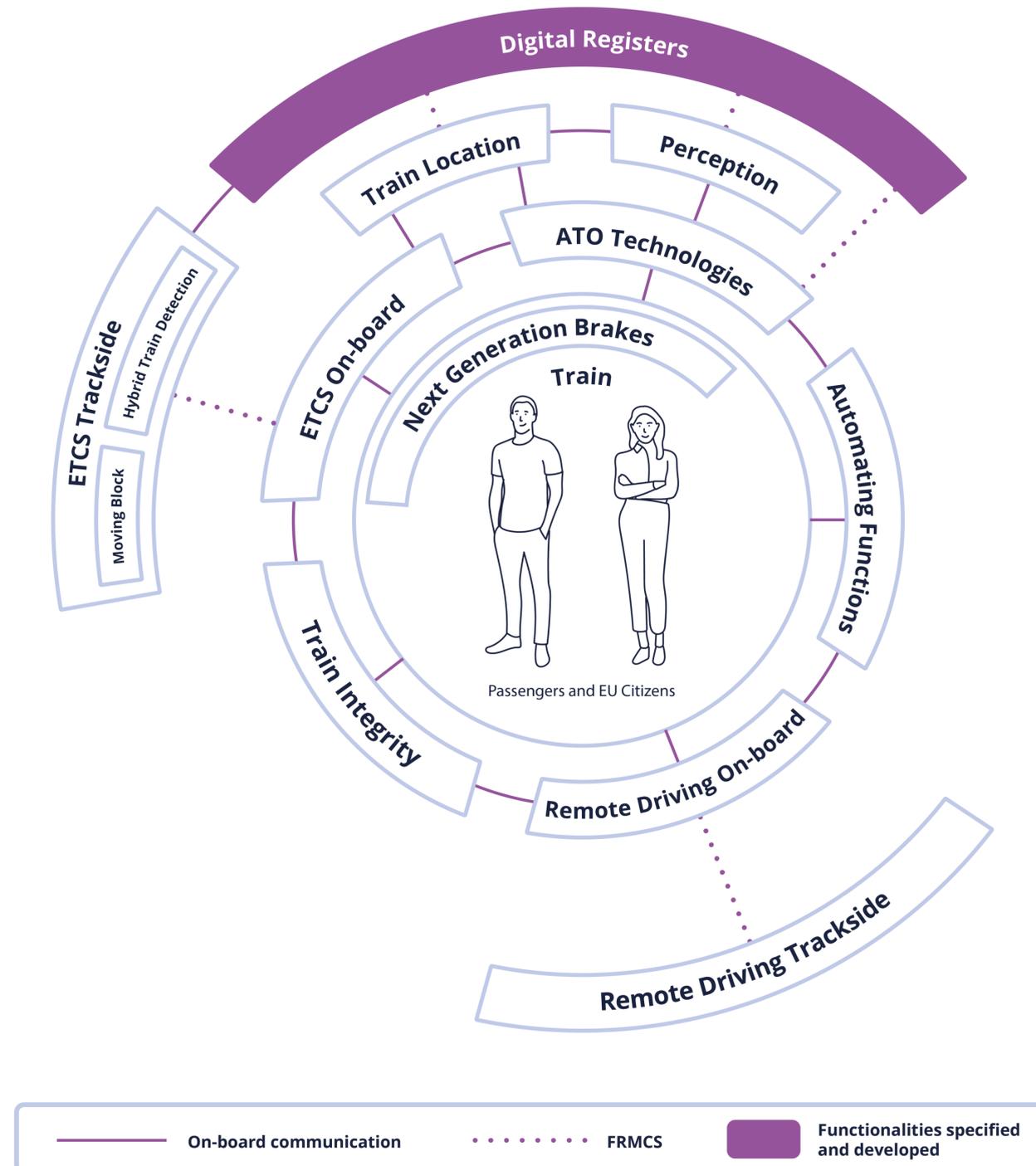
Which WP are concerned by this topic ?

WP36

Which TE ?

TE16

Which demonstrator ?



How does it comes together ?

Test and validation means

Insights about fonctionnalities and their development ?

- Deliver a common strategy, process and means of test for virtual certification of new onboard subsystems as ASTP to enable the fastest possible development and deployment of new technologies.
- Deliver a digital twin for traction/braking systems and switches/crossings to enable virtual certification and reduce onsite testing.

Which WP are concerned by this topic ?

WP 34 WP 35

Which TE ?

TE14

IT architecture

Insights about fonctionnalities and their development ?

