GATE4RAIL Geo-distributed simulation and verification platform

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Presentation prepared with the CEDEX support

1st Advisory board meeting

Web meeting -15th October 2020

CONTEXT

- The introduction of GNSS in ERTMS by means of virtual balises (VB) will require suitable test-beds able to tests the new features and to reduce the field tests.
- The proposed test-bed would allow an end-user to perform different test scenarios for different objectives, like:
  - Designing a new ERTMS line with VB
  - Testing a line with VB
  - Test of components
- The project is connected to previous projects on GNSS and ERTMS (e.g. VITE, ERSAT-GGC)

MAIN GOAL

DESIGN, DEVELOPMENT and TESTING
a simulation and verification platform
for the evaluation of the GNSS performances in the railway environment.

GNSS

RAIL

Geodistributed

OPEN

Automated

USERS & OPERATIONAL USE CASES

USERS

- *Infrastructure managers*
- *Railway undertakings*
- *Manufacturers*
- *Notified Bodies*

USE CASES

- *Support for the new line design engineering*
- *Validation of the line engineering*
- *Tests for the Certification of different components*
- *Support for route compatibility test*
- *Support to the characterisation of a railway line*

REQUIREMTS DEFINITION

- *User requirements*
- *System requirements*
- *Functional requirements*
- *Operational requirements*

USER REQUIREMENTS

In the following some user requirements are reported as example

Requirement ID	Title	Description	Proof of Concept Compliance
GR-UR-001	Main needs	The simulation platform shall implement the defined use cases	Yes (only operational use case (5))
GR-UR-004	Test Reporting	The simulation and verification infrastructure shall allow the user to obtain a test report in automated way once the test is completed	Yes
GR-UR-005	Learning	The simulation and verification infrastructure shall allow the users to evaluate the impact on system considering new functionalities	No

System Requirements

In the following some system requirements are reported as example

Requirement ID	Title	Description	Proof of Concept Compliance
GR-SR-001	Geo-distributed Architecture	The simulation and verification infrastructure shall connect GNSS and ETCS laboratories and facilities for performance evaluation of the end-to-end system	Yes
GR-SR-004	H/W and S/W Upgrades Easy Integration	The simulation and verification infrastructure shall allow an easy integration if new H/W and S/W upgrades in the labs or in general new functionalities for the product under test are required	No
GR-SR-005	Real and simulation components	The simulation and verification infrastructure shall support the use of both real system components and simulation elements for an end-to-end simulation chain providing unified and standardized interfaces allowing to several involved parties to contribute to the same testing layout	No
GR-SR-007	Scenarios Flexibility	The simulation and verification infrastructure shall support different configurations for a railway operation environment (i.e. run with different real track data or with simulated track data) and configure different GNSS conditions (considering global and local failures)	Yes
GR-SR-008	Maintainability	The simulation and verification infrastructure shall be maintainable and able to include new features (as S/W release notes)	Yes
GR-SR-009	Automated Test Results Evaluation	The simulation and verification infrastructure shall implement an automated analysis of test results	Yes
GR-SR-010	Automated Test Report	The simulation platform shall provide an automated generation of test reports	Yes
GR-SR-011	Automatic test repetition	The test bed shall be able to provide automatic test repetition	Yes
GR-SR-012	Automated Test update	The simulation platform shall provide an automated test update	Yes

FUNCTIONAL REQUIREMENTS

In the following some functional requirements are reported as example

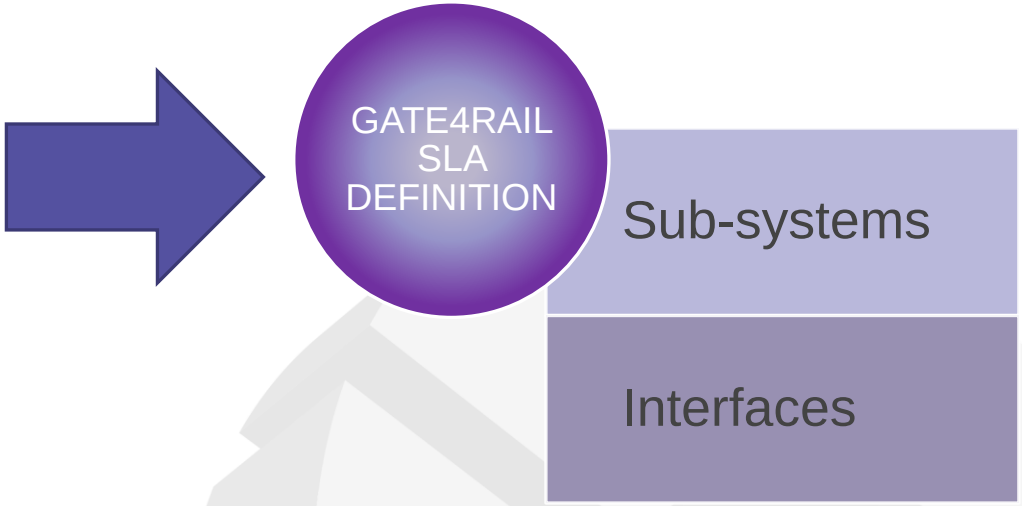
Requirement ID	Title	Description	Proof of Concept Compliance
GR-SFR-001	Multi-constellation	The simulation and verification infrastructure shall be able manage signals from both GPS and GALILEO constellations at least	Yes
GR-SFR-002	Multi Frequency	The simulation and verification infrastructure shall be able manage L1/ E1, L5/E5a GNSS signals at least	Yes
GR-SFR-003	ERTMS Scenario generation	The simulation and verification infrastructure shall support the generation of different ERTMS scenarios: Full Supervision, Start of Mission, Staff Responsible	Yes
GR-SFR-005	Rail Traffic generation	The simulation and verification infrastructure shall be able to generate different train movement profiles	Yes
GR-SFR-006	Global Hazard modelling	The simulation and verification infrastructure shall be able to inject global hazard on GNSS signals and raw measurements (e.g. ephemeris fault, satellite clock fault, multiple failures, etc.)	Partially
GR-SFR-007	Local Hazard modelling	The simulation and verification infrastructure shall be able to inject local hazard on GNSS signals and raw measurements (e.g. multipath, EMI, jamming and spoofing)	Partially
GR-SFR-009	Additional Sensors data generation	The simulation and verification infrastructure shall support the generation of additional sensors data synchronous and coherent with the simulation	Partially (only IMU)
GR-SFR-010	Used Signals	The simulation and verification infrastructure shall be able to feed the On Board Unit with signals recorded in rail measurement campaigns as well as with synthetic signals.	Partially
GR-SFR-011	Area map	The simulation and verification infrastructure shall be able to import a 3D layout of the environment taking into account the height of the obstacles (e.g. tunnels, bridges, presence of buildings, railway station, etc.)	Partially

