FP2
R2DATO

Cluster Overview

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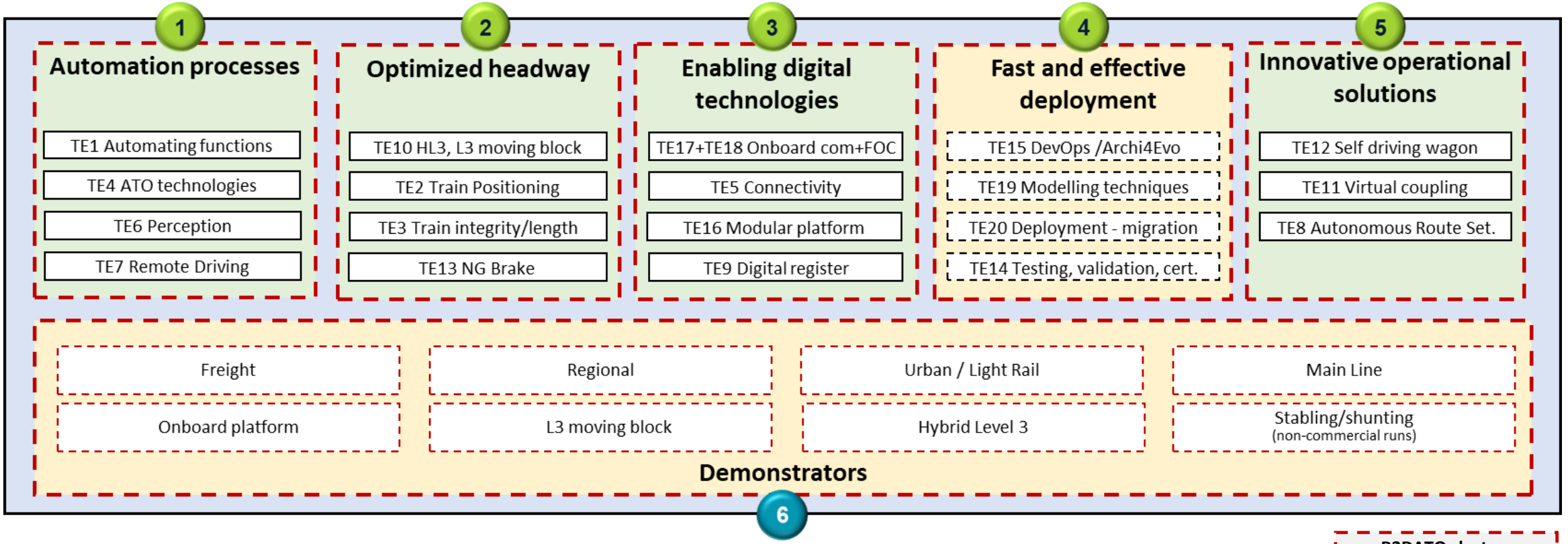
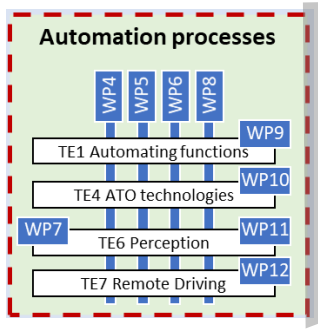
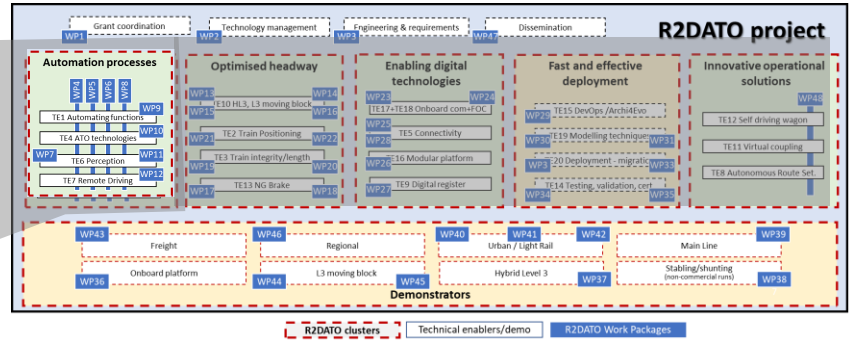
FP2 R2DATO – [Cluster] Overview



Cluster [CL1] „automation processes“





WP Objectives

TE 1 Automatic Functions

WP 9 functional prototypes for automating functions (TE 1) will be developed, tested, and validated against the defined system architecture specification (up to TRL4/5)

