    - Moving Block signalling system test methods – M18 (This to include specification of any tools required)
    - Report on Moving Block Operational and Engineering Rules – M24
- Deliverables of work stream 2 are expected to be available as specified below:
    - For item a(i): by M6;
    - For item a(ii): by M9;
    - For item a(iii): by M12
    - For item a(iv): by M15
    - For item b(i): by M9
    - For Item b(ii): by M12
    - For item c: by M9

Expected Impact:

Regarding the work stream 1 the activities are expected to contribute to:

- Understanding of the test processes required in order to bring a Moving Block signalling system into use.
- Enhancement of the Moving Block Operational and Engineering Rules, including highlighting differences from traditional signalling systems to the future ones.

Regarding the work stream 2 the activities are expected to contribute to:

- Refining the knowledge of the market to accept and request also very innovative and potentially disruptive transportation solutions.
- Understand the real feasibility for applying VCTS according to the different characteristics of the lines, of the railway structure and of the Railway Undertakings and Infrastructure Managers needs or constraints.
- Identify the potential application roadmap for the introduction of VCTS taking into account the switch over from the traditional systems and the possible transition issues.

Type of Action: Research and Innovation Action

S2R-OC-IP2-02-2018 - Modern methodologies and verifications for GNSS in Railways and virtual test environment

Specific Challenge:

In the framework of the technological developments foreseen within the Innovation Programme 2 of Shift2Rail Master Plan, the application of the new technologies for train localisation using GNSS are seen being one of the most promising technologies able to increase line capacity reducing the trackside life cycle costs. The main challenge is to identify and assembly the basic data necessary to accomplish and apply the GNSS in the Railway environment.

The call also aims to study new methodologies and assessment procedures for maintaining the simulation environment, in line with the introduction of new functionalities in the system. It is important to perform tests of innovative products and services using up-to-date simulation environment in order to support new (type) approval processes or even a harmonised European approval process in the context of control, command and signalling systems.

Scope**:**

Regarding the activities related to the GNSS application in railway (TD2.4) of the Multi Annual Action Plan) the main scope is to achieve a realistic characterization of the environment, in terms of railway and GNSS infrastructures, able to evaluate performances and properties of some Fail-Safe Train Positioning components with respect to normal and specific failure conditions. The activity also aims to lay dawn a geographical and distributed infrastructure able to verify and take advantage from the results of the existing laboratories.

Regarding the activities linked to TD2.6, it is important to remark that any simulation environment has to be aligned with the evolution of the system and of the configuration of the track / station. In addition, the obsolescence of different parts of the system needs to be taken into account while improving the test environment. The main scope is to find out a technical solution which can reduce the need for re-assessments due to the upgrade so maintaining the simulation and testing environment in line with the latest evolutions such as:

- changing the hardware due to obsolescence or product enhancements;
- changing the software due to new functionality, upgrade of specifications.

For supporting these activities the test environment as well as the simulation, needs to show the following capabilities:

- Automated upgrade of the simulation environment including the automated repetition of already available test cases including automated evaluation of the test results to fulfill the requirements of system integrators and assessors;
- Ease of upgradeability in terms of limited effort for approving the test environment;
- Support physical as well as virtual test and simulation environments.

The proposals should address all work streams described below, in line with the Shift2Rail Multi-Annual Action Plan (MAAP):

1. In the framework of the introduction of GNSS technologies (linked with TD2.4 of the Multi Annual Action Plan) and in collaboration with the project X2Rail-2 (S2R-CFM-IP2-01-2017) and subject to the available results of related projects as STARS and ERSAT, the following activities are expected to contribute to the Fail-safe train positioning (satellite) (TD2.4):
    a. Identify and develop a Simulation Environments able to characterize the Railway and the GNSS infrastructures and to evaluate the performance of the GNSS application. The characterization has to at least include the following features:
        - Railway infrastructure peculiarities according to the application of GNSS into the different market segments (e.g.: Main Lines, Regional Urban/Suburban and Freight lines);
        - Characterization of the Satellite Constellation availability and coverage (related to the position and the date/time);
        - Capability to define test cases and evaluate impact and performance reproducing normal and failure modes of parts of the modules: related to Railway and/or GNSS infrastructure.
    b. Develop a comprehensive methodology able to:
        - Characterize the GNSS into Railways Application domains;
        - Carry out the models able to verify the properties of some Fail-Safe Train Positioning components with respect to specific faults (e.g. due to multipath, radio frequency interference, spoofing, …)
    c. Setup of a geographically distributed verification infrastructure able to exploit the features of existing complex and expensive laboratories.