OPERATIONAL REQUIREMENTS

In the following some operational requirements are reported as example

Requirement ID	Title	Description	Proof of Concept Compliance
GR-SOR-001	Test-bed availability	The test-bed availability is continuous and a message shall be sent to user when the test-bed is not available for simulations	No
GR-SOR-002	Maximum time acceptable for the user to generate report	Maximum time acceptable for the user to generate report when the simulation is successfully completed lower than 1 hr	No
GR-SOR-003	Test-bed operation modalities	The test-bed shall be able to operate both on a part of the complete ERTMS/GNSS chain (for example verifying the system performance in particular scenario operative conditions) and on complete chain (train ride), considering the different ERTMS and GNSS scenarios occurring in the train ride)	Yes
GR-SOR-004	Number of simultaneous users	The test-bed shall be able to operate with number of simultaneous users higher than 2	No
GR-SOR-005	Sensitivity analysis	The test-bed shall be able to perform a sensitivity analysis on the considered scenario (varying the main GNSS parameters included in the input configuration file according to selected values)	Yes
GR-SOR-006	Number of repetitions of the same test to performed	The test-bed shall be able to perform a number of the same test repetitions higher than 2	Yes

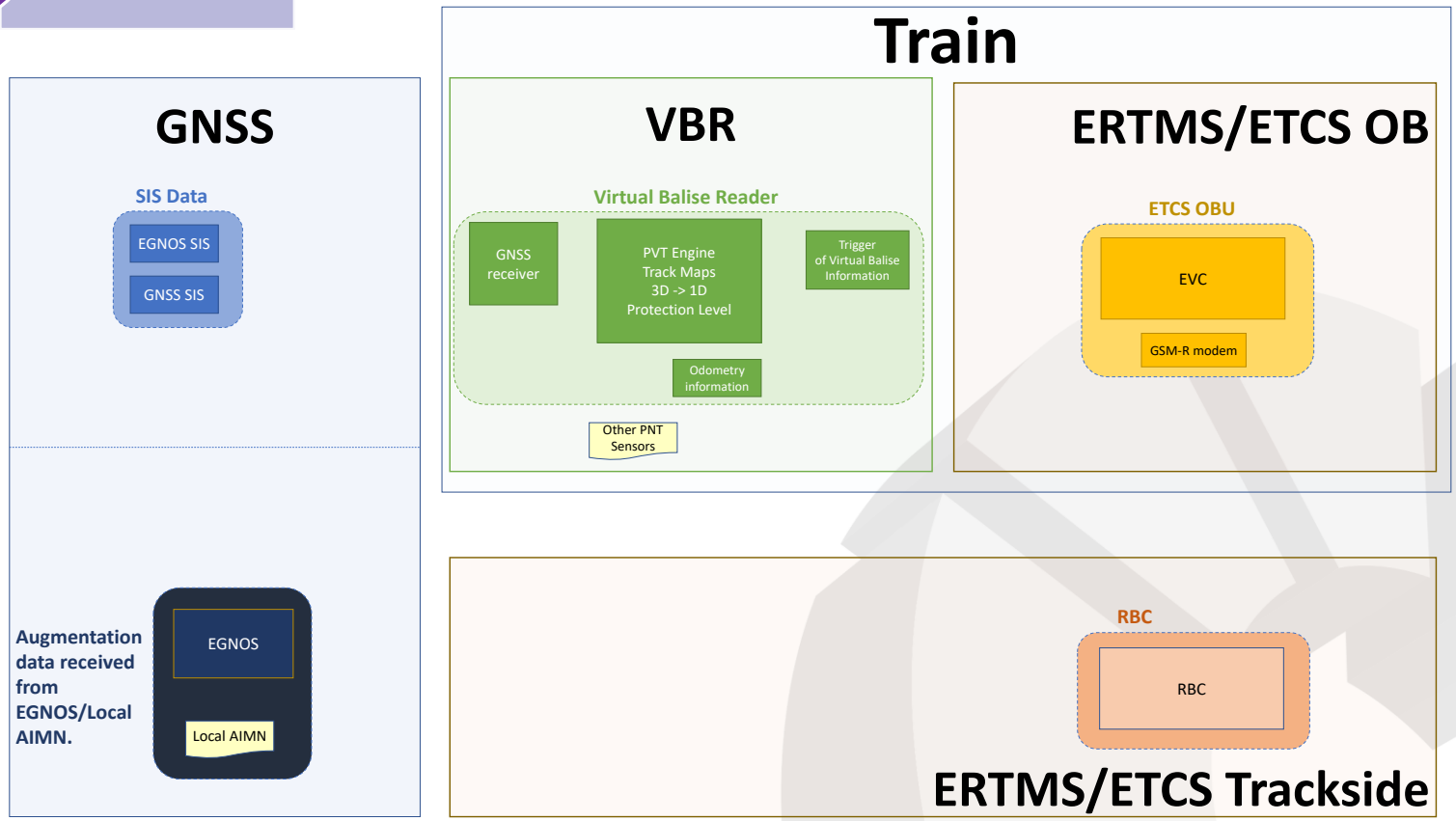
SYSTEM LEVEL ARCHITECTURE (SLA)



SYSTEM LEVEL ARCHITECTURE (SLA)