TE 4 ATO Technologies

WP 10 to create a technical enabler suitable to demonstrators, taking into account the experiences realized during S2R test (e.g., pilot line and laboratory from the X2R1/5

TE 6 Perception

WP 7 setting framework for collaborative solution in the rail sector, the “Data Factory”, to jointly collect, store & annotate sensor data & build up all required infrastructure for processing the data as a prototype

WP 11 focus on detailed design, development & validation of the Perception system defined in Perception Architecture &System Specification up to TRL4/5

TE 7 Remote Driving

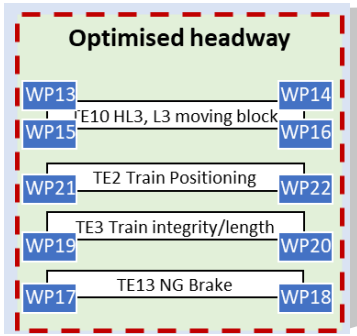
WP 12 functional prototypes for remote control will be developed, tested, and validated against the defined system architecture specification (D6.8)

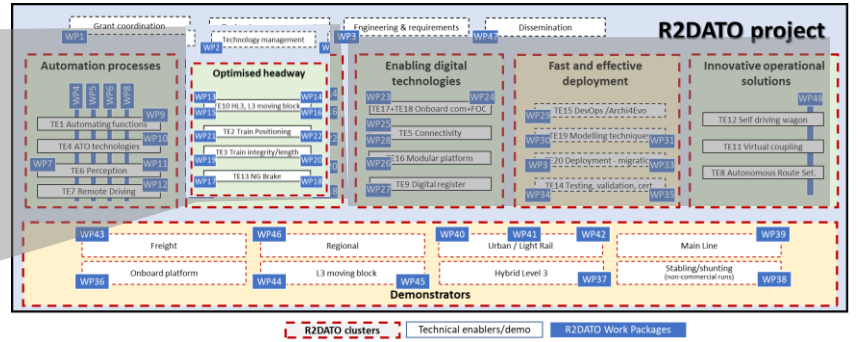
WP 4	**coordinates activities within the cluster “Automation Processes” ensuring coherence within the subproject**
WP 5	**identify already specified functions, use cases, user requirements or operational scenarios that must be considered in the rail automation processes (e.g., from S2R)**
WP 6	**specify a System Architecture Specification (SAS) to support the evolution of DATO up to GoA3/4 in cooperation with SP, WP2 and WP4**
WP 8	**centrally cover aspects of safety in the Automation Processes subproject: activity requires close cooperation with System Pillar and the System Coherence (WP3)**

TE results in

TE 1	TE 4	TE 6	TE 7
Demonstrator 3 **Urban**	Demonstrator 1 **Freight**	Demonstrator 1 **Freight**	Demonstrator 3 **Urban**
Demonstrator 7 **Stabling & Shunting**	Demonstrator 2 **Regional**	Demonstrator 2 **Regional**	Demonstrator 7 **Stabling & Shunting**
	Demonstrator 3 **Urban**	Demonstrator 3 **Urban**	
	Demonstrator 4 **Mainline**	Demonstrator 4 **Mainline**	
	Demonstrator 5 **ETCS HL 3**		
	Demonstrator 7 **Stabling & Shunting**		

Cluster [CL2] „optimized headway“





WP Objectives

TE 10 HL3, L3 Moving Block

WP 13 define a high capacity, low cost, high reliability signalling system, based on a train-centric approach using Full Moving block principles

WP 14 development and test of Moving Block prototypes of up to TRL 6 based on the specification of the Moving block Specification WP

WP 15 align and integrate the Hybrid ERTMS/ETCS Level 3 (HL3) approach into the future Functional Railway System Architecture

WP 16 development and test of Hybrid Level 3 prototypes of up to TRL 6 based on the specification of the Hybrid Level 3 Specification WP 15

TE 2 Train Positioning

WP 21 development of modular and scalable absolute safe train positioning (ASTP) system

WP 22 (1) Definition of a ASTP system architecture (2) testing of the developed ASTP solutions (3) General assessment and evaluation of ASTP solutions, as well as the impact analysis of ASTP with regard to TSI gaps, need for TSI CSS modifications

TE 3 Train Integrity/ Length

WP 19 consolidation of requirements for the Train Integrity and Train Length Determination solutions and their insertion into the on-board architecture.

