

## **S2R-OC-IP2-01-2018 - Analysis for Moving Block and implementation of Virtual Coupling concept**

### Specific Challenge:

In the framework of the technological developments foreseen within the Innovation Programme 2 of Shift2Rail Master Plan, the application of the most advanced Train Separation systems like Moving Block or other new systems based on Train Centric solutions, are seen being one of the most effective and promising technologies to increase line capacity reducing the trackside life cycle costs due to less train detection systems to be installed.

The challenge is to boost innovative and cost-efficient technologies and systems for railway signalling while, at the same time, achieving a level of safety consistent with methods and standards to be applicable in all railway segments.

### Scope:

The aim of the work should be:

- To identify and assess the most suitable methodology in order to test and bring into service Moving or Fixed Virtual Block contributing to the definition of the Operational Procedures and highlighting the differences with the traditional signalling systems.
- To analyse the potential business and market response thanks to the application of the Virtual Coupling concept identifying pros/cons in terms of performance and cost. To investigate new kind of Train-to-Train (T2T) communication solutions, getting ideas from other domains (e.g.: automotive), in order to perform the needed functions required by Virtually Coupled Train Sets project.

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 Moving Block technologies (linked with TD2.3 of the Multi Annual Action Plan) the activities are expected to cover the following points:
  - a. Starting from the current signalling architecture (with a particular focus on trackside detection system), define approaches to the testing of Moving Block signalling systems, including consideration of how much testing must be performed on site, and how much testing can be performed in the office.  
This work should be performed in collaboration with work within the Action stemming from the call S2R-CFM-IP2-01-2018, addressing TD2.6 and S2R-CFM-IP2-01-2015 (X2RAIL-1).
  - b. Provide feedback on the Moving Block Operational and Engineering Rules, to highlight differences from traditional signalling systems, and propose changes, which might result in easier application of Moving Block “signalling systems” or their evolution to a different traffic management approach.
2. In the framework of the introduction of the Virtual Coupling concept (linked with TD2.8 of the Multi Annual Action Plan) the activities are expected to cover the following points:
  - a. Produce the Business Case analysis for the application of the Virtually Coupled Train Sets VCTS concept. The activity has to identify:
    - i. The potential markets, which can be interested to introduce VCTS (Main Lines, High Speed Lines, Urban/Suburban, Regional Lines, Freight).
    - ii. For each of the above market segments is requested to provide the cost/effective analysis assessing the potential benefits of VCTS application, from the point of view of an Operator, highlighting pros/cons in terms of performances (e.g.: line capacity improvement, passengers increase, CAPEX

- and OPEX reduction) compared with the traditional train separation system (Fixed and Moving Block).
- iii. For each of the above market segments is required to provide the expected roadmap for the introduction of VCTS focusing the main business and market actions, which are deemed necessary in order to foster the application of VCTS. The activity should make assumptions in terms of cost identifying the foreseen trade-off between the start-up cost of R&D and of the potential implementation vs the positive returns thanks to the application.
  - iv. For each of the above market segments to identify the potential risks in terms of business due to the introduction of VCTS providing also the related actions, suggestions, mitigations in order to overcome the potential obstacle and achieving the objective.
- b. Investigate the use of new communication structure in agreement with IP2 and IP1 CFM complementary actions for allowing the communication between trains within the train convoy. The activity has to:
    - i. Analyse the up to date radio communication wayside and/or on board infrastructures able to provide the full data exchange between trains. The activity has to analyse pros/cons of each communication technology in terms of real time domain, throughput, reliability, availability, cost, applicability to the specific domain in relation with the requirements that will be defined by the complementation Action stemming from the call S2R-CFM-IP2-01-2018.
    - ii. According to the above analysis and for each market segment, select the most suitable communication structure providing the evidence (with a theoretic but rigorous approach) of the goodness of the choice. The analysis has to provide an in depth study for demonstrating the real effectiveness of the solution with regards the compliancy of the requirements that will be defined by the complementation Action stemming from the call S2R-CFM-IP2-01-2018.
  - c. Investigate the application, solutions and dynamics of automated car driving currently in order to evaluate the applicability in the railway field. The study has to analyse similarities between automotive and railway fields and to provide insights highlighting the part of the railway system that can take advantage from the application of systems, sensors, functions, procedures coming from the automotive domain.

The action that is expected to be funded under this topic will be complementary to the actions 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
- S2R-CFM-IP1-02-2018 Implementing new technologies for the TCMS
- S2R-CFM-IP2-01-2015 Start-up activities for Advanced Signalling and Automation Systems (X2RAIL-1).

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<sup>37</sup>:

- Deliverables of work stream 1 are expected to be available as specified below:
  - Moving Block signalling system test strategy – M12

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<sup>37</sup> 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.

- 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 assemble 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.