

## S2R-OC-IP2-03-2018 - Communication environment assessment and validation

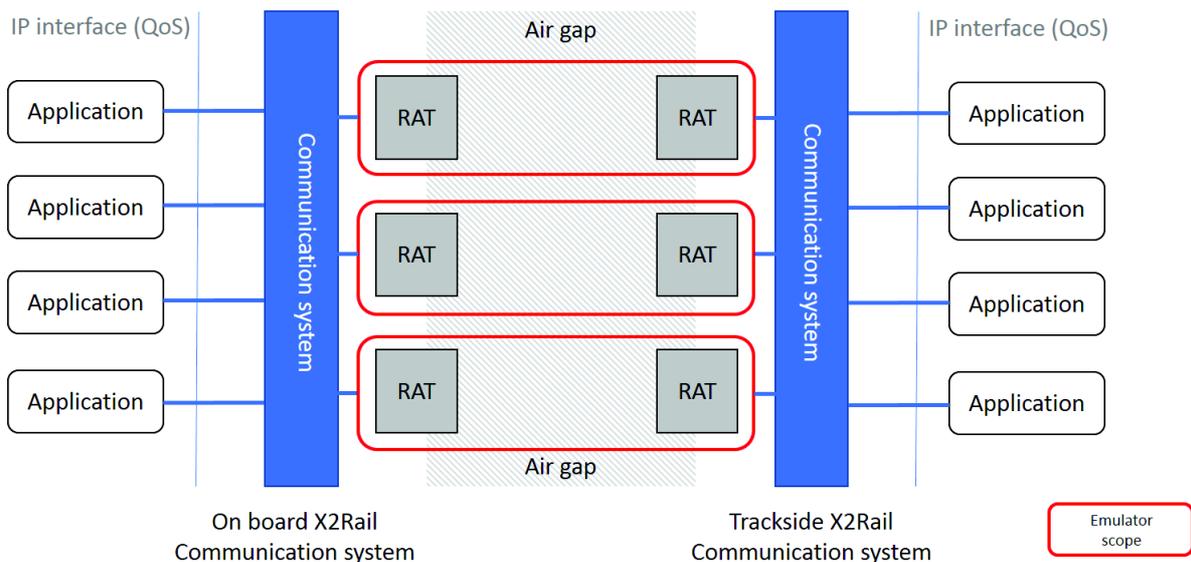
### Specific Challenge:

In the context of the IP2 adaptable communication technology demonstrator the development of the prototypes relies on comprehensive testing and validation activities. These activities shall also cover test scenarios to verify the functionality and capabilities of the adaptable communication system with multiple radio access systems and reproduce the railway environment including radio link perturbations, overload scenarios and other events, which impact the communication bearer and ultimately the applications.

To avoid the complex and expensive installation and operation of various real radio access equipment in the development labs the outlined test campaigns shall rely on a radio access emulation, which can act as flexible, configurable and programmable laboratory tool supporting the end-to-end validation and verification activities.

Scope: The proposed activity should address the following domains and functional areas in line with the goals of the adaptable communication system technical demonstrator defined in TD2.1 of the Shift2Rail Multi-Annual Action Plan (MAAP):

The radio access emulator shall support multiple emulation instances of one or more access networks, including but not limited to LTE, LTE-Advanced, GSM-R, 5G, WiFi/802.11, SatCom networks.



The emulation of each bearer (marked red in the diagram above) shall support configurable and programmable parameters for typical communication perturbations perceivable at the radio system interfaces, including packet delay, packet error, average/maximum/guaranteed throughput, latency, jitter and packet loss. The emulation of each channel shall support programmable sequences of parameter changes over time (1s granularity) to validate the communication for specific environment use cases or railway scenarios (train in tunnel, train passing hilly terrain ...) and differentiate between uplink and downlink transmission in both nominal and degraded mode.

It is required to have support for QoS profile requests by different applications per radio channel, in order to verify behaviour with multiple concurrent applications at the same time.

The interface to the adaptable communication system (network/terminal) should be based on the relevant standardized interfaces (at a minimum and plain IP interface, for 3GPP access emulators the IP bearer should be offered by the Gi network interface and other relevant 3GPP control interfaces).

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

- a. Analysis of communication characteristics perceivable by the applications and services using the communication bearer (like throughput, packet loss, jitter etc.).
- b. Assessment of communication capabilities of existing radio access networks (including LTE, LTE-A, 5G, GSM-R, WiFi/802.11, SatCom etc.) and how these could be emulated.
- c. Investigation of communication scenarios covering degraded modes, outages, overload scenarios, interferences and other perturbations with occur in the railway environment or can be expected in the future.
- d. Definition of elements which should be variable, configurable and programmable in the radio access emulation tool.
- e. Design and implementation of the radio access emulation tool.
- f. Support for integration of the radio access emulation tool in the verification labs.

For the avoidance of doubt, it is not required to simulate the internal functions of the radio access networks and related air gap specifics, including but not limited to resource management, prioritization, hand overs or interferences, distortion, other radio perturbations. Only the resulting implications perceivable at the external interfaces of the emulation should be covered by the test & validation tool. In other words, the action should provide a fully functional and comprehensive radio access emulation tool in line with the aforementioned functional requirements and not a radio access simulation tool.

The activity is complementary and closely linked to the work of the Action stemming from the call S2R-CFM-IP2-01-2018 "Advanced Signalling and Automation System". The main deliverable of this activity provides a radio access emulator and is expected to be used during the test and validation tasks within the Action stemming from the call S2R-CFM-IP2-01-2018. Hence, the radio access emulator should become available for the project related to S2R-CFM-IP2-01-2018 latest 12 month after start of the activity, as per indicative scheduling here below.

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>39</sup>:

- Deliverable of work stream "a" are expected to be available by M3;
- Deliverable of work stream "b" are expected to be available by M4;
- Deliverable of work stream "c" are expected to be available by M5;
- Deliverable of work stream "d" are expected to be available by M5;
- Deliverable of work stream "e" are expected to be available by M12;
- Deliverable of work stream "f" are expected to be available by M15;

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<sup>39</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.

Expected Impact:

Actions will contribute to the development and testing activities for the adaptable communication system for all railway technology demonstrator (TD2.1) in IP2. In detail it will help to

- Reduce the complexity and linked costs during testing and validation of the communication prototypes within the TD2.1 activities with the usage of emulation instead of installing and operating real radio equipment
- Deliver radio access emulation to simplify the testing and contribute to the cost reduction targeted by the TD2.6 zero on-site testing activities.
- Support the development and help to deliver more reliable and robust prototypes with the ability to emulate various critical conditions, even ones which occur very rarely

Type of Action: Research and Innovation Action