WP 20 further consolidation of specs, the performance of a safety analysis and the realisation of demonstrators for the Train Integrity and/or Train Length Determination function

TE 13 NG Break

WP 17 New adhesion determination systems (ADS) and BAMS functions will be delivered and pre-validated test rigs, research trains, demonstrator

WP 18 Related to testing/ realisation, the operational demonstration and validation of BAMS and the ADS use of a train demonstrator or a test rig will be prepared

TE results in

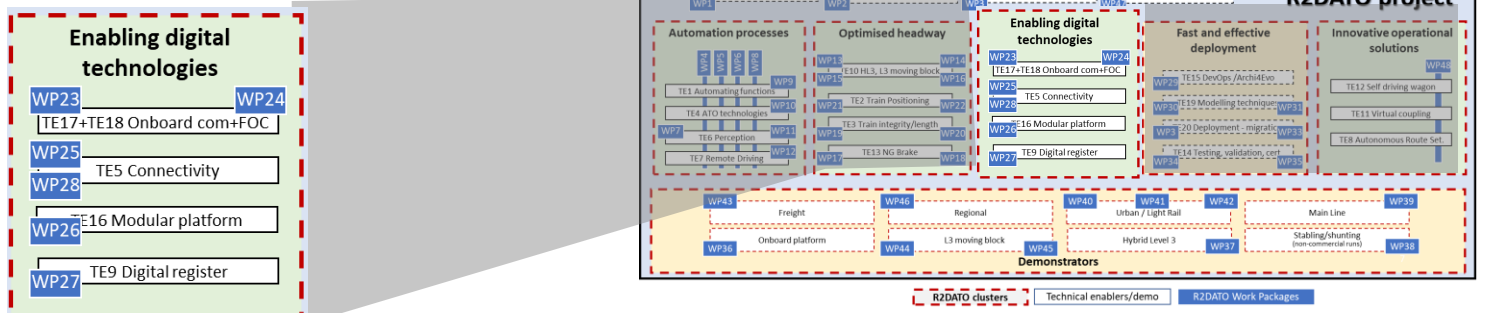
Demonstrator 2 **Regional**
Demonstrator 4 **Mainline**
Demonstrator 5 **ETCS HL 3**
Demonstrator 6 **L3 MB**

Demonstrator 1 **Freight**
Demonstrator 3 **Urban**
Demonstrator 7 **Stabling & Shunting**
Demonstrator 8 **Onboard Platform**

Demonstrator 1 **Freight**
Demonstrator 2 **Regional**
Demonstrator 4 **Mainline**
Demonstrator 5 **ETCS HL 3**
Demonstrator 6 **L3 MB**

Demonstrator 7 **Stabling & Shunting**

Cluster [CL3] „enabling digital technologies”



WP Objectives

TE 17 Onboard COM Network

TE 18 Functional Open Coupling

WP 23 focusses on the communication functionality plus building up a lab environment for PoCs.

WP 24 focusses mainly on the network management functionality and the CCS/TCMS interoperability

TE 5 Connectivity

WP 25 Connectivity between train and trackside is obviously key for automated rail operations.

WP 28 investigate how multiple radio bearers can be used concurrently to serve the needs of both the Gigabit train & future rail operations, & how the FRMCS architecture and specifications can potentially be expanded in this direction

TE 16 Modular Platform

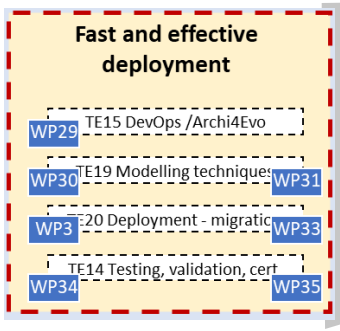
WP 26 focuses on developing the architecture and specifications for the development, testing, and certification of modular and safe computing platforms for onboard and trackside systems which host safety-related and non-safety related functions, incl. standardized approaches for monitoring, diagnostics, and configuration management

