

S2R-OC-IP5-01-2018: Radio communication and simulation of train dynamics for Distributed Power within long trains

Specific Challenge:

Long trains up to 1,500 m with distributed traction units enable operators and infrastructure managers to increase competitiveness and capacity of railway system rapidly. Distributed Power Systems (DPS) steering multiple traction units within 1,500 m trains need:

1. efficient and reliable technologies to transmit traction and braking commands between locos, and
2. simulation-driven traction and braking regimes which optimize upcoming in-train-forces and follow an integrated safety management.

Within the challenges highlighted in the IP5 part of the S2R Master Plan, the following specific challenges should be addressed by the proposal in answer to this topic:

1. The challenge in **Radio communication for long trains** is to develop and implement a GSM-R-based radio communication system for Distributed Power systems (DPS) in freight trains and to demonstrate it in trial runs up to 1,500 m train-length.
2. The challenge in **train dynamics simulation** is to identify upcoming and tolerable in-train-forces in different operational scenarios and to integrate this into a safety assessment of the operation of long trains.

The consortium should bring experience in the field of both hardware and software for both work streams.

Scope:

The activities should address the following elements, in line with the Shift2Rail MAAP:

The work expected in work stream 1 concerning **Radio communication for long trains** should include:

- Design and standardisation of a GSM-R-based signal transmission technology for DPS in long freight trains up to 1,500 m
- Development and testing of a GSM-R-based radio communication system integrated in DPS for long freight trains incl. Hardware and Software components
- Integration of the radio system on two locos for the demonstration of the DPS in 740 m trains in 2019
- Integration of the radio system on up to four locos for the demonstration of the in 1,500 m trains in 2020

This work stream should consider the work carried out in previous research projects.

The work expected in work stream 2 concerning **train dynamics simulation** should include:

- Simulation of upcoming and tolerable in-train-forces within trains up to 1,500 m and up to four distributed locos
- Deduction of optimal traction and braking behaviour of DPS within dynamic operational scenarios of 1,500 m trains
- Execution of an integrated safety assessment of in-train-forces

The consortium shall be able to:

- Demonstrate the integration of the radio system into existing locos of industry partners of the project FFL4E (S2R-CFM-IP5-03-2015)
- Demonstrate a fast and reliable communication between two locos within one 740 m train and up to four locos within one 1,500 m train
- Demonstrate the compliance of the radio system with reliability and availability requirements derived from train dynamics simulation
- Standardise and homologate the used radio protocols in a way that communication of radio systems of different suppliers within one train is ensured
- Make use of TrainDy for simulation which is validated and certified to ensure the acceptance of simulation results by Railway Authorities (this is an advice in order to maximise the compatibility of results with the complementary projects).

The proceeding of S2R-OC-IP5-01-2018 must continue the outcomes of the project FFL4E (S2R-CFM-IP5-03-2015). The results of S2R-OC-IP5-01-2018 must be aligned – regarding timing and content – with the corresponding work and targets of S2R-CFM-IP5-01-2018 in order to achieve the overall goals of IP5. The Open Call consortium shall design its planning according to the long-term roadmap of the running consortium FFL4E (S2R-CFM-IP5-03-2015).

The expected result of both work streams to provide a system integration in a relevant environment (TRL 5).

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:

- S2R-CFM-IP5-03-2015: Freight propulsion concepts
- S2R-CFM-IP5-01-2018: Technology demonstrators for competitive, intelligent rail freight operation

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.

The S2R JU considers that proposals requesting a contribution from the EU of around €0.5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude the submission and selection of proposals requesting other amounts.

Expected Impact:

The research activities shall contribute to:

- The development of new business cases through doubling of train lengths in rail freight up to 1,500 m based on Distributed Power technology
- Efficiency gains and strengthening of the modal competitiveness through unmanned operation of one or multiple slave locomotives in the train consist

Specific metrics and methods to measure and achieve impacts should be included in the proposals, with the objective to achieve by the end of the S2R Programme the quantitative and qualitative targets defined in the S2R MAAP related to TD5.5 in line with the relative planning and budget.