5G PPP

5G-DRIVE

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FINAL RESULTS

5G-HARMONISED RESEARCH AND TRIALS FOR SERVICE EVOLUTION BETWEEN EU AND CHINA

5G-DRIVE

eMBB DEVELOPMENT AND TRIALS RESULTS

RESULT #1

5G NSA basic performance trials have been successfully conducted by **University of Surrey** at 5GIC trial site (Surrey, UK), **VTT** at Espoo trial site (Espoo, Finland) and **Orange** at Warsaw trial site (Warsaw, Poland) over 3.5 GHz by 5G-DRIVE partners. Moreover, joint 5G NSA/SA basic performance trials have been done together with 5G-DRIVE Chinese twin project partners over 2.6 GHz in China. Based on the current achieved trial results, 5G SA offers better basic performance than NSA in terms of both data rate and control plane latency, however this comparation may including the factors caused by various tested UEs.

RESULT #2

A set of new network slicing KPIs (proposed by **Orange** in 5G-DRIVE research work package) with focus on parameters which are related to network slicing in an agnostic way, have been tested through experiments using complex and resource-demanding slice templates. It is shown that slice deployment and termination time can be impacted by several factors. The proposed KPIs and the conducted tests can serve as a starting point for further assessment and research related to MANO performance.

RESULT #3

A service level joint demonstration between **OTE** and **ORION** has been established based on the integration of the ORION developed services and VNFs, namely the vCache, in the OTE trial testbed. Various modifications on the SDN control plane have been enforced in order to verify the proper service of the VNF and evaluate its performance.

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V2X DEVELOPMENT AND TRIALS RESULTS

RESULT #1

For the experimental evaluation of co-channel coexistence method C in ETSI TR 103 766 using commercial ITS-G5 and LTE-V2X devices, results showed that to a certain level, ETSI method C contributed to reducing PER in the commercial ITS-G5 receiver compared to PER values observed under an LTE-V2X interfering signal. Experiments results of the impact of ITS-G5 signals on the performance of the Semi-Persistent Scheduling (SPS) algorithm running in the MAC layer of commercial LTE-V2X devices, showed that SPS achieved a PER in the LTE-V2X receiver close to 0% and a very stable Inter-Packet Gap distribution for all interfering signals at the expense of increasing end-to-end packet latency.

RESULT #2

Laboratory experiments of frequency jamming on ITS-G5 (non commercial grade prototyping equipment), showed the impact of the jamming source power and its placement on performance while considering the distance between communicating devices. The laboratory experiments using OpenC2X of a Misbehaviour Detection System (MDS) to detect grey hole attacks, evaluated the impact of radio interferences on the accuracy of MDS and enhanced its resilience.

RESULT #3

The field trial results of a day-1 C-ITS service in the JRC Ispra campus using commercial ITS-G5 and LTE-V2X devices, illustrated the different trade-offs between key performance metrics of commercial ITS-G5 and LTE-V2X devices. Overall, field tests results suggested a more robust performance of the LTE-V2X PHY and MAC layers than those of ITS-G5 devices at the expense of increasing end-to-end latency.

RESULT #4

The importance of accurate and reliable hybrid positioning messaging for C-V2X, particularly in challenging satellite visibility environments, was validated through the hybrid navigation tests. These tests also showed the benefits of multi-sensor positioning systems using C-V2X communication to complement the positioning quality.

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5G TECHNOLOGIES AND SERVICE INNOVATION RESULTS

RESULT #1

In the area of Radio Access Technologies there have been made a research on beam squint exploitation in millimetre-wave multi-carrier systems; 3D beamforming evaluation; orthogonal-SGD based learning approach for MIMO detection over URLLC; correlation-based dynamic task offloading for user energy-efficiency maximisation; distributed learning-based edge traffic offloading in 5G networks and beyond and on distributed learning framework for the resource orchestration in computation offloading.

RESULT #2

In the area of RAN transport, the phase-modulated Radio over Fiber for efficient 5G fronthaul uplink; flexible and efficient fronthaul by incorporating a combined multiplexing technique solutions have been proposed; moreover, a comparison of DSP-assisted analogue 5G fronthaul approaches has been made.

RESULT #3

In the area of network virtualisation and slicing, the RAN slicing approaches have been analysed, and it has been proposed implementation of network slicing in O-RAN as well as the O-RAN, network slicing, SON and MEC integration; the AI-driven RAN resource orchestration for multi-tenant RAN slicing, and the performance of Deep Packet Inspection function implemented as VNF has been evaluated.

RESULT #4

In the area of security and personal data protection in future 5G vehicular networks, the security and personal data protection challenges in IoV within the 5G ecosystem have been identified by analysing relevant legal frameworks in the EU and China. Furthermore, an overview of the international standards and recommendations was performed. The proposed technical solutions include a situation-centric and dynamic pseudonym changing strategy; a privacy-by-design approach; a situation-centric and dynamic misbehaviour detection system; an SDN-Based privacy protection framework for 5G vehicular networks; a blockchain for cooperative location privacy preservation, and a blockchain-SDN based architecture for 5G-enabled vehicular fog computing.

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EU-CHINA JOINT ACTIVITIES

TECHNICAL COORDINATION

Regular coordination and technical alignment with the Chinese Twin Project on joint trial planning, trial execution, result analysis and preparation of joint publications.

EXAMPLE OF JOINT TRIALS

Massive MIMO 3D beamforming techniques have been evaluated through both field trial and calibrated with theoretic analysis by University of Kent together with 5G-DRIVE Chinese partners. It was found, for 3D beamforming, in a typical building with a medium distance from gNB, good coverage performance can be achieved in all the low, medium and high-rise floors.

The field trial results of the joint EU–China trials performed in Tampere, Finland, and in Shanghai, China, under the joint EU-China V2X trial harmonised framework of the 5G-DRIVE and 5G Large-Scale trial projects, showed that parallel comparison in many ways, such as trial use cases, trial specifications and assessment methodology (i.e., jointly defined KPIs: end-to-end latency and Packet Error Rate (PER)) were encouraged and operable in field trials. The KPIs of latency (mean) showed similarity: around 15 ms to 25 ms in the joint trials in Shanghai and around 30 ms in the joint trials in Tampere. The PER were both below 10% which met the target requirement when LTE-V2X devices are within communication range.

DISSEMINATION JOINT ACTIVITIES

1) Joint Kick-off event, featuring the Ceremony of Signature of the Cooperation Agreement (2018)
2) Digital Around the World - Joint EU-China Cooperation Workshop (2020)
3) 7th Global 5G Event - Collaborative Presentation from the Coordinators on both sides (2019)
4) IEEE ICC Conference 2019 (Shanghai) Joint workshop
5) Two Presentations @IEEE 5G for CAM 2021 and a Runners-Up paper award
6) EuCNC 2021 Special Session on EU-China Collaboration and Virtual Exhibition

Among the different joint events attended and participated, also joint publications were developed between 5G-DRIVE partners and the Chinese Twin Project.

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