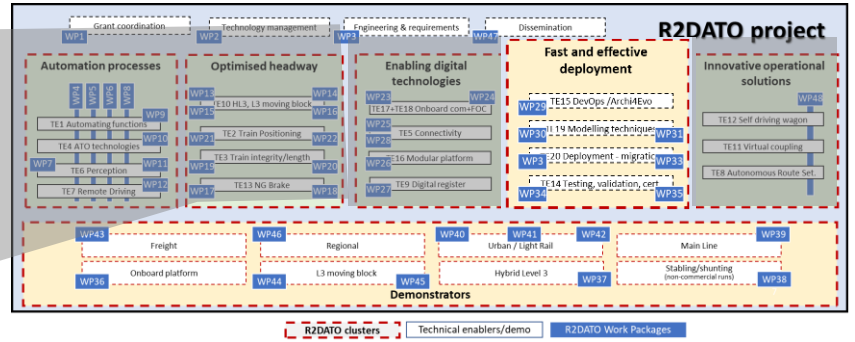
TE 9 Digital Register

WP 27 focuses on the specification, development, and implementation of the Digital Register in the sense of a database supporting assisted and automated train operations (including, e.g., traffic management systems) and optionally safe train positioning

TE results in				
	Demonstrator 8 **Onboard Platform**	Demonstrator 2 **Regional** Demonstrator 4 **Mainline** Demonstrator 8 **Onboard Platform**	(Demonstrator 7 **Stabling & Shunting**) Demonstrator 8 **Onboard Platform**	Demonstrator 1 **Freight** Demonstrator 6 **L3MB** Demonstrator 8 **Onboard Platform**

Cluster [CL4] „fast & effective deployment“





WP Objectives

TE 15 DevOps

TE 15.1 Architecture & Design 4 Evolution

WP 29 explore ways to improve the evolvability of architectures and for the quick realisation to focus on ideas from the DevOps approach. Both have to be done consistently with requirements from standards and regulations, harsh environment, safety-criticality and long lifetime.

TE 19 Modelling Techniques

WP 30 focused on modelling techniques for automated formalisation thus enabling also automated authorisation

WP 31 focused on delivering & developing (a) a functional correct model for ATO Onboard & Remote Supervision & Control, and (b) formal modelling & specification of TCMS Data Service

TE 20 Deployment & Migration

WP 3 coordinate the technical activities within the Flagship Area 2 as well as with the projects interacting with R2DATO in order to achieve the technical coherence of the Enabling technologies and the Demonstrators

WP 33 illustrate the potential to deploy DATO technology in European networks, both from a technical and a people-oriented perspective

TE 14 Testing, Validation, (virtual) Certification)

WP 34 Define & provide common strategy & process for virtual certification of complete railway systems as well as functional upgrades & define a certification platform to support the virtual certification in an iterative process

WP 35 Implementation of different level of prototypes to evaluate the defined processes; Definition the certification methodology; Development of digital twins focus on some subsystems and functionalities

TE results in

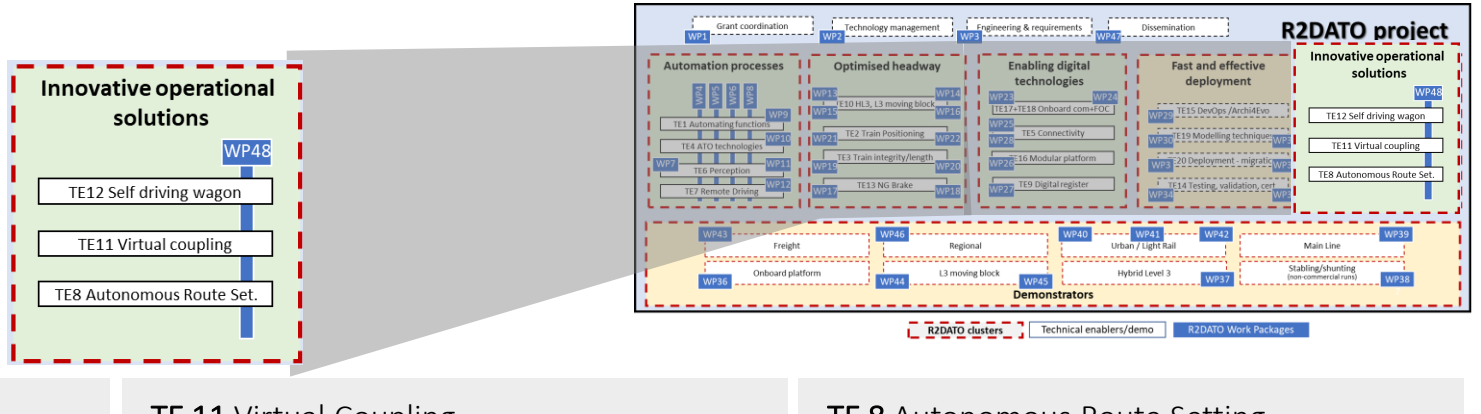
Demonstrator **n/a**

Demonstrator **n/a**

Demonstrator 1 **Freight**
Demonstrator 2 **Regional**
Demonstrator 3 **Urban**
Demonstrator 4 **Mainline**
Demonstrator 5 **ETCS HL 3**
Demonstrator 6 **L3 MB**
Demonstrator 7 **Stabling & Shunting**
Demonstrator 8 **Onboard Platform**