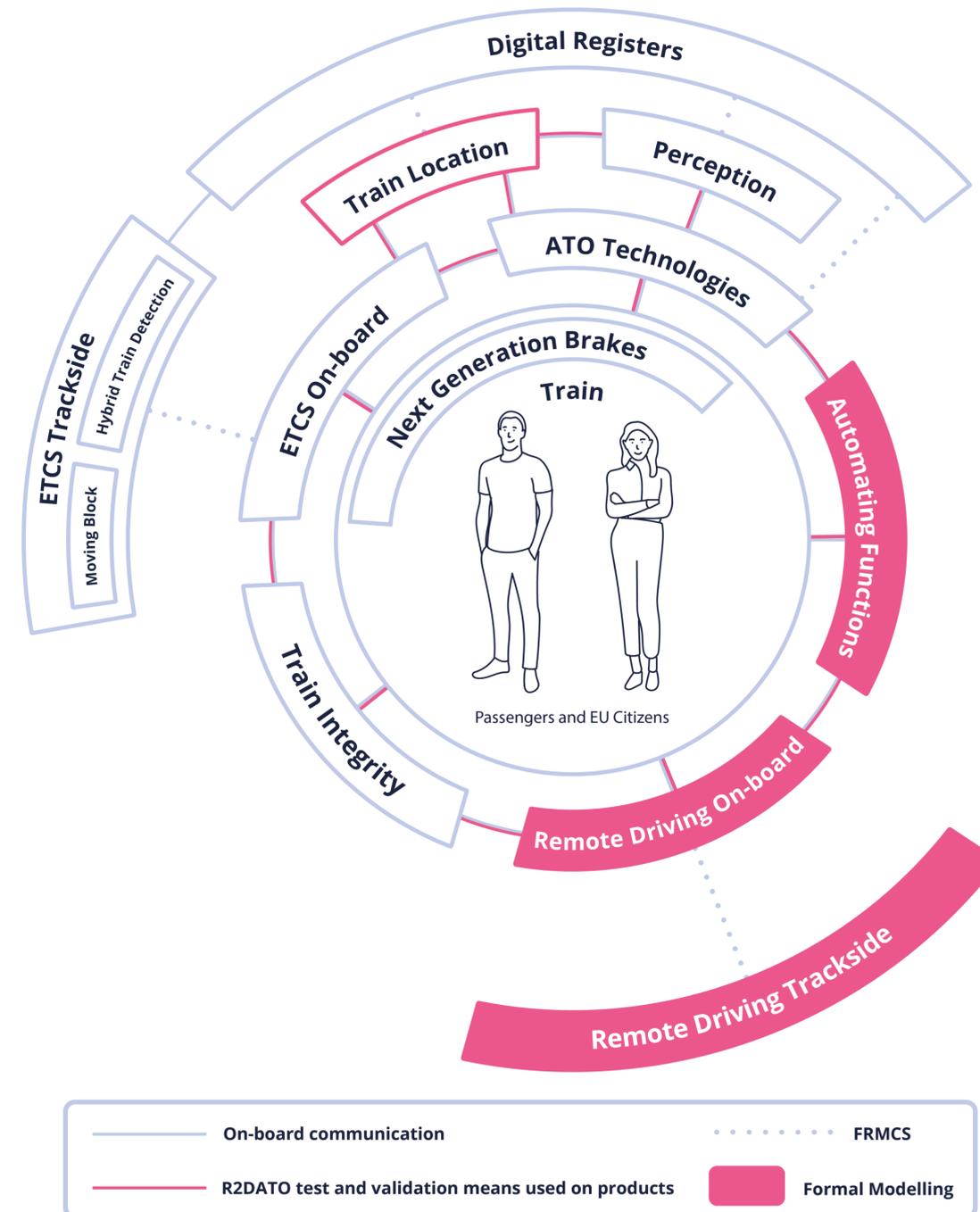
- Provide ways to improve the evolvability of software architectures over their long lifetime (e.g. through modularization, services and containerization).
- Use DevOps approaches to realize and deploy software releases faster (e.g. through automation).

Which WP are concerned by this topic ?

WP 29

Which TE ?

TE15



Enable benefits: faster, cheaper, less risks, improved quality and managed complexity

Formal modelling

Insights about fonctionnalities and their development ?

- Requirements validation
- Modelling techniques to enable automated authorizations of products
- A functional model for ATO onboard & Remote Supervision & control to enable specification testing
- A model and specification of TCMS data service

Which WP are concerned by this topic ?

WP 30 WP 31

Which TE ?