GATE4RAIL SLA DEFINITION

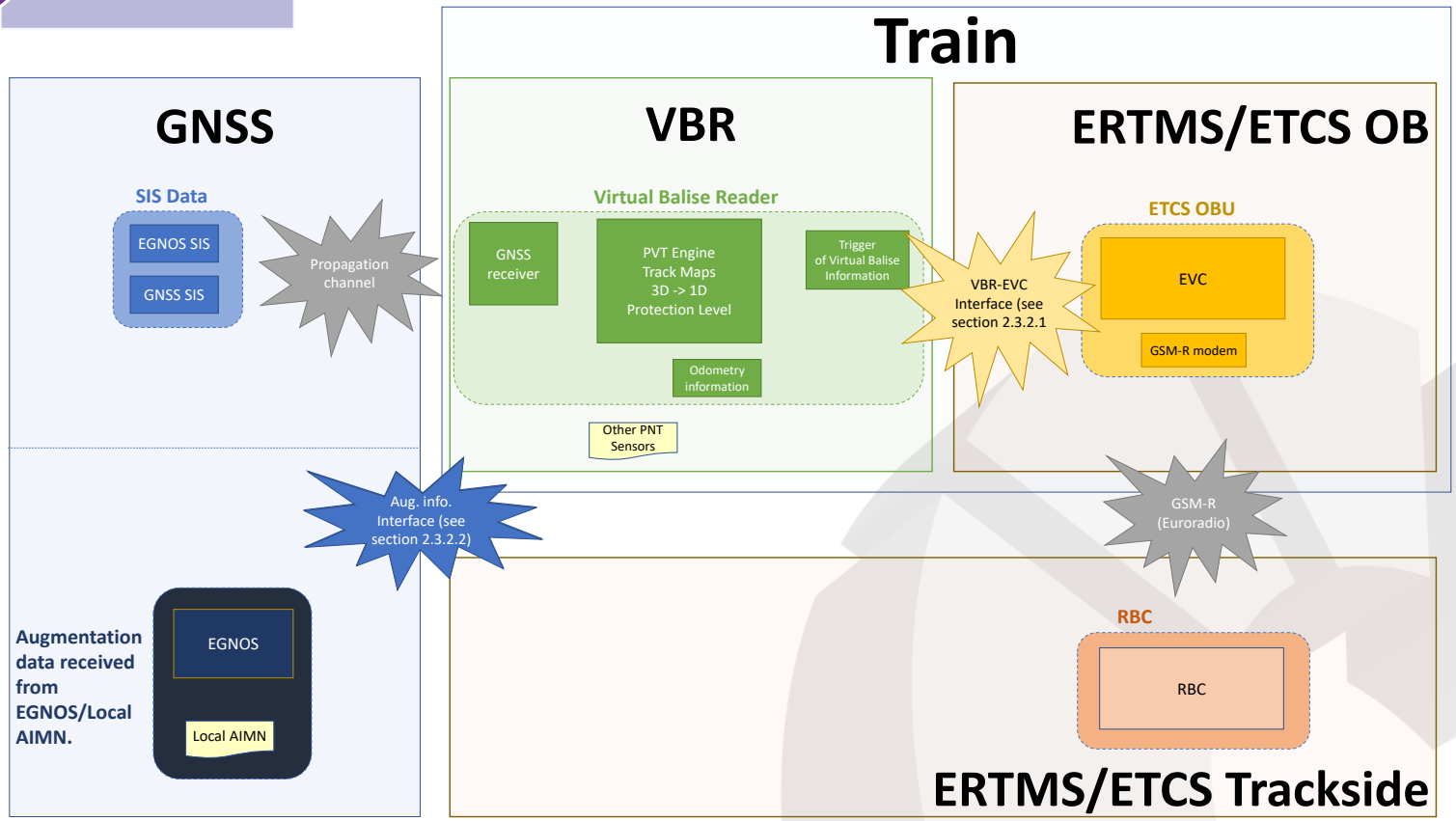
SUB-SYSTEMs



SYSTEM LEVEL ARCHITECTURE (SLA)

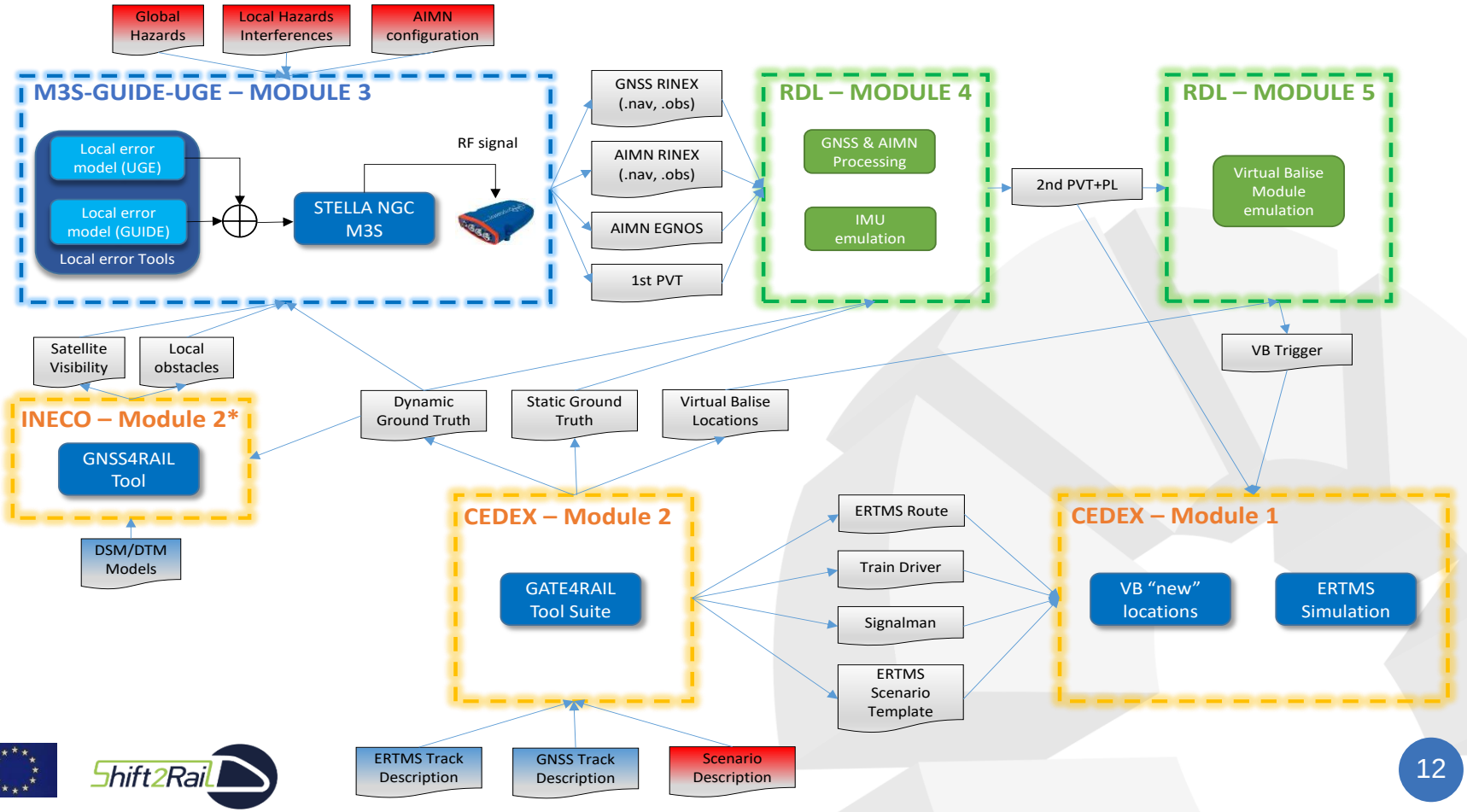
GATE4RAIL SLA DEFINITION

INTERFECES



GATE4RAIL SLA IMPLEMENTION

SLA Constituent	GATE4Rail Modules	GATE4Rail Partner
SIS Data + Augmentation from EGNOS/Local AiMN	Module #3	M3S+UGE+GUIDE
Virtual Balise Reader	Module #4 & Module#5	RADIOLABS
ERTMS/ETCS OBU + ERTMS/ETCS Trackside	Module #1	CEDEX
Test Management + GNSS-ERTMS Synchronization	Module #2	CEDEX+INECO