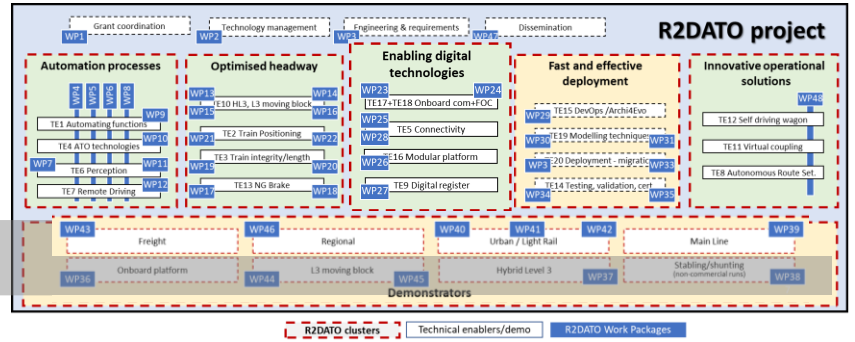
Demonstrator 1 **Freight**
Demonstrator 3 **Urban**

Cluster [CL5] „innovative operational solutions“



	TE 12 Self-Driving Freight Wagon	TE 11 Virtual Coupling	TE 8 Autonomous Route Setting
WP Objectives			
WP 48	**aims for specific innovative use cases targeting for solutions with even higher grades of automation closer to autonomy. It is one approach to operate trains, consists or even individual vehicles as e.g. freight wagons individually and to enable the infrastructure to react on the requests set by those vehicles. Consequently, this WP shall focus on three innovative operational solutions, which are core to enable this approach, namely, Autonomous Route Setting (AnRS), Virtually Coupled Train Sets (VCTS) and Self-Driving Freight Wagons (SDFW). These operational solutions rely on two core technology elements related to communication and localisation: short-range communication (SRC) and relative localisation (RL).**		
TE results in	Demonstrator **n/a**	Demonstrator **n/a**	Demonstrator **n/a**

Cluster [CL6] „demonstrators“ [1|2]



WP Objectives

DEMO 1 Freight

WP 43 To allow a smooth deployment of GoA 4 technology with different possible technological solutions, the systems need to be tested in real conditions in a demonstrator. The freight demonstrator will be equipped with sub-systems studied in the Technical Enablers. Tests will be performed, enhancing autonomous freight train operations.

DEMO 2 Regional

WP 46 provide the bridge between R2DATO and FA6 demonstrations by supporting validation and testing of technical enablers in regional line environment, before they are handed over to FA6 for further adaptation and integration.

DEMO 3 Urban

WP 40 make two trams ready for demonstration of different use cases and technologies along the project lifetime, which means to design, modify, and integrate appropriated systems which allows development of autonomous driving functions

WP 41 **implement a REMOTE DRIVING AND TELECOMMAND demonstrator up to TRL7**

WP 42 **implement an AUTONOMOUS MOVEMENTS demonstrator up to TRL6**

DEMO 4 Mainline

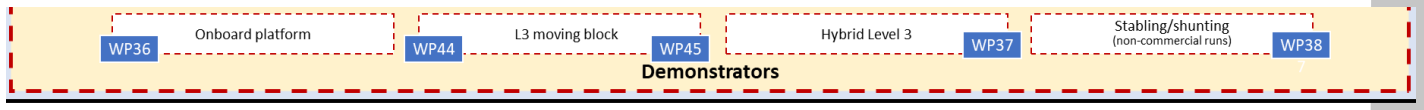
WP 39 (a) Prepare to demonstrate the solutions DATO over ERTMS technology can bring to relieve bottlenecks in main lines in high-density networks with heterogeneous traffic

