CLUG 2.0: Project overview

EUSPA UCP – 07/11/23

Valentin Barreau – SNCF
CLUG 2.0 project technical coordinator

Context & Objectives

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CLUG 2.0 OBJECTIVES

Demonstrate the technological readiness of an on-board safe localisation system based on a GNSS+EGNOS 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
    - 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

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CLUG 2.0 In a Nutshell

Partners: **10**

Duration: **24 months**

Starting date: **Feb 23**

End date: **Jan 25**

unife THE EUROPEAN RAIL INDUSTRY

RINA

DB

SNCF

SBB CFF FFS

SIEMENS

AIRBUS

CAF

SYNTONY GNSS

ENAC

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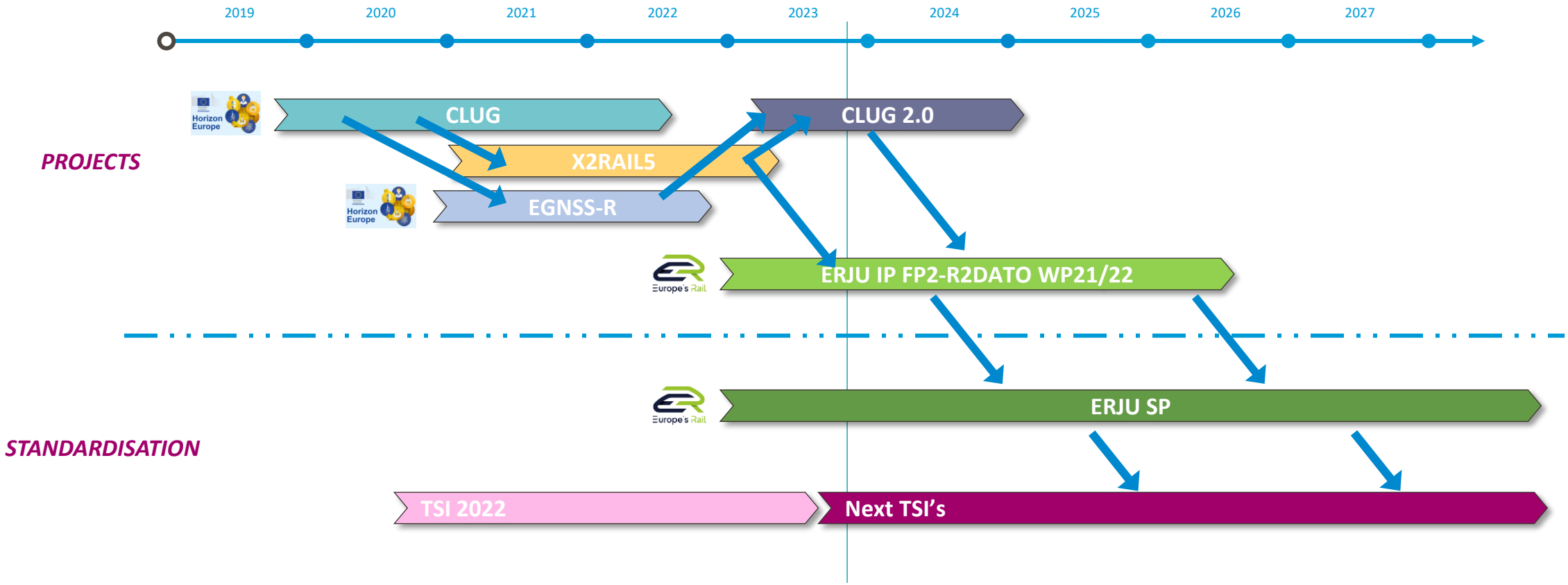
CLUG REASONING and ROADMAP



