



CLUG 2.0: Project overview

EUSPA UCP – 07/11/23

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CLUG 2.0 project technical coordinator





Context & Objectives

15/12/2023

CLUG 2.0 In a Nutshell



Partners: **10**



Duration: **24 months**



Starting date: **Feb 23**



End date: **Jan 25**



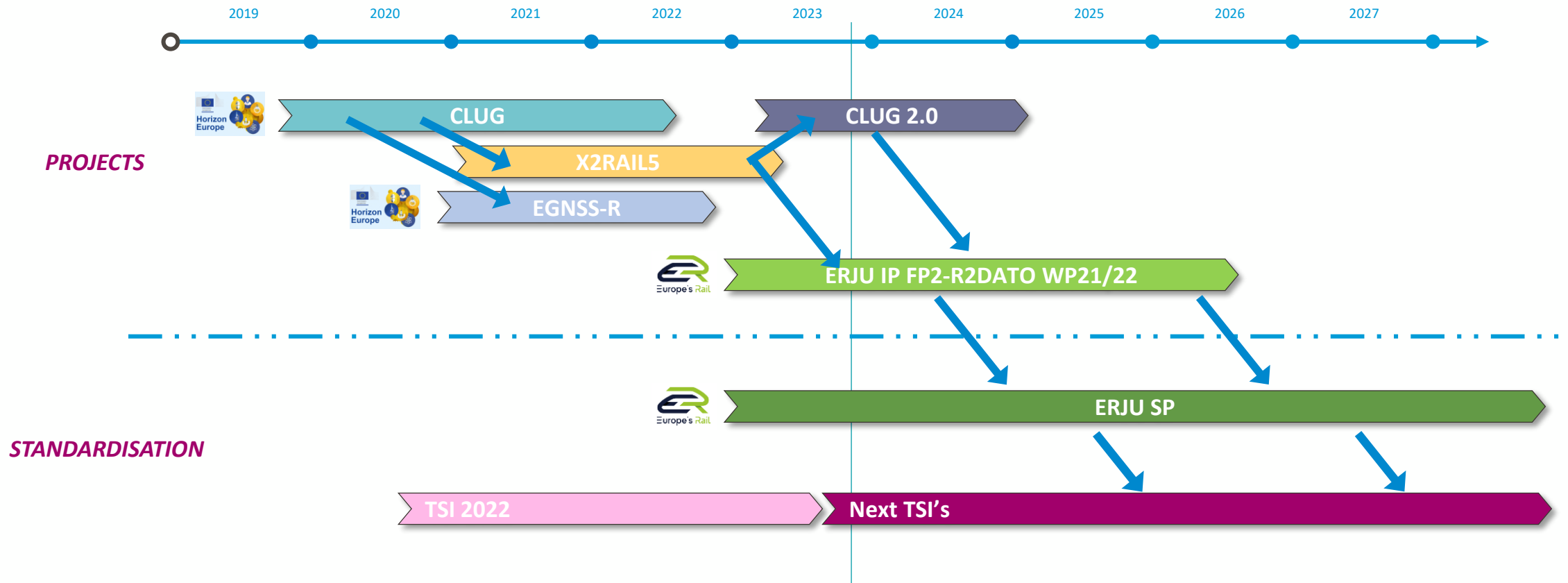
CLUG 2.0 OBJECTIVES



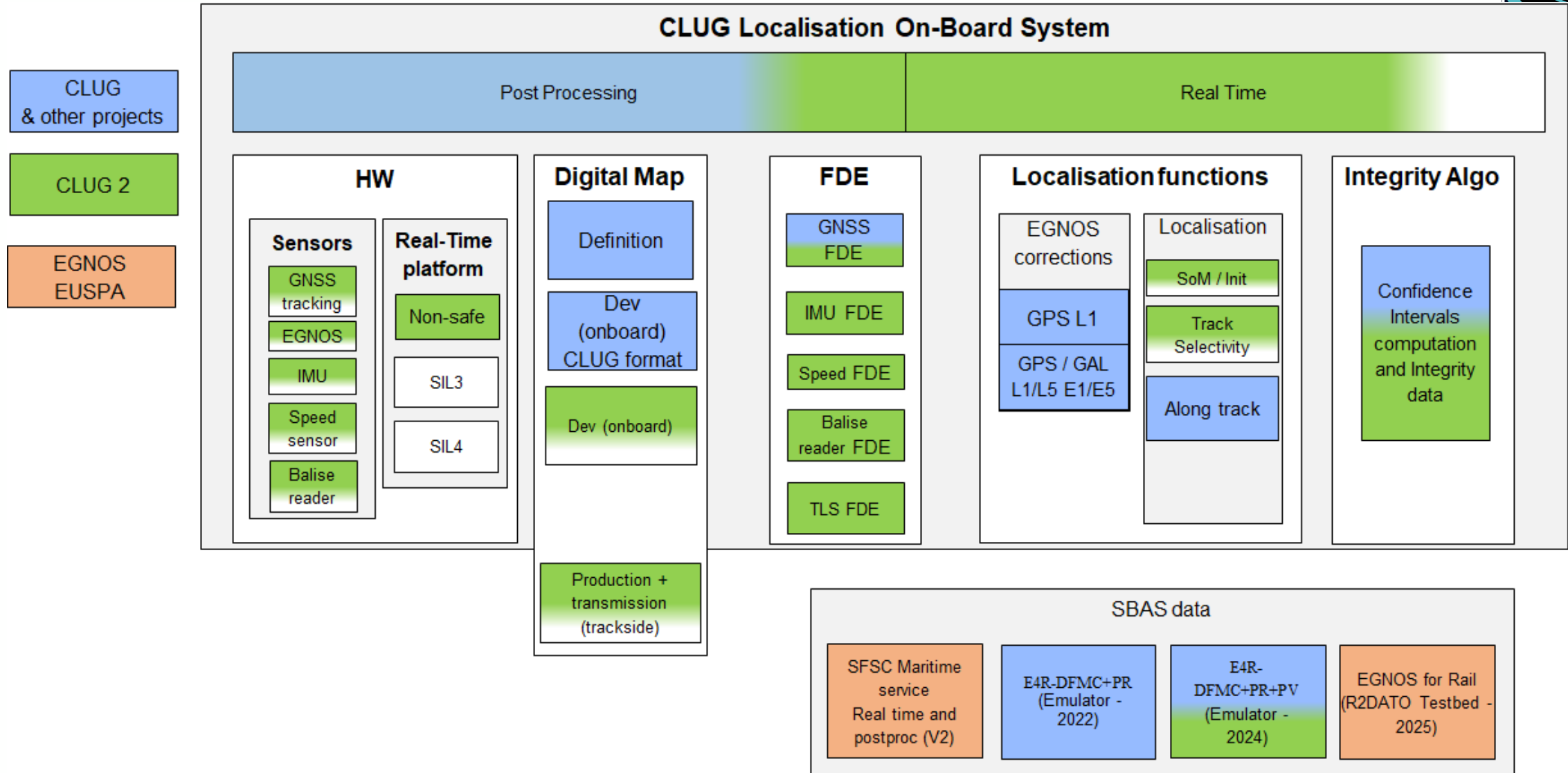
Demonstrate the technological readiness of an on-board GNSS+EGNOS based multi-sensor fusion architecture enabling absolute safe train positioning for signalling in a ETCS frame

- The main objectives of CLUG 2.0 are based on work performed in CLUG
 - Consolidation of user needs and system requirements (Along Track, Start of Mission and Track selectivity)
 - Consolidation of safe localization system architecture and prototype new critical functionality
 - Track Selectivity and Safety
 - Sensor and system levels FDE algorithms
 - Confidence Intervals computation and global Integrity concept
 - RAMS analysis on the consolidated functional architecture of the system.
 - Live demonstration (Switzerland) and Replay to consolidate readiness of the CLUG multi-sensor fusion algorithms