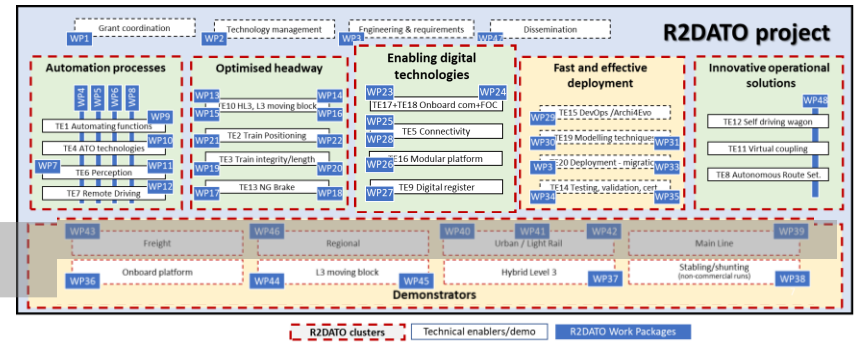
(b) Showing the relevant advantages deriving from the synergy between the digital automatic train operation up to GoA 4 and the CCS evolution, increasing the capacity and punctuality of railway lines, by enabling ETCS L3 moving block with minimum infrastructure elements

DEMO Input from

DEMO 1 Freight		DEMO 2 Regional		DEMO 3 Urban		DEMO 4 Mainline	
TE2 ASTP	TE9 **Digital Register**	TE2 ASTP	TE6 **Perception**	TE1 Automatic Functions	TE6.1 **Data Factory**	TE3 Train Integrity	TE10 **HL3, L3 MVB**
TE4 **ATO Technology**	TE14 **Testing, Validation, (Virtual) Certification**	TE3 Train Integrity	TE6.1 **Data Factory**	TE3 Train Integrity	TE7 **Remote Driving**	TE4 **ATO Technology**	TE20 **Deployment & Migration**
TE5.1 FRMCS	TE20 **Deployment & Migration**	TE4 **ATO Technology**	TE10 **HL3, L3 MVB**	TE4 **ATO Technology**	TE14 **Test., Val. & (virt.) Certif.**	TE5 Connectivity	
TE6 **Perception**		TE5 Connectivity	TE20 **Deployment & Migration**	TE6 **Perception**	TE20 **Deployment & Migration**	TE6 **Perception**	

Cluster [CL6] „demonstrators“ [2|2]





WP Objectives

DEMO 5 ETCS HL 3

WP 37 develop migration and deployment strategies to accelerate the application of ETCS Hybrid Level 3, in order to reap the benefits as quickly as possible, thus avoiding costly investments in new infrastructure

DEMO 6 L3 MB

WP 44 prepare the ground for a successful demonstrator: (a) identify relevant use cases/test cases to demonstrate (b) provide a demonstrator specific specification (architecture, functional requirements, interfaces)

WP 45 **demonstrate a modular train-centric trackside protection system enabling moving block operations with generic safety core up to TRL6 in R2DATO**

DEMO 7 Stabling & Shunting

WP 38 (a) Testing the performance of the technical enabler(s) incorporated in the demonstrator

(b) Providing feedback to the TE-developer, in order to improve the functioning of the TE, or to enhance/improve/modify the specifications

(c) Performing measurements to show the improvement of the new (sub)system over the existing system, so as to contribute to the realisation of the KPIs defined in the call.

DEMO 8 Onboard Platform

WP 36 implement & validate a prototype & blueprint of the future-proof onboard connectivity & IT platforms that are required in a highly automated rail system, with the expectation that latest from EU-RAIL phase 2 on all larger-scale demonstrators would utilize these platforms; implement & validate in a lab environment (up to TRL 5/6) how railway application(s) can be hosted on a modular computing platform, making use of a safe Runtime Environment (RTE), standardized Platform Independent (PI) API, onboard FRMCS functions and a unified diagnostics service API

DEMO Input from

DEMO 5	DEMO 6	DEMO 7	DEMO 8
TE3 **Train Integrity**	TE3 Train Integrity	TE1 Automatic Functions	(TE2 **ASTP**)
TE4 **ATO Technology**	TE5.1 **FRMCS**	TE4 **ATO Technology**	TE5 Connectivity
TE5.1 **FRMCS**	TE9 Digital Register	TE6 **Perception**	TE5.1 **FRMCS**
TE10 **HL3, L3 MVB**	TE10 **HL3, L3 MVB**	TE7 **Remote Driving**	TE9 **Digital Register**
TE20 **Deployment & Migration**	TE20 **Deployment & Migration**	TE13 **NG Brake**	TE16 **Modular Platform**
		(TE16 **Modular Platform**)	TE17 **onboard COM Networks**
		TE20 **Deployment & Migration**	TE20 **Deployment & Migration**

Thank you for your attention!

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