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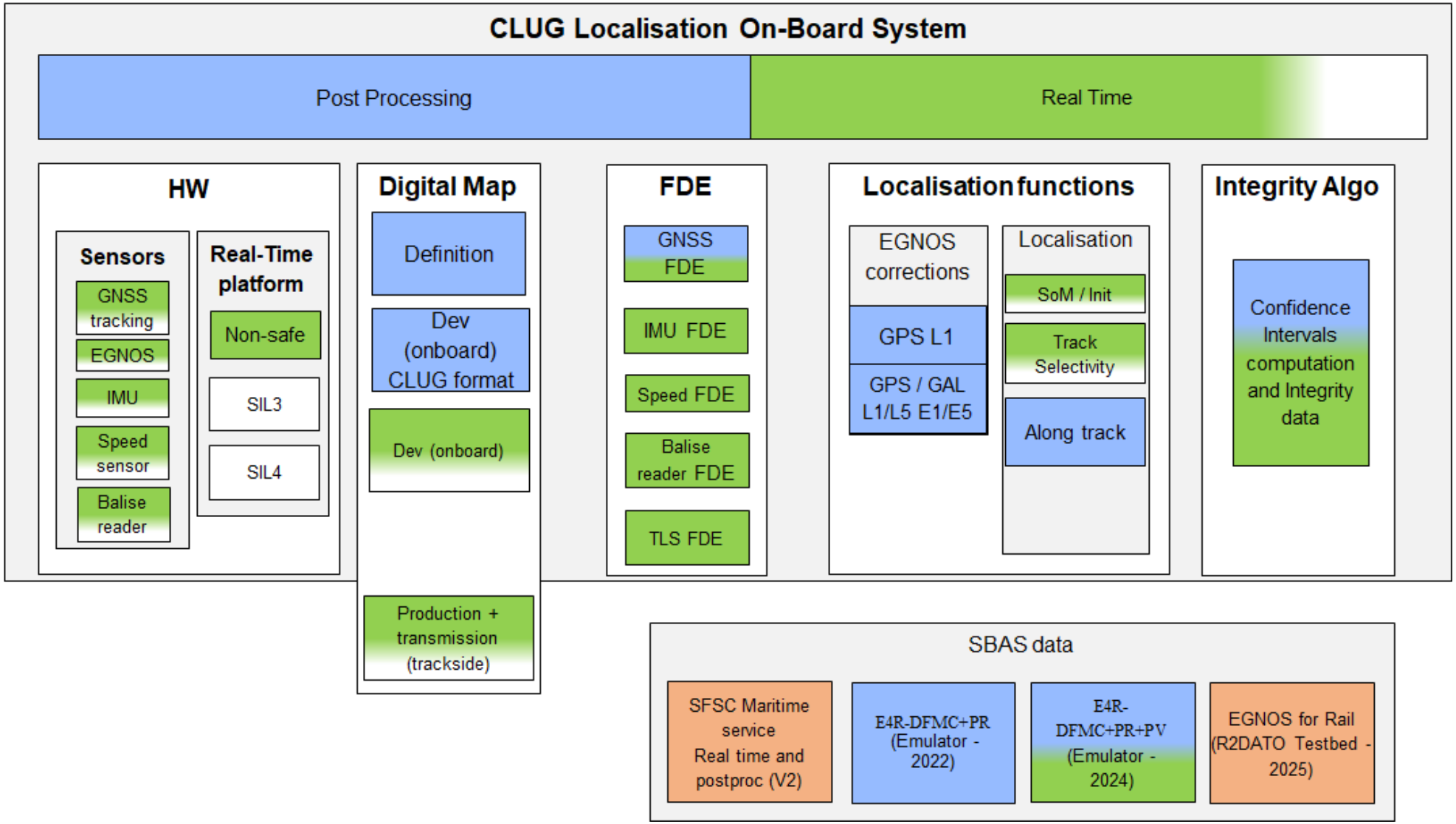
CLUG REASONING and ROADMAP