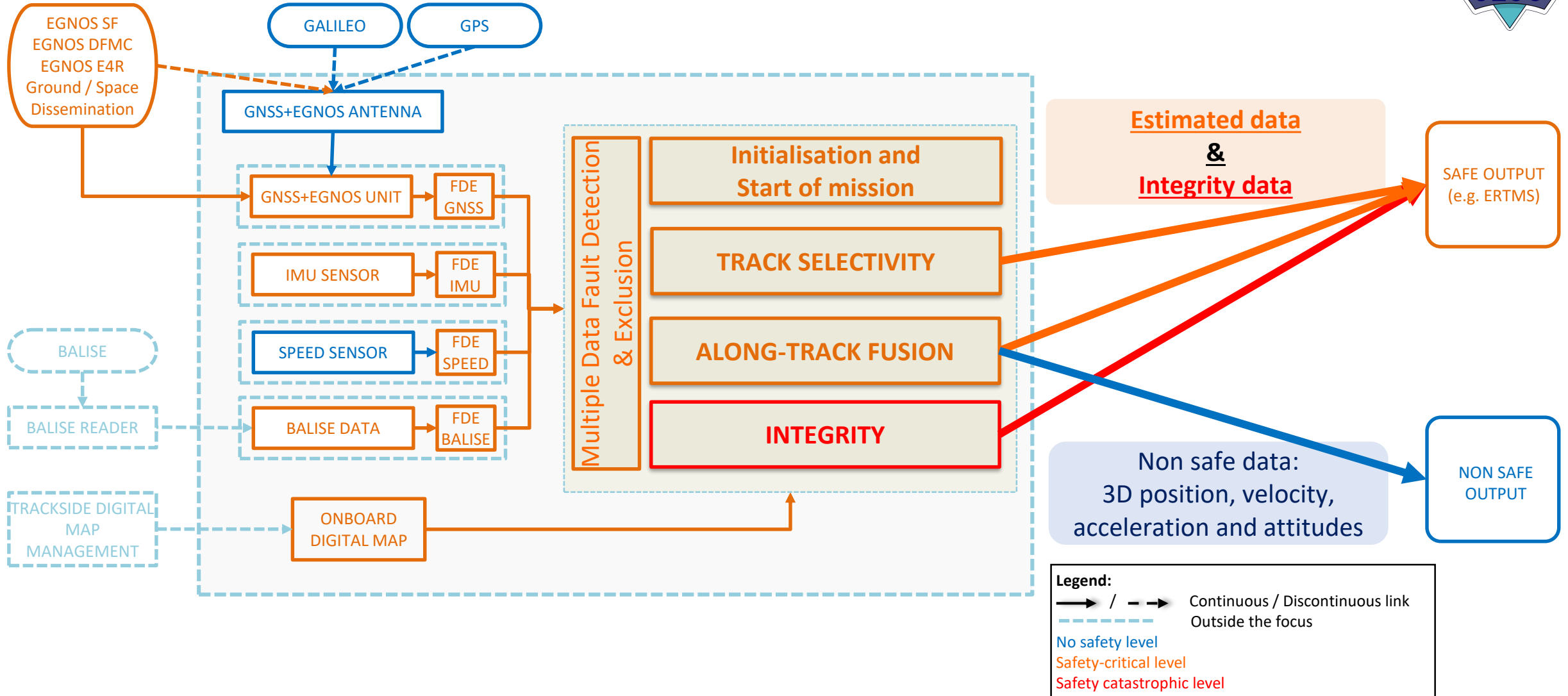
CLUG REASONING and ROADMAP



CLUG REASONING and ROADMAP



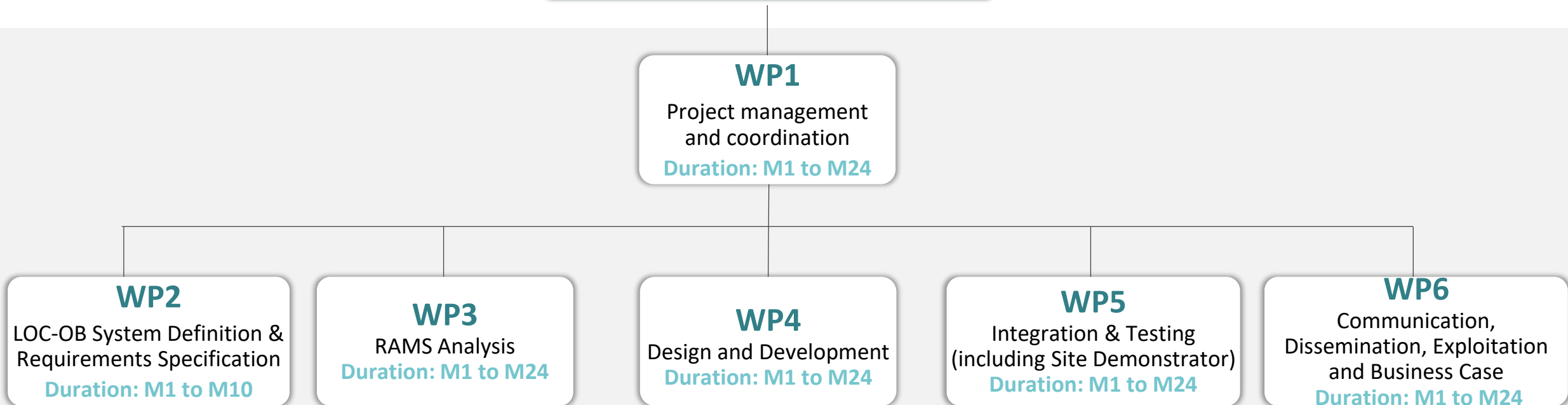
CLUG architecture



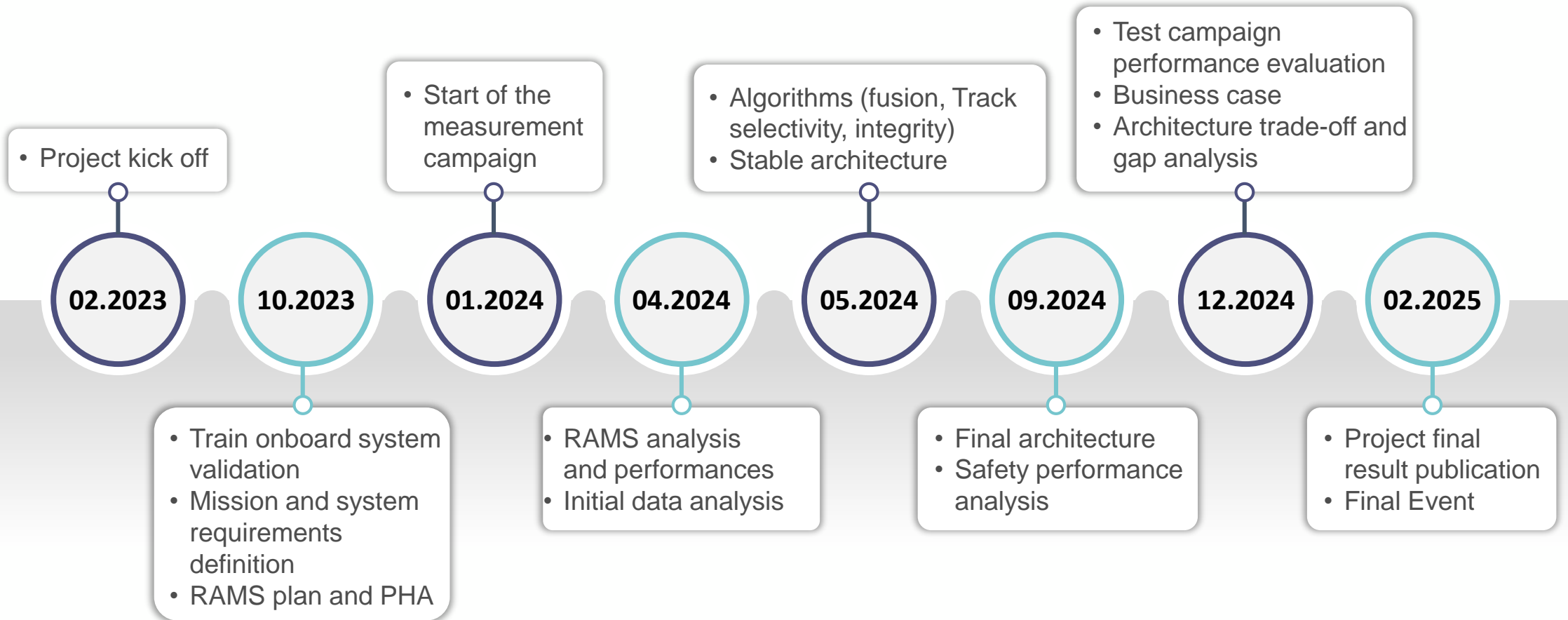
WP organisation



CLUG 2.0 PROJECT



High level timeline





Project technical status

15/12/2023



Define the user needs, operational context, initial assumptions, system boundary and requirements

Scope of work

- Operational needs of IM and RU and system capabilities to be fulfilled by absolute safe train positioning.
- Operational scenarios including nominal and degraded scenarios with regards to Start of Mission and track selectivity.
- System context, functions, and constraints of a LOC-OB system.
- LOC-OB System requirements including functional and non-functional requirements.

Status

- WP2 documents delivered to EUSPA by end of November 2023; publicly released early 2024
- The documents and their content is already been used in WP21 of FP2-R2DATO project in ERJU



To specify RAMS requirements and to demonstrate the safety targets for the CLUG LOC-OB, with respect to Common Safety Methods and CENELEC standards

Scope of work

- To specify the Reliability, Availability, Maintainability and Safety (RAMS) requirements in line with the overall SIL criteria of a railway embedded system to obtain a certifiable CLUG Localisation On-Board (LOC-OB) System
- To demonstrate that the CLUG LOC-OB functional system architecture and interfaces are in line with the specified safety targets