GATE4RAIL SLA IMPLEMENTION

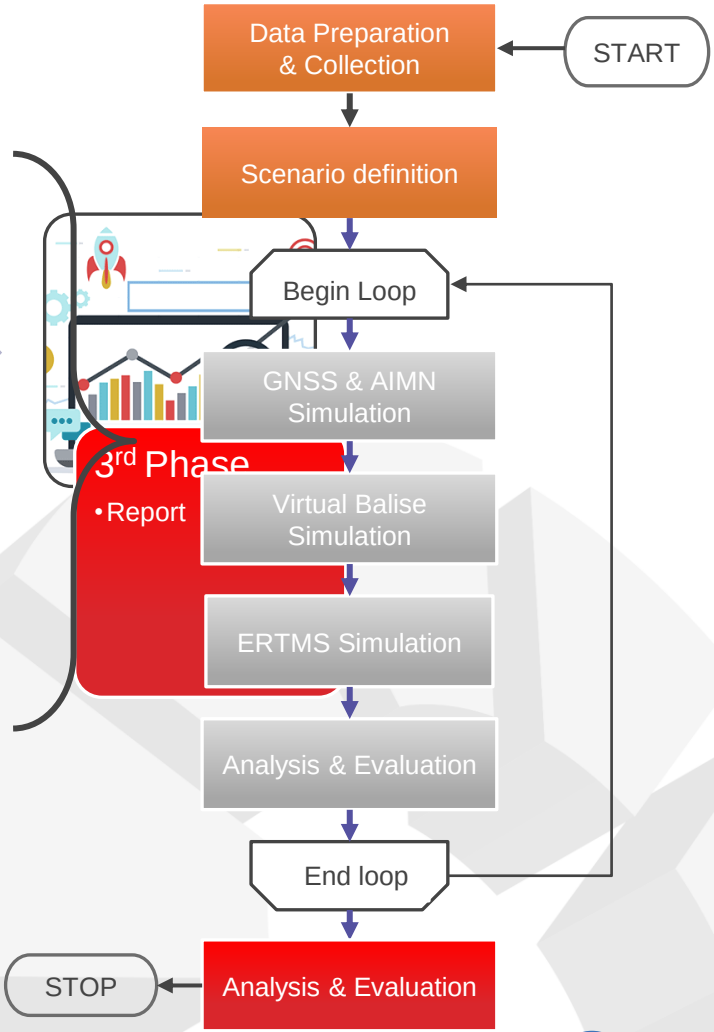
SLA FUNCTIONAL BEHAVIOR

1st Phase

- Data Preparation & collection
- Scenario definition

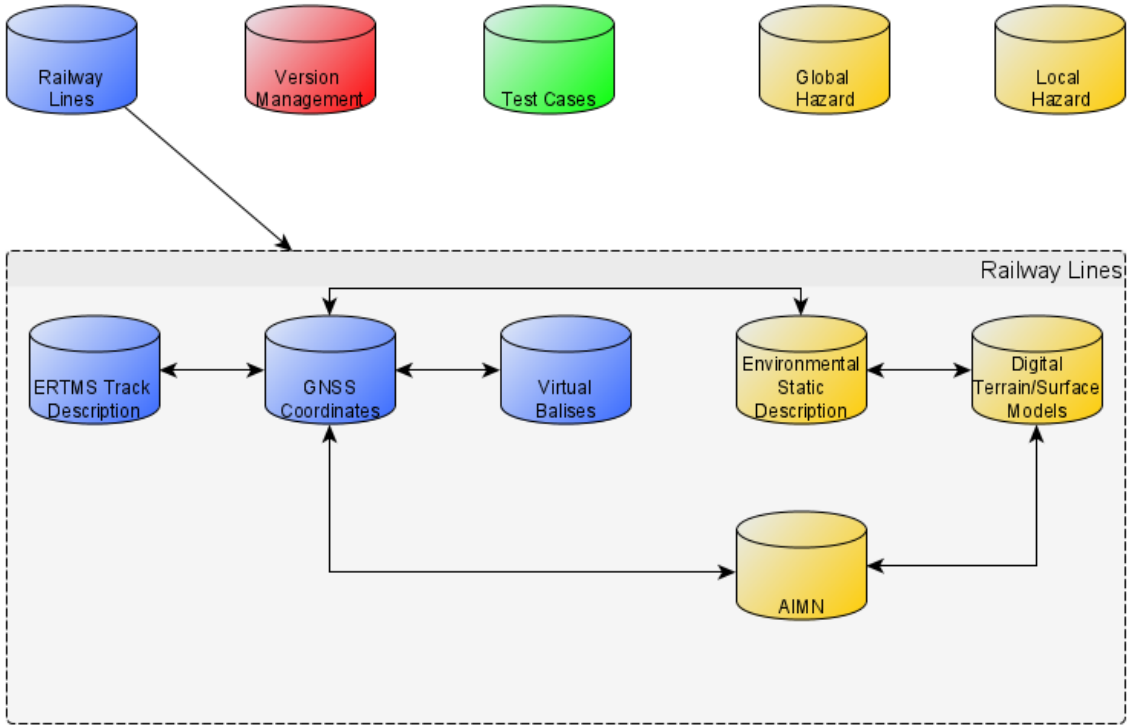
2nd Phase

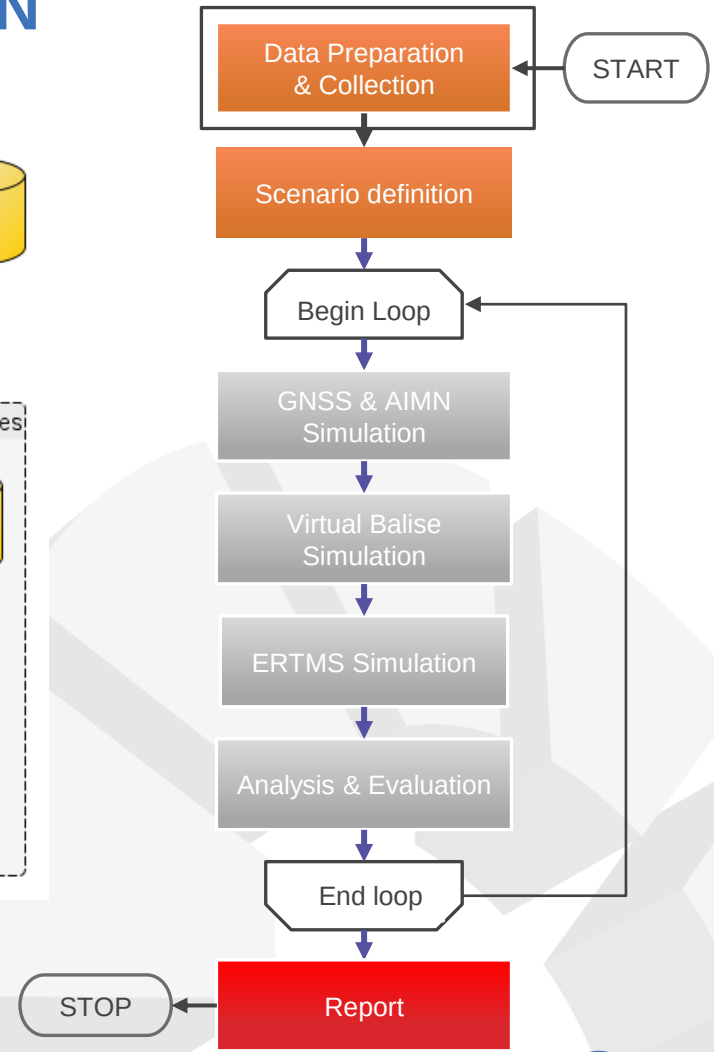
- GNSS & AIMN Simulation
- Virtual Balise Simulation
- ERTMS Simulation
- Analysis & Evaluation



