Next-generation communications for V2X applications

Paper ID# 350
Dr. Meng Lu* (Dynniq, The Netherlands), Robbin Blokpoel (Dynniq, The Netherlands), Dr. Jaime Ferragut (European Commission – Joint Research Centre), Dr. Matti Kutila (VTT, Finland), Dr. Tao Chen (VTT, Finland)

Introduction
The paper targets Internet of Vehicles (IoV) based on Long Term Evolution Vehicle-to-Everything (LTE-V2X) using the 5.9 GHz band for Vehicle-to-Vehicle (V2V) and the 3.5 GHz band for Vehicle-to-Network (V2N).

Main objectives
- To test and demonstrate the latest 5G key technologies in pre-commercial 5G networks
- To study key innovations in network slicing, network virtualisation, 5G transport network, edge computing and 5G NR features
- To stimulate EU-China 5G collaboration
- To investigate the robustness and performance of 5G technologies considering automated vehicles

V2X use cases and KPIs
- GLOSA KPIs: 1) Packet Error Rate (PER): ratio of unsuccessfully received packets in the OBU vs. total number of packets sent by the RSU (%); 2) Latency: the radio access network contribution to the total elapsed time, measured from the instant the RSU sends a packet to the moment when the OBU receives it (ms).
- Collaborative Awareness KPIs: 1) Signal Phase and GLOSA KPIs: 1) Packet Error Rate (PER): ratio of unsuccessfully received packets in the OBU vs. total number of packets sent by the RSU (%); 2) Latency: the radio access network contribution to the total elapsed time, measured from the instant the RSU sends a packet to the moment when the OBU receives it (ms).
- Intelligent Intersection KPIs: 1) PER (see above); 2) Latency (see above); 3) Total active stations: this KPI tracks how many other stations were active at the same time while in communication range of the test subject; 4) Total channel load in MB/s: The total load of the channel is an important contextual variable to determine how much interference can be expected; 5) Total messages/s on channel: One other client using a load of 1MB/s has much less chance of packet collisions than a hundred clients transmitting at 10 KB/s.

Architectures and Trials

Preliminary results
The network is LTE based, operating in BAND 38 (2575 - 2615 MHz). The site is also equipped with ITS G5 devices for capturing reference performance indicators.

Discussion and Conclusion
When the signal level is -90 dB basically, the network becomes useless for transport and automated driving needs where coverage and low latencies are critical to guarantee safe and remotely supervised real-time driving. LTE-V2X has inherent limitations in bandwidth, latency and reliability to support new features, particularly automated driving in V2X applications. Communication requirements for automated driving will be substantially more challenging.

Acknowledgements
The paper presents some preliminary results of 5G-DRIVE (HarmoniseD Research and Trials for service Evolution between EU and China), which is funded by the European Commission Horizon 2020 Research and Innovation Framework Programme, under Grant Agreement No. 814956. The authors would like to thank other consortium partners for their kind support.

More information
Dr. Meng Lu
Dynniq Nederland B.V. , The Netherlands
Phone: +31 6 4505 4735
Email: meng.lu@dynniq.com
www.dynniq.com
5G-DRIVE web link: https://5g-drive.eu

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