

4.2.4 S2R-OC-IP2-01-2020 - Modelling of the Moving Block system specification and support for Railway Minimum Operational Performance Standards

SPECIFIC CHALLENGE

The objective of the call is to delineate, through system models of Moving Block, the behaviour of the system in order to identify potential additional hazards due to the introduction of the Moving Block in the diverse market segments and with the diverse signalling systems. This will support the activities of the Technology Demonstrator and help bringing the developments not only as close as possible to the market but also support the possible update of the regulatory framework.

In the field of Train Localisation (based on the use of combined technologies such as for example EGNSS, IMU, kinematics, Digital Map) the main objectives are to contribute with enhanced railways Fault Detection and Exclusion algorithms for facing local feared events, data fusion algorithms suitable for railway safe applications, EGNSS monitoring techniques also based on carrier phase measurement and multi-frequency technology, and to provide Independent Assessment Report on the proposed technologies and solutions, in accordance with the objectives of the IP2 TD2.4 Fail Safe Train Positioning (including GNSS) described in the S2R MAAP.

SCOPE

In order to address the challenges described above, proposals should address all the following work streams, in line with the S2R MAAP:

Work-stream 1:

Within the framework of the Moving Block the proposal has to carry out the following work:

- a. To create semi-formal or formal models of the Moving Block systems, which have been defined by the work in S2R X2Rail-1⁴⁸, and by using the Formal Method methodology developed in X2RAIL-2⁴⁹, in order to examine the system behaviour, and check for additional hazards arising from the use of Moving Block. The action could also consider the method included in the EULYNX Modelling standard⁵⁰.
- b. To update the above modelling based on the updates to the Moving Block specifications which will result from the work in S2R X2Rail-3⁵¹ (based on the deliverables from X2RAIL-1).
- c. To create semi-formal or formal models of the enhancements to the Moving Block architectures, as proposed by the “Future Moving Block Architectures” topic within the project S2R X2Rail-3⁵². The method used should be the same as used for modelling the results from X2Rail-1.

Expected TRL: 3

This work should be performed in collaboration with work carried out within the action stemming from the S2R-CFM-IP2-01-2020. It is expected that the Open Call will present the results of the modelling to the CFM project.

⁴⁸ Deliverables related to WP5 of X2RAIL-1 (moving block) are publicly available on the project website (results and publication): https://projects.shift2rail.org/s2r_ip2_n.aspx?p=X2RAIL-1

⁴⁹ Deliverables related to WP5 of X2RAIL-2 (formal methods) – D5.1: https://projects.shift2rail.org/s2r_ip2_n.aspx?p=X2RAIL-2

⁵⁰ EULYNX Modelling Standard - Published by EULYNX at www.eulynx.eu (EULYNX Document Number: Eu.Doc.30)

⁵² Expected to be delivered in May 2020

Work-stream 2:

Within the framework of the Fail Safe Train Localisation, the proposal has to carry out the following work:

- a. Perform a review of feared events (both system and local) and characterise threats in terms of their impact on code and carrier phase measurements;
- b. Definition and Development of Railway Fault Detection and Exclusion (FDE) algorithms for coping with railway system and local feared events in the context of both mono/dual constellations and mono/dual frequencies; in the context of these FDEs, perform a technology assessment and review of the state of the art for methods and techniques to improve the robustness of carrier phase tracking in the railway environment, to enable use of carrier phase measurements as possible monitoring techniques;
- c. Definition and Development of Data Fusion algorithms among different possible technologies such as for example EGNSS, IMU, Kinematics, Digital Map suitable for providing a safe position in the position domain along with the associated integrity (e.g. accuracy, integrity risk, confidence interval along the track, time to notify alerts to the consumer of the position information);
- d. Select candidate techniques and algorithms for the implementation of a Proof of Concept;
- e. Specify (including respective safety analyses), design and develop a Proof of Concept implementing the selected techniques and algorithms;
- f. Test and assess performances in a real or simulated railway environment;
- g. Independent Assessment Report, done by a Notify Body, on the developed Proof of Concept;
- h. Contribution to the definition of the Railway Minimum Operational Performance Standards and the trade-off analysis about the use of the Standard SBAS (e.g. EGNOS) augmentation systems.

Expected TRL: 3

An indicative scheduling of the deliverables is suggested below⁵³:

- Deliverables under work-stream 1 is expected by M20. Deliverables under work-stream 2 is expected by M12.

The S2R Joint Undertaking considers that proposals with a duration of 30 months would allow this topic to be addressed appropriately. Nevertheless this does not preclude submission and selection of proposals with another duration.

COMPLEMENTARITY

As specified in section 2.3.1 of AWP 2020 in order to facilitate the contribution to the achievement of the S2R JU objectives, the options regarding 'complementary grants' of the S2R JU 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 JU Grant Agreements.

The action that is expected to be funded under this topic will be complementary to the actions that are expected to be funded under the following topics:

⁵³ 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

- S2R-CFM-IP2-01-2020: Completion of activities for Adaptable Communication, Moving Block, Fail safe Train Localisation (including satellite), Zero on site Testing, Formal Methods and Cyber Security

The action stemming from this topic will also be complementary to actions carried out within the following projects:

- X2RAIL-3 (GA 826141)

EXPECTED IMPACT

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

- Improvement of the technical coherency of the Moving Block system specifications being defined within the action from the S2R-CFM-IP2-01-2020. Thus improving the process of application of Moving Block signalling. Moving Block signalling in turn will contribute towards increased capacity (up to 50% for high speed and freight most notably), reduced life cycle costs, and improved reliability, depending on the type of railway.

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

- Improved knowledge regarding the application of RAIM algorithms in Railway and on the performance achieved with the use of the standard SBAS augmentation systems.

Type of Action: Research and Innovation Action (RIA)