5G PPP PHASE 3, PART 4: COMPLEMENTARY PROJECT

5G-DRIVE

Concept and objectives

5G-DRIVE aims to bridge current 5G developments in Europe and China through joint trials and research activities to facilitate technology convergence, spectrum harmonisation and business innovation before the large-scale commercial deployment of 5G networks occurs. 5G-DRIVE will realize this jointly with its Chinese twin-project "5G Large-scale Trial", which is running in parallel, and with both projects interacting and cooperating in order to achieve their joint objectives. 5G-DRIVE will develop key5G technologies and pre-commercial testbeds for eMBB (enhanced Mobile Broadband) and V2X (Vehicle-to-Everything) services. Specifically, 5G-DRIVE will trial and validate the interoperability between EU and China 5G networks operating for eMBB and V2X scenarios.

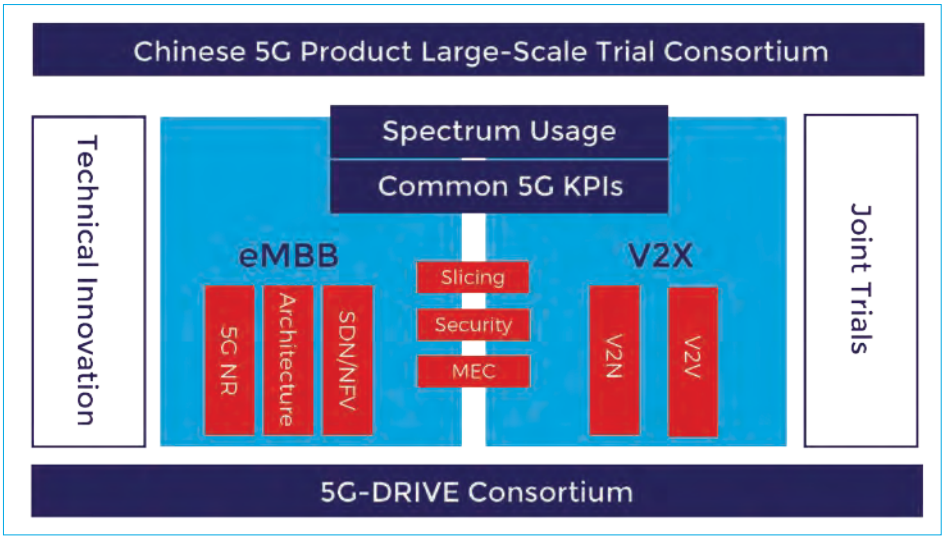

Fig. 41: 5G-DRIVE concept

5G-DRIVE's specific objectives are organised into three main areas: technical, regulatory and business. The technical objectives focus on researching and developing eMBB and V2X technologies and services and trialling them based on pre-commercial end-to-end testbeds in three EU locations (Surrey, Joint Research Centre (JRC) Ispra and Espoo);

analysing potential system interoperability issues in Europe and China, and provide joint reports, white papers and recommendations to address them accordingly; and submitting joint contributions to 3GPP and other 5G standardisation bodies regarding the key 5G technologies developed and evaluated in the project. The regulatory objectives focus on evaluating spectrum usage at 3.5GHz for indoor and outdoor environments in selected trial sites, and investigating regulatory issues regarding the deployment of V2X technologies. Lastly, the business objectives focus on investigating and promoting 5G business potential; strengthening industrial 5G cooperation, and promoting early 5G market adoption.

eMBB development and test plan

In the eMBB scenario, 5G-DRIVE aims to build pre-commercial end-to-end (E2E) testbeds with sufficient coverage to evaluate the performance of eMBB on the 3.5 GHz spectrum band. The building of such testbeds is to allow the testing of 5G NR (New Radio) with a focus on eMBB using close-to-commercial equipment in realistic settings that can reproduce near real-life network performance. The trialling activities will use the 5G trial and testing pre-commercial network trials framework provided by the NGMN (Next Generation Mobile Networks) Alliance.

For eMBB, the trials to be deployed will cover three scenarios: indoor hotspots, focusing on high user density and high capacity/throughput in indoor small coverage areas; dense urban areas, focusing on high user density and high traffic loads in city centres with outdoor coverage scenario, and indoor hotspots, focusing on continuous coverage in urban areas and macro cells. The trials conducted will be in either the SA (Stand Alone) or NSA (Non-Stand Alone) architecture.