CLUG & other projects

CLUG 2

EGNOS EUSPA



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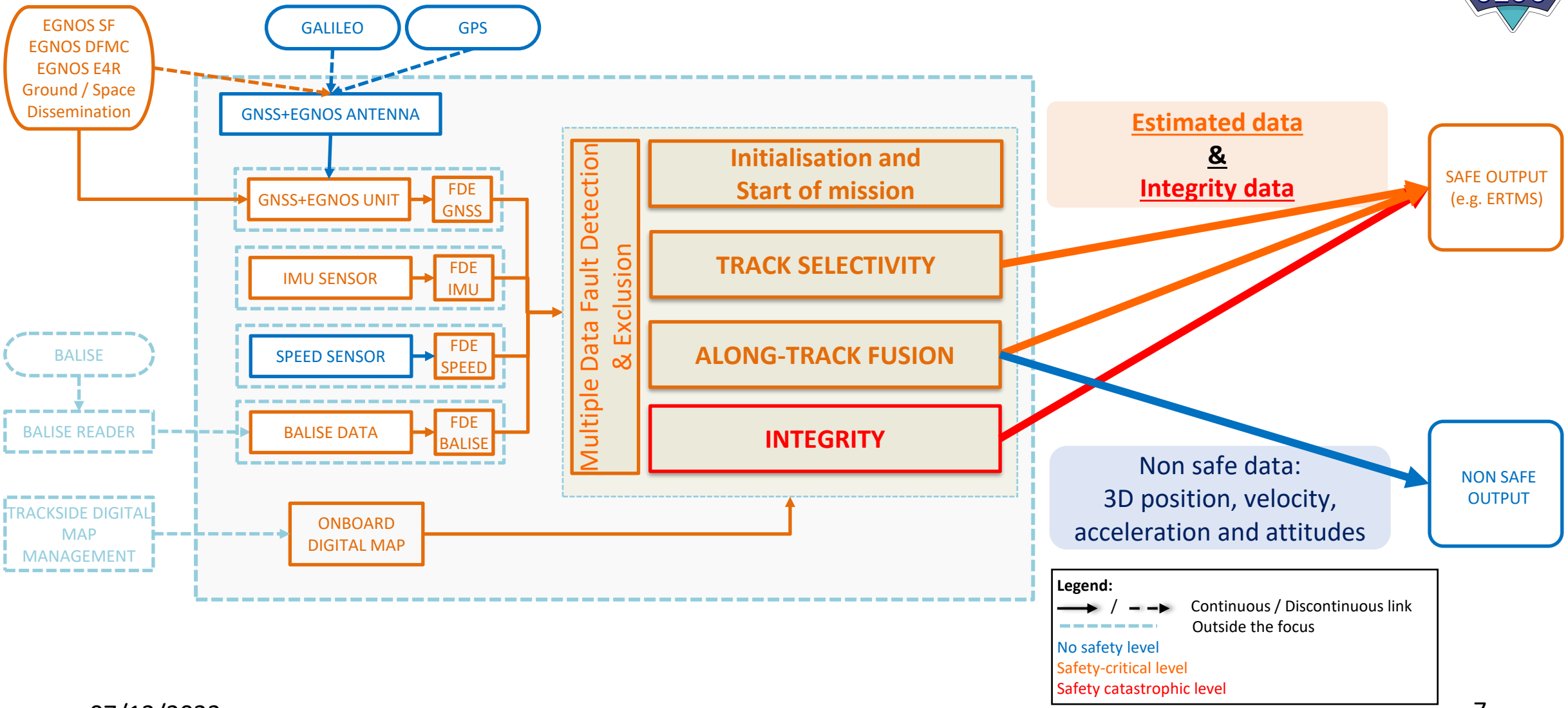
CLUG architecture



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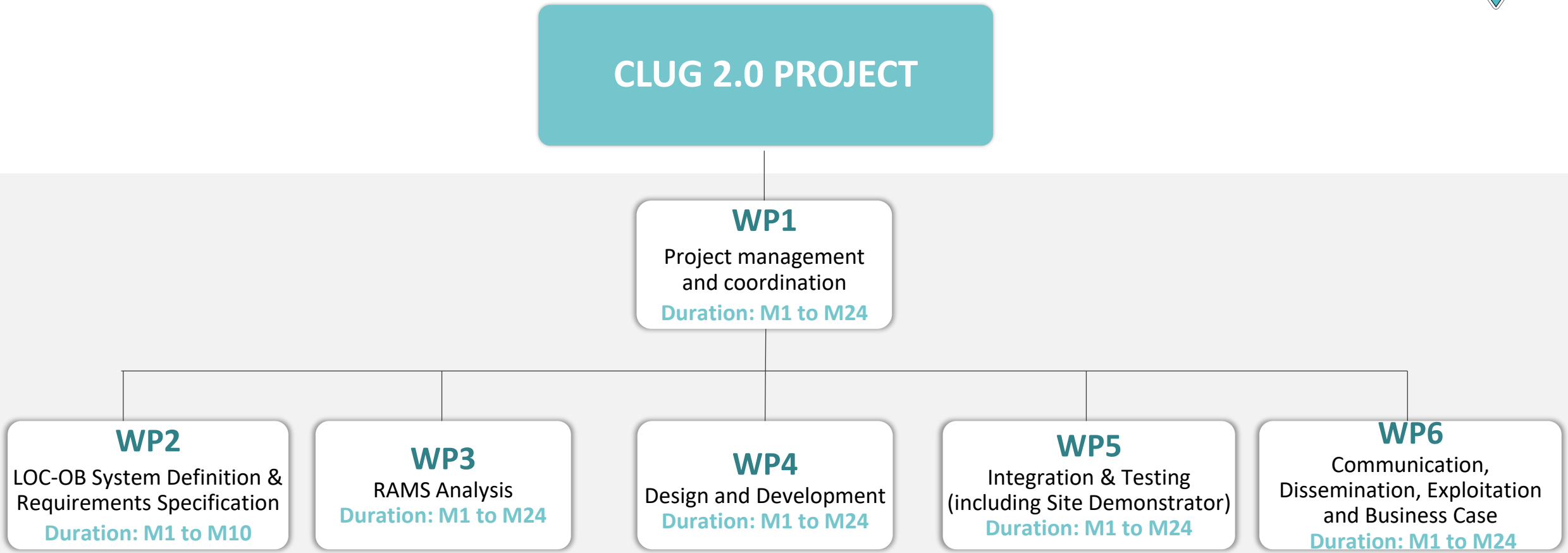
WP organisation