TE19

Status and goals

Achievements : what have we done already

- Use cases (WP5) for the Technical Enablers have been identified and prioritised.
- Updated ATO GoA3/4 Capella model issued.
- Requirement specification for the Technical Enablers and prioritised use cases completed.
- ATO GoA3/4 safety analysis

Key exploitable results

- This cluster will deliver prototypes for components that can be exploited together or separately:
 - Automated driving (ADM) and automated processing module (APM)
 - Onboard perception system module
 - Data factory
 - Remote driving onboard and trackside modules
 - Set of automated functions to be deployed in several subsystems, such as the TCMS, APM, ADM or other onboard elements.

Road map

Q4 2025

Q4 2025 / Q1 2026

Q2 2026

May 2026

ATO Technologies

Remote driving

Perception

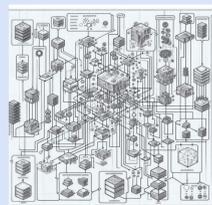
Automating Functions

First Step

Finalisation of the architecture required to implement and demonstrate the prioritised use cases.

Completion of the safety studies for all technical enablers.

Availability of first prototypes.



Second Step

Availability of all prototypes required for demonstration.

Validation of prototypes in the laboratory.

Prototypes being gradually supplied to the demonstrators for integration.



Third Step

Prototypes being validated in the field, in the demonstrators.

Feedback from demonstration eventually considered and implemented in prototypes or parked for its integration in the 2nd wave of FA2.



Status and goals

Achievements : what have we done already

- **Use Cases and specifications:**
 - ✓ Full ASTP, Hybrid Level 3, Moving Block, Train integrity and train length: uses cases and requirements and draft common architecture.
 - ✓ For ASTP : draft common architecture and for Moving Block a way for managing Domain Data.
 - ✓ NG Brake: use cases/ user stories, adhesion data description, draft system architecture.
- **Safety activities**
 - ✓ Full ASTP: preliminary PHA proposed.
 - ✓ Hybrid Level 3 and Moving Block : safety analysis.
- **Testing activities:**
 - ✓ Full ASTP demonstrators designed and test plan prepared.
 - ✓ NG Brake: RAMS performance validation on test rigs and a test train/ ADS concept evaluation.

Key exploitable results

- Full ASTP. Hybrid Level 3 and Moving Block requirements are used as input for digital register (WP27), testing strategy activities (WP34/35) or FP6, common architecture will give prerequisites to define future CCS on-board architecture (SP-TrainCS).
- All the Public deliverables may be used as input for the harmonization activities in the System Pillar, for UNISIG activities and for the next TSI.
- TRL 6 Prototype based on the established Moving Block specification.
- NG Brake: robust demonstration of BAMS/ADS benefits up to TRL7, linked to the WP38 demonstrator. Fundamentals set for use of BAMS/ADS in (DATO) rail traffic, ready for standardization input.

Road map

Mid 2025

Late 2025

May 2026

Train Localisation

Moving Block and Hybride Level 3

Train Integrity

NG Brake

First Step

- Localisation : Design of the demonstrators achieved, safety studies completed.
- Hybrid Level 3: Use Cases established, safety studies completed.
- Moving Block Specification: Requirements for degraded situations.
- Train integrity and train length requirements consolidation, Use Cases established.
- NG Brake: data for operational simulation (benefit assessment of BAMS/ADS) aligned with FP1 WP9.

Second Step

- Localisation : Testing of the demonstrators achieved, consolidated common architecture provided.
- Moving Block Specification: Ready for TRL6 demonstrator.
- Train Integrity: Test Cases and first version of safety analysis.
- NG Brake: design and equipment ready for BAMS/ADS demonstrator integration (WP38).

Third Step

- Localisation: assessment of the demonstrators, gap analysis on ASTP.
- Hybrid Level 3: Implementation of the prototypes and completion of the specification activities.
- Moving Block specification: Feedback from demonstrators and completion.
- Train Integrity: Implementation of the prototypes and closing of the specification and safety analysis phase with the results from the prototype testing activities.
- NG Brake: architecture integration aligned with WP3 and results/ definitions finalized and transferrable for standardization etc.