GATE4RAIL SLA IMPLEMENTION

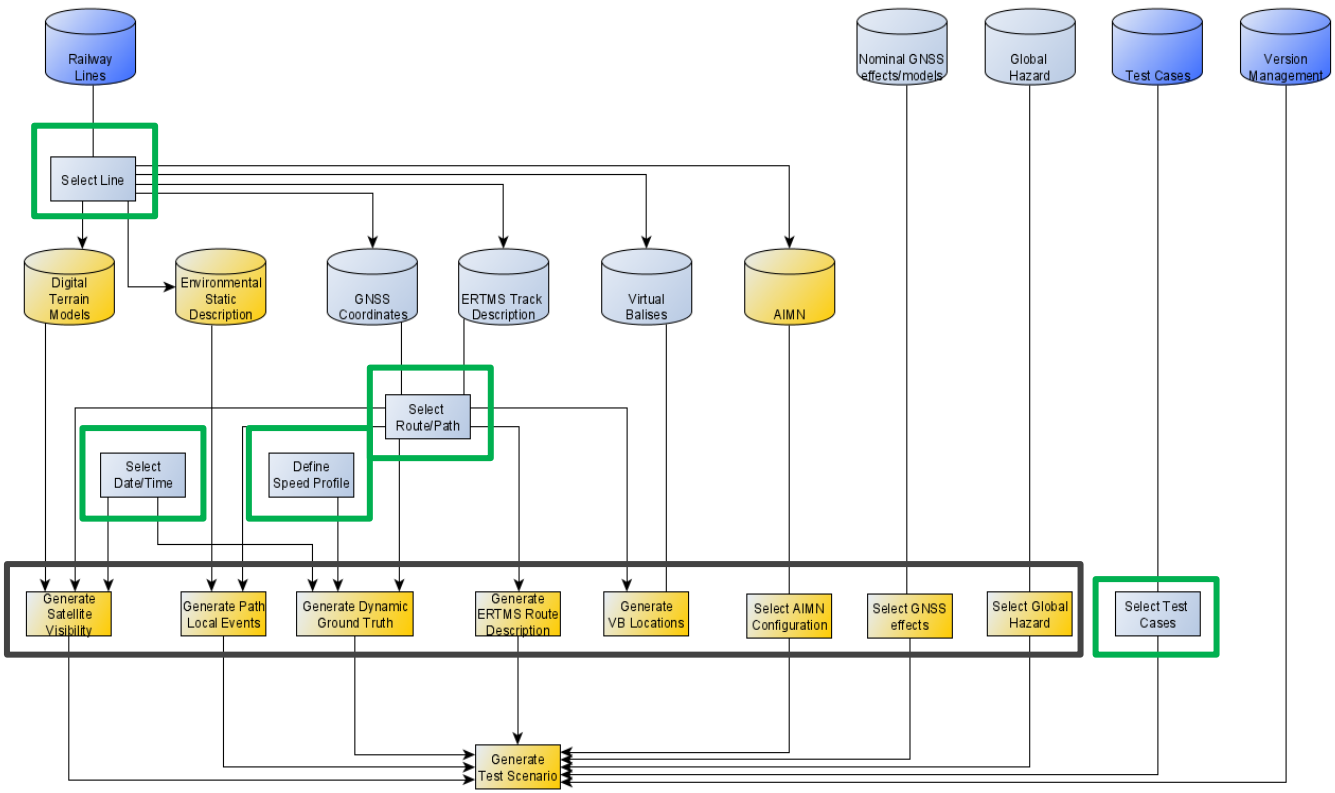
DATA PREPARATION & COLLECTION

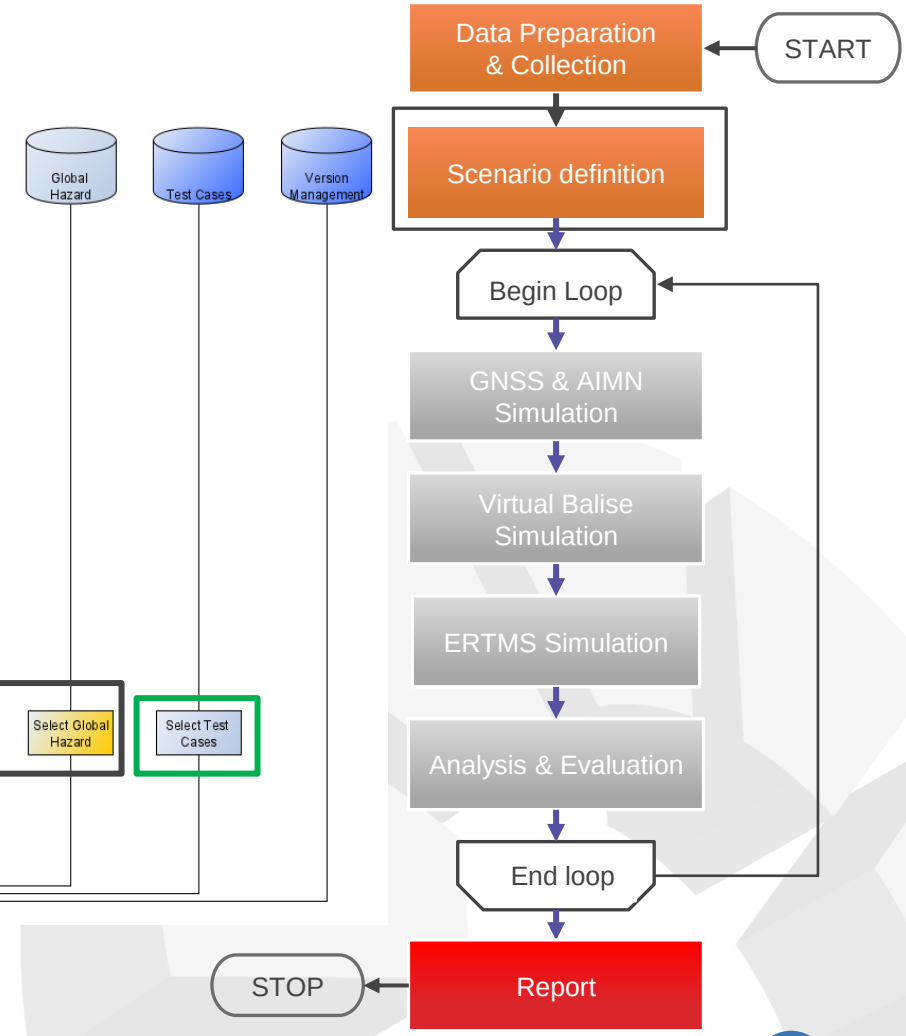




GATE4RAIL SLA IMPLEMENTION

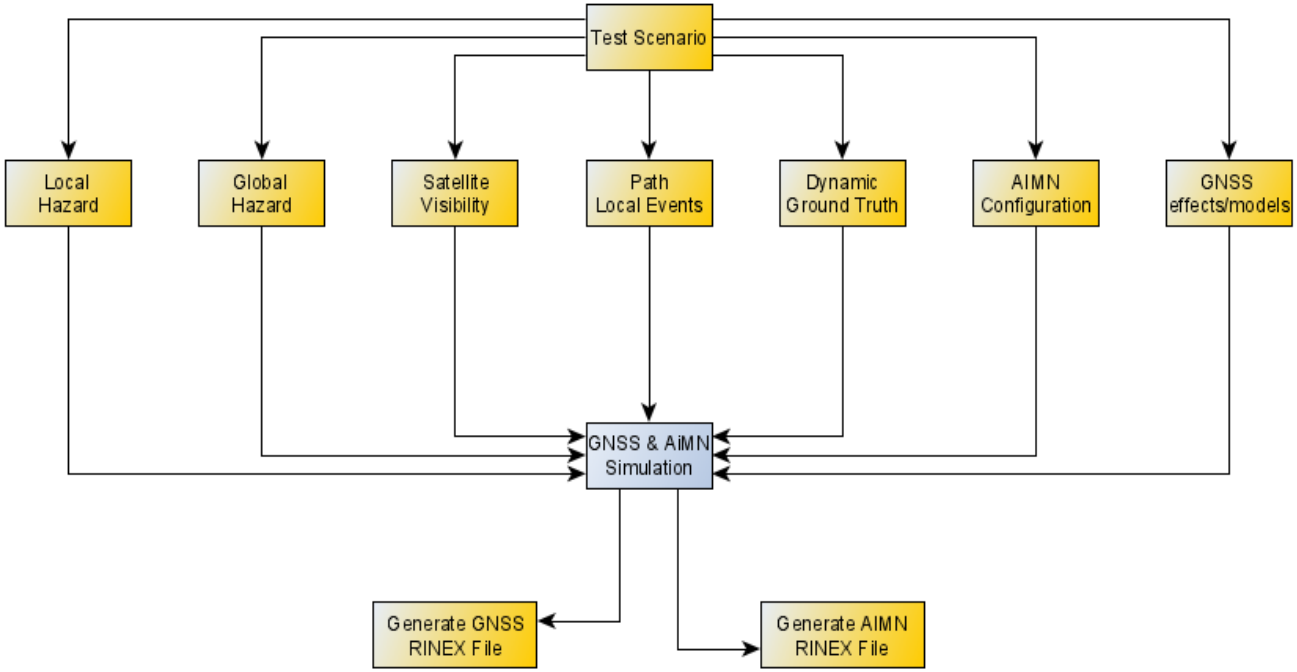
SCENARIO DEFINITION

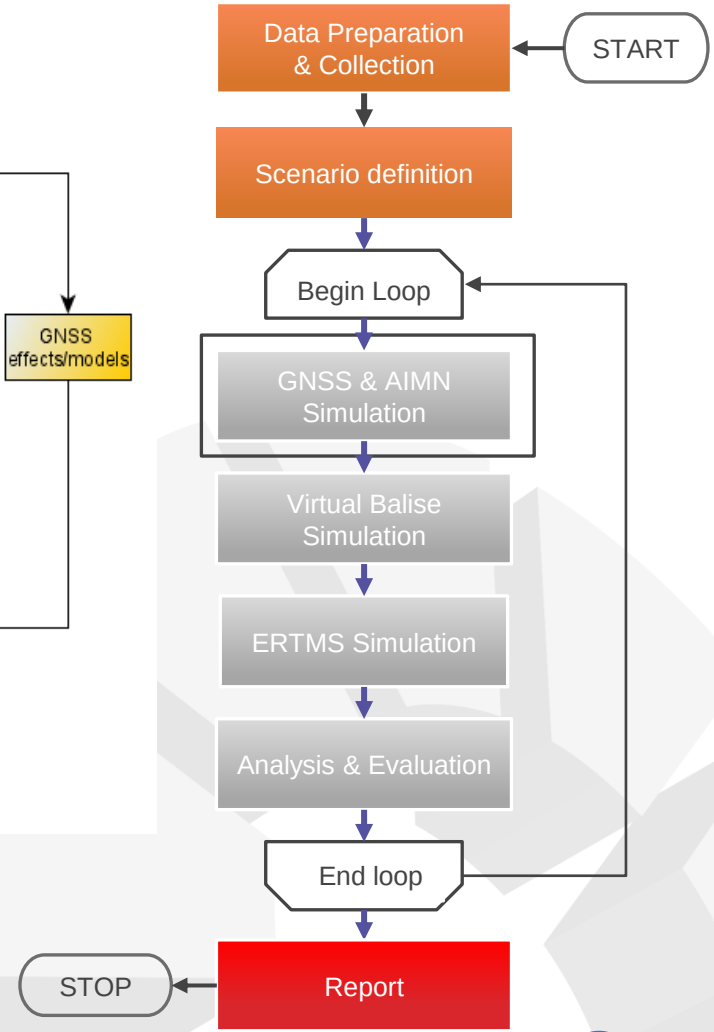




GATE4RAIL SLA IMPLEMENTION

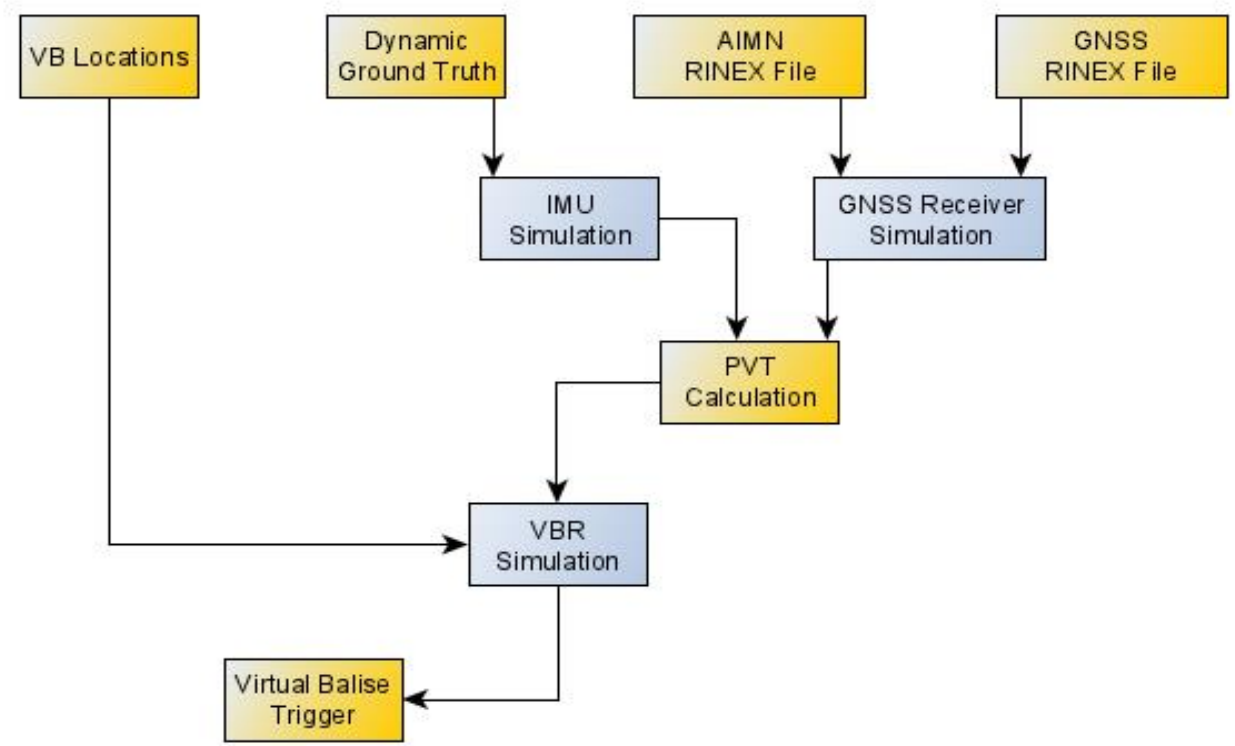
GNSS & AIMN SIMULATION

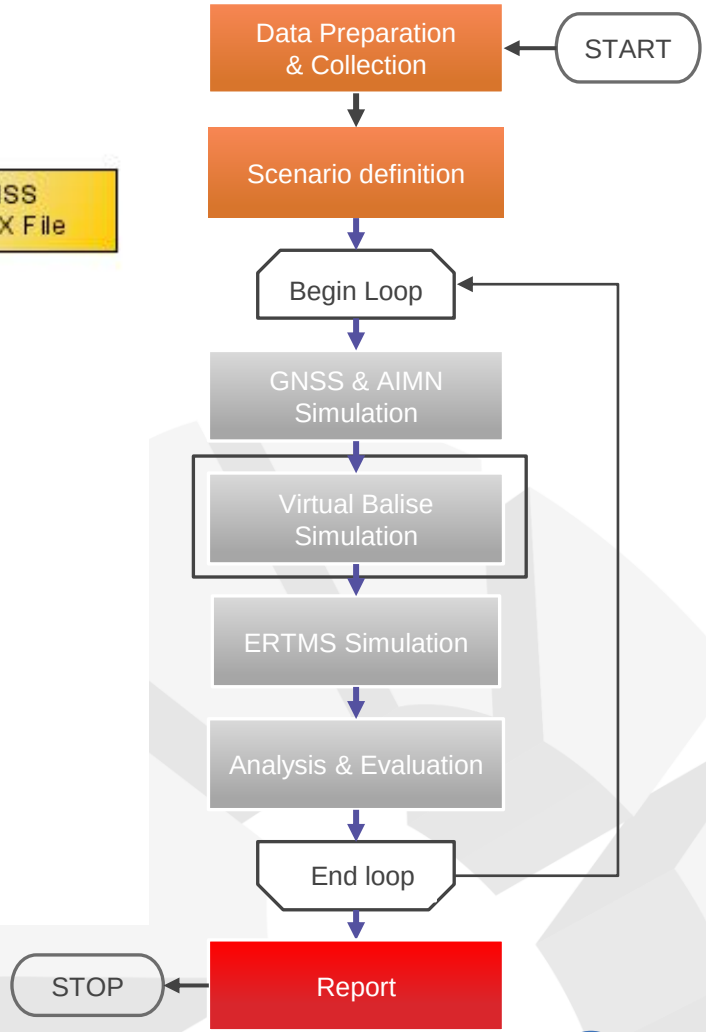




GATE4RAIL SLA IMPLEMENTION