- To consolidate the remaining work to be performed to obtain a certifiable localisation unit in the future

Status

- RAMS Plan and PHA are about to be delivered (11/23)
- FMEA, RAM, functional and external interfaces analyses are about to start (11/23)



Design and development activities of the functional architecture of LOC-OB targeting the WP2 and WP3 requirements.

Scope of work

- Refine LOC-OB system and functions functional architecture
- LOC-OB critical Functions prototypes for design demonstrations: implementation of data FDE, track selectivity, Confidence status and Intervals computation, Along Track position and speed small upgrade
- LOC-OB safety performance analysis by engineering simulation: integrity availability assessment to provide compliant output data in accuracy and within the integrity level (SIL).
- EGNOS services data generation to enable prototyping tests in WP5.

Status

- Data FDE have been consolidated, ongoing prototyping
- Track Selectivity algorithm design & development ongoing
- On going along-track algo robustification

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Design and develop tools and an onboard demonstrator to analyse and improve the performance of the CLUG positioning solution.

Scope of work

- Develop and install a system to collect field data from all sensors for the offline simulation of the CLUG solution, and perform live demonstrations on a train of SBB
- Prepare the data sets, generate the Ground Truth and validate the Digital Map for post processing with the fusion and integrity algorithms developed in WP4
- Analyse the performance of the developed solution and identify potential improvements

Status

- Onboard demonstrator has been developed and installed. On going validation
- Ongoing ground Truth process and Digital Map validation
- Test plan definition
- Ongoing analysis tools improvement

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Ensure that the project results and outputs are disseminated widely and effectively exploited by their target groups

Scope of work

- Perform a cost-benefit-analysis (CBA), starting over the EUG-LWG CBA performed in 2022.
- Perform architecture Trade-off Analysis and Proposed Localisation On-Board System
- Conduct Gap Analysis on Proposed Localisation On-Board System Requirements
- Publish technical papers

Status

- Paper submitted for the TRA24 conference by SNCF/ADS, “Sensor fusion and GNSS augmentation services for safe train positioning - Accuracy and integrity performance evaluations”



Way forward

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Way forward



- Share the work performed in WP2 with ERJU, notably FP2-R2DATO WP21 regarding rail user needs and system requirements
- Share the work performed in WP6 with ERJU, notably FP2-R2DATO WP22 regarding the ETCS gap analysis and LOC-OB system boundaries wrt ETCS
- Demonstrate the CLUG solution performance in the frame of FP2-R2DATO WP22

Thank you

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