2. In the framework of the evolution of the simulation environment technologies (linked with TD2.6 of the Multi Annual Action Plan) the activities are expected to cover the following points:
    a. Develop a concept for the automated update of test environments due to multiple changes;
    b. Develop a concept for continuous integration as well as automated test repetition and automated evaluation of these tests, taking the safety aspect into account. The concept shall support the safety approval of the overall system as well as the changed function taking into account the requirements of representative bodies (Notified Bodies, Designated Bodies and Assessment Bodies).
    c. Ensure that the concept for upgrading the test environment as well as the test candidate can be approved by an independent safety assessor.
    d. The proposed solution shall contain as a minimum:
        i. Methodologies and tools feasible for continuous update and integration of the test environment as well as the test candidate; The proposal shall not be limited to Software;
        ii. Methodologies and tools for test automation and automated analysis of test results giving the necessary KPIs for safety approval;
        iii. Concept for improving assessors tasks and linking testing to approval;
        iv. The proposed solution shall support multiple sites for testing;
        v. The proposed solution can be based on representative examples.

The action that is expected to be funded under this topic will be complementary to the action that is expected to be funded under the topic S2R-CFM-IP2-01-2018: Advanced Signalling, Automation and Communication System and Automated Freight Train Operation.

The action expected to be funded under this topic will also be complementary to action carried out in the project funded under S2R-CFM-IP2-01-2017 (X2RAIL-2).

As specified in section 2.3.1 of S2R AWP for 2018, in order to facilitate the contribution to the achievement of S2R objectives, the options regarding 'complementary grants' of the S2R Model Grant Agreement and the provisions therein, including with regard to additional access rights to background and results for the purposes of the complementary grant(s), will be enabled in the corresponding S2R Grant Agreements.

An indicative scheduling of the deliverables is suggested below[38]:

- Deliverables of work stream 1 are expected to be available as specified below:
    - For item a; by M12
    - For item b; by M18
    - For item c; by M24

- Deliverables of work stream 2 are expected to be available as specified below:
    - Overview over today's approval processes in different countries; by M9
    - Set of common requirements for NoBo approval of a test environment and the necessary upgrades; by M12
    - Agreed update and approval process for system simulation and test environment; by M22

Expected Impact:

[38] The scheduling of the deliverables is provided to facilitate the complementarity with the CFM actions and it is not binding. Additionally, each deliverable may have some flexibility in the scheduling.

Regarding the work stream 1 the activities are expected to contribute to:

- The development of the GNSS architecture as planned in the Multi Annual Action Plan;
- Simplify the analysis of the pros/cons for the GNSS application according to the different lines characteristics and market segments;
- Help the characterisation of the architecture in order to achieve the optimised balance between the constraints due to the lines and the railway environment and the maximisation of the performances.

Regarding the work stream 2 the activities are expected to contribute to:

- the development of a Zero on-Site Testing (TD2.6) environment. As more and more test are transferred from the field to the lab, the needs of enhancing and increasing the efficiency of the test environment becomes fundamental.
- Reduce costs and improve efficiency. The positive results thanks to the definition of a dedicated process for upgrading the lab environment as well as the system in the field are expected to yield direct benefits in terms of:
    - Reduction of costs of lab resources due to the reduction of real lab equipment needs (acquisition, obsolescence, maintenance, use of energy and space, etc.) and introduction of 'state of the art' technology;
    - Increase of the efficiency of test resources management;
    - Full accessibility to the test environment available from different locations;
    - Support of the necessary safety integrity level.

Type of Action: Research and Innovation Action