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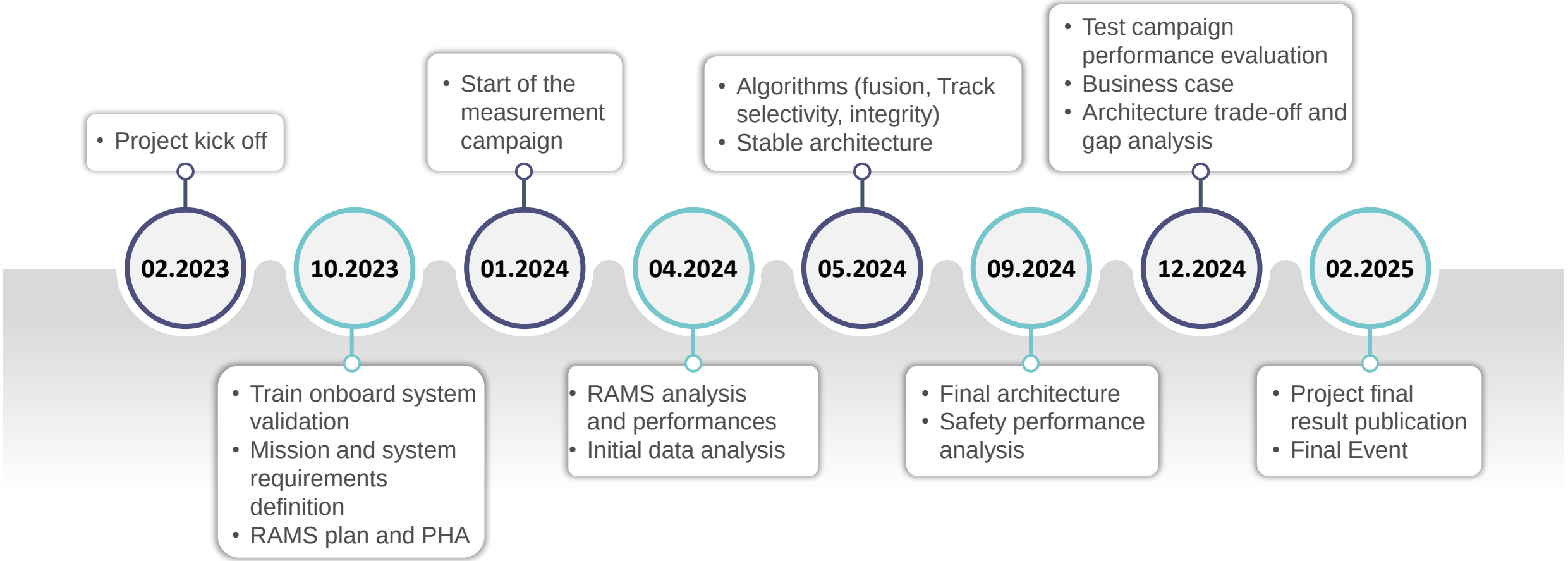
High level timeline



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Project technical status

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WP2

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 constrains 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

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WP3

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)

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WP4

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

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

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WP5

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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WP6

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”

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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

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Thank you

Jose Bertolin – UNIFE - Project coordinator
Jose.bertolin@unife.org

Valentin Barreau – SNCF – Project technical coordinator
valentin.barreau@sncf.fr

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