Status and goals

Achievements : what have we done already

Completed Specification Work

- List of use cases for the Onboard Communication Network. (D23.1)
- Definitive and aligned requirements set for Onboard Communication Network and Basic Services. (D23.2)
- List of solution candidates. (D23.3)
- Consolidate prior research works incl. Proposal on integration of ACS components in FRMCS. (D25.1)
- High-level consolidation of prior work and agreement on the Modular Platform specification to happen in R2DATO. (D26.1)
- Intermediate Modular Platform requirements, architecture and specification. (D26.2)
- Final Modular Platform requirements, architecture and specification. (D26.3)
- Set of requirements on the Digital Register in R2DATO. (D27.1)
- Specification of the Digital Register implementation(s) required in R2DATO. (D27.2)

Key exploitable results

- Operational requirements for specific topics, architectures, processes and technologies as basis for future research, demonstrators and standardisation.
- Several demonstrators will be delivered, integrating solutions and building upon integration tests conducted in the technical enabler.
- They aim to validate their feasibility and maturity in a real-world operational environment.

Road map

SPECIFICATION

IMPLEMENTATION AND TEST PREPARATION

TESTING

May 2026

On board networks

FRMCS

Digital Register

Computing Platform

First Step

WP23

- Homologation concept for Onboard Communication Network

WP24

- Requirements set for managing an Onboard Communication Network and a selection of management functionality.
- Network management specification and proof-of-concepts
- Report on feasibility of CCS / TCMS interface component.

WP26

- Study on modular certification and Homologation.

WP27

- Digital Register (DR) Object Catalogue for the Data Factory. (D27.5)

Second Step

WP23

- Realized selected proof-of-concepts for T23.3.

WP25

- Updated Onboard and Trackside Gateways, Lab Test Plans and Results.
- Design and development of Onboard and Trackside antenna prototypes and lab experimental results.
- Report on Infrastructure and trains preparation for demo.

WP27

- Updated requirements and specification DR
- DR implementation for the Moving Block Demonstrator.
- DR implementation of the Interaction between Trackside and Onboard

WP28

- Prototype of ACS/Multiconnectivity Platform for Regional Line.

Third Step

WP25

- ETSI 2023 and 2024 FRMCS-Plug Tests. (D25.3)
- FRMCS Antennas Field Evaluation Results. (D25.5)
- FRMCS Field experiment plan and Report. (D25.6)

Status and goals

Achievements : what have we done already

- Delivered a testing strategy, requirements for digital twin and tests bench for certification that will help save time and improve quality by detecting and correct defaults as soon as possible (WP34)
- Defined user stories and requirements, investigated DevOps approaches as well as architectural patterns from other domains, and derived a collection of DevOps building blocks as well as a catalogue of architectural patterns for the railway domain (WP29)
- Created a prototype environment using upper/lower ontology, with preliminary validation using (mainline) infrastructure data examples in RDF/OWL (semantic web technology) (WP30)
- Developed a design process guideline for GoA2 / GoA4 model and simulation (WP31)
- Developed a driving simulator for human-factor evaluation with 3D environment (WP31)

Key exploitable results

- Test and validation
 - Testing strategy definition for subsystems (D34.1), Requirements for certification for ASTP (D34.2)
 - OB ETCS Test bench requirements and development to allow first ASTP demonstrator evaluation (D34.3, D34.4)
 - Digital twin requirements for traction/braking systems and switches/crossings for virtual certification
- IT architecture
 - List of user stories & requirements (D29.1)
 - Investigation of solution approaches for DevOps and architectural evolvability from other domains (D29.2)
 - Catalogue of architectural patterns for evolvability in the railway domain (D29.3)
 - Catalogue of DevOps process building blocks (D29.4)
- Formal Modelling
 - Algorithm architecture for GoA2
 - Modelling environment description for ATO modelling and simulation

Road map

Q1/Q2 - 2025

Q3/Q4-2025

Q1/Q2 2026

May 2026

Test and validation means

IT architecture

Formal modelling

First Step

- WP35**
 - Identify the safety Feared Events for ASTP system and the use in certification process
- WP29**
 - Describe architecture alternatives/variants and a DevOps process framework
 - Describe the demonstrator for evaluation of architectural patterns and DevOps technologies
- WP30**
 - Create reference design (Level 3 trackside)
- WP31**
 - Specification of GoA2 and GoA4 technical movement use case

Second Step

- WP 35**
 - Match the Feared Events with a test procedure and means of tests for certification
- WP30**
 - Perform V&V using prototype demonstrator

Third Step

- WP 35**
 - Develop means of tests and start validation of certification use case on ASTP demonstrator or model
- WP29**
 - Consolidate architectural patterns for evolvability and DevOps process building blocks and framework
- WP30**
 - Disseminate results and learning
- WP31**
 - ATO Onboard and Remote Supervision & Control strict formal model demonstrator process description
 - Simulation report