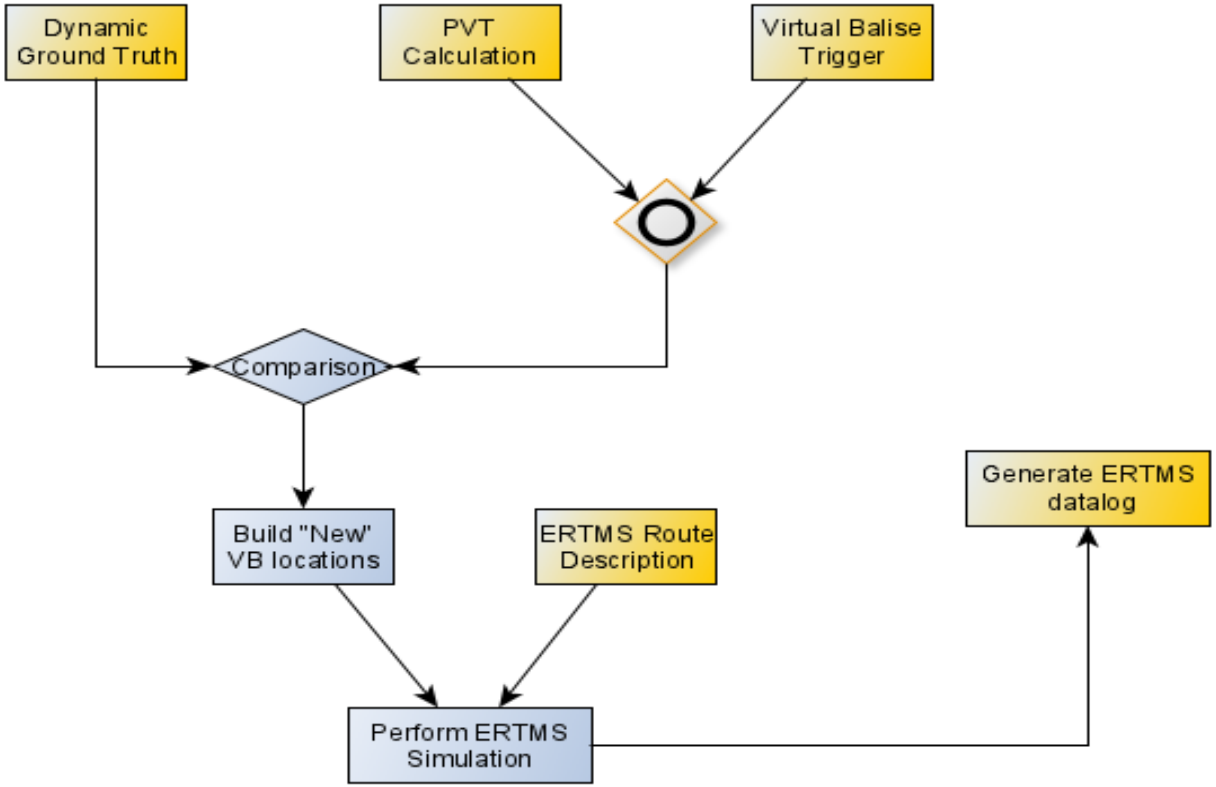
VIRTUAL BALISE SIMULATION

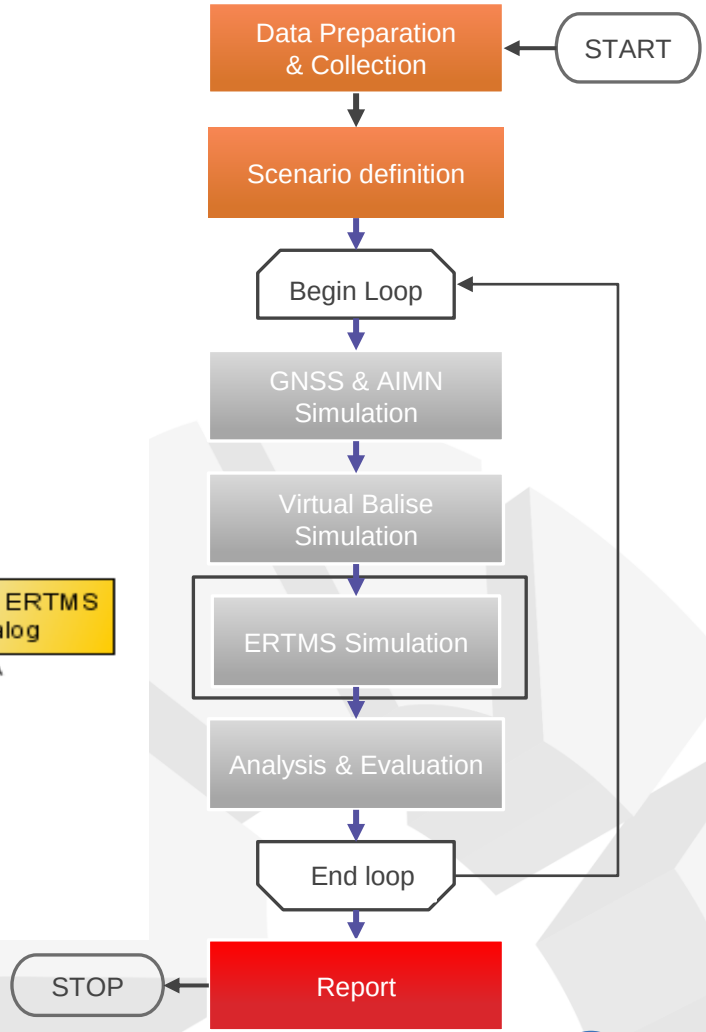




GATE4RAIL SLA IMPLEMENTION

ERTMS SIMULATION

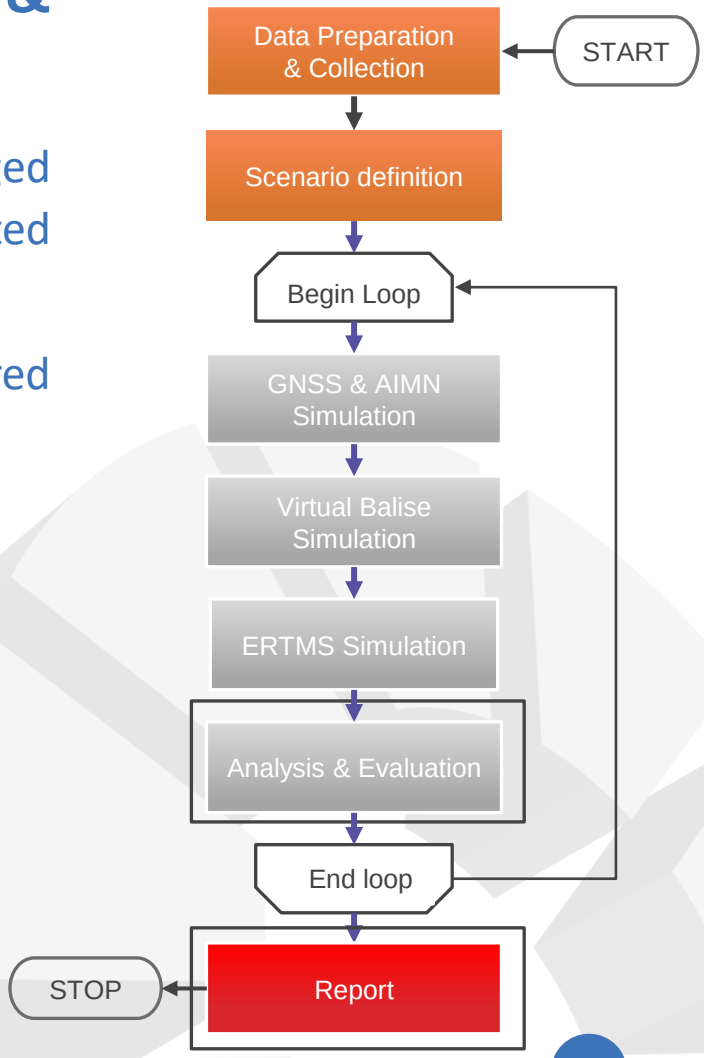




GATE4RAIL SLA IMPLEMENTION

ANALYSIS AND EVALUATION & REPORT

- In the *Analysis and Evaluation* procedure, the logged and stored simulation data are analysed and evaluated against the test scenario prescription.
- In the REPORT procedure, the results are considered for a final Report.



