Modelling and Examination of Collective Perception Service for V2X Supported Autonomous Driving

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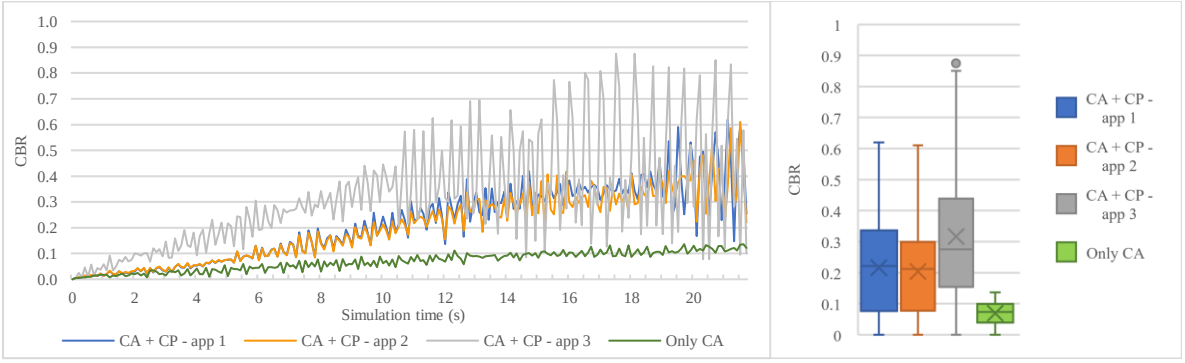
Cooperative V2X (Vehicle-to-Anything) communication is one of the core elements of the latest driver assistance/autonomous driving systems nowadays, through which the traffic participants can exchange information in real time with each other and the available infrastructure (Intelligent Transport System, ITS). Thus, the traffic participants do not have to use only their own perceptions of the environment to make a certain decision in a traffic situation, but also have the opportunity to use external originated data, which information could be hardly perceived or even totally unperceivable from their own perspective. Collective Perception Service (CPS) [1] is a Day 2 V2X service which can be used by an ITS-Station (ITS-S) to share information about its environment with other ITS-Ss by providing data about perceived objects (e.g., vehicles, obstacles, pedestrians) and available free space which can be safely allocated by other ITS-Ss (e.g., in an overtaking maneuver). Collective Perception Message (CPM) used by CPS could include and share very rich sensor data like position, speed or dimension and even perceived objects and free space which describe the environment of the station around. Consequently, CPS reduces uncertainty of an ITS-S about the current environment, therefore supporting autonomous driving in the future [2].

With the growing penetration of V2X applications and V2X-capable devices the load on the used channel will also increase. Frequent exchange of sensor data representations with greater size demand like in case of CPS will further aggravating this problem. Therefore, simulation-based realistic modelling and examination of CPS and relating services is essential for further development of such advanced V2X solutions.

This article introduces our initial simulation results gathered from Artery-based [3] CPS and sensor models we designed and developed. This implementation was then deployed and measured in an environment with changing