The eMBB trial activities will be carried out at three sites. JRC (Ispra, Italy) will focus on the performance characterisation of commercial 5G NR base stations delivering eMBB services in the 3.5 GHz band; the VTT 5G testbed (Espoo, Finland) will facilitate the testing of SDN/MEC, indoor positioning, latency reduction, reliability, among others; the 5G Innovation Centre (Surrey, UK) will focus on the evaluation of eMBB, including 5G service with controlled latency to support AR services across two regions.

The methodology used for the eMBB trial measurements includes an initial specification of the technical requirements and respective system functionality to support the eMBB use cases. It also includes the definition of Key Performance Indicators (KPIs) to measure the success criteria of system functionality and to determine test network setups for validating the eMBB use cases. The test measurements and analysis of results for each setup will be realised according to 3GPP recommendations. The main KPIs to consider in the analysis include peak data rate, user experienced data rate, cell-edge user data rate, user plane latency, control plane latency, cell capacity, spectral efficiency, coverage, mobility, reliability and area traffic capacity. These KPIs will be tested at one or more of the eMBB trial sites.

Trial results will be analysed within the 5G-DRIVE project and together with the Chinese twinning project, in order to assess and validate the interoperability.

V2X development and test plan

In the V2X scenario, 5G-DRIVE aims to demonstrate 5G technologies at pre-commercial testbeds with V2X services and then demonstrate Internet-of-Vehicle (IoV) services using Vehicle-to-Network (V2N) and Vehicle-to-Vehicle (V2V) communications. The demonstrations will be carried out through different trials with the objective of testing 5G network capabilities to deliver ultra-reliable lower-latency communication (URLLC) for self-driving scenarios. They will also aim to validate 5G KPIs in terms of bandwidth, latency and communication coverage in different scenarios and pilot sites as well as to evaluate V2V and V2N communications resilience against cyber/RF attacks and interference under real-life conditions.

The V2X scenario trials will be carried out in three phases. The trial setup and preparation phase will define and specify the trial environment, the trial scenarios and the evaluation methodology. The execution phase will provide a description of the methodology to implement and coordinate the execution of the trial. The evaluation phase will evaluate the results of the trials and deliver conclusions about the benefits and challenges of using 5G in the context of V2X scenarios. The information in these three phases is specific to the activities of each trial site.

To evaluate the potential benefits of 5G on V2X scenarios, trials scenarios will be carried out at two pilot sites: Espoo (Finland) and JRC (Ispra, Italy), each trial site having complementary objectives.

Trials at Espoo aim to demonstrate 5G benefits for the automated driving use case and will be done in three phases: setting up the V2I devices (LTE and ITS-G5) on the cars and drive baseline data for identifying latencies and bandwidth capacity; implementing C-V2X devices (LTE Uu, release 14) to two different cars operating on the 2.6 GHz and 5. GHz band; and implementing C-V2X devices (LTE, release 15/16) which are operating on the 5.9 GHz band, depending on the availability of communication modules. The aim is to understand eMBB, URLCC and also slicing feature opportunities when proceeding forward with real 5G networks.

The trials at Ispra aim to evaluate the co-existence of ITS-G5 and LTE-V2X and will focus on the experimental evaluation of V2X scenarios both at the laboratory and field test levels. V2X testing will address two scenarios: on-the-field C-ITS service demonstration and LTE-V2X/ITS-G5 coexistence in the 5.9GHz band. The former one aims to demonstrate a selected day-1 C-ITS service using ITS-G5 and LTE-V2X equipment. The demonstration will involve a non-automated vehicle, two roadside units (one LTE-V2X, one ITS-G5) and two on-board units (one for each V2X technology). The latter one will evaluate the "out-of-the-box" coexistence of commercial off-the-shelf ITS-G5 and LTE-V2X devices. This particular demonstration will involve the conducting of a subset of the RF compliance tests and the characterization of the co-channel interference of each technology by evaluating the same RF metrics in a joint ITS-G5/LTE-V2X deployment.

The V2X demonstrations will combine two main types of testing. At the Espoo site, vehicles will drive in a real environment, while at Ispra, testing will be done in a controlled environment, based on harmonised standards. This combination intends to provide the required diversity of testing for evaluating the suitability and benefit of 5G for V2X scenarios.