DEMOSTRATION

GOALS

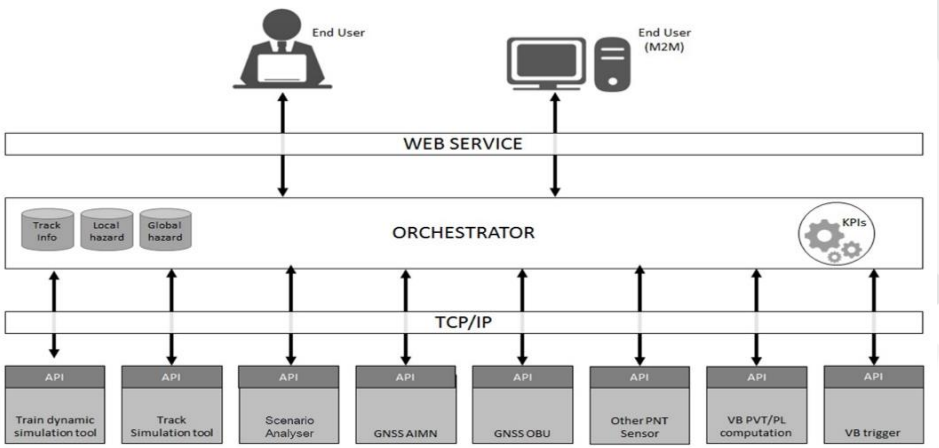
- Demonstrate the functioning of the GATE4Rail infrastructure
- Demonstrate the capabilities in terms of automated update of test environment and automated test repetition

DATE OF THE DEMONSTRATION : end of January (TBC)

DEMONSTRATION STATUS

FUTURE EVOLUTIONS

- Evolution of service-oriented architecture
- Standardization of the VBR and AIMN interfaces
- Configurable GNSS and ERTMS/ETCS scenarios by the end-user
- Fully automatization of the test execution and test results evaluation



REFERENCE DOCUMENTS

D4.1 - Geo-distributed Simulation and Verification Infrastructure Modules and Interfaces functional and Operational Requirements (PUBLIC)

D4.2 – Geo-distributed Simulation and Verification Infrastructure Modules and Interfaces Detailed Design (CONFIDENTIAL)

That's all!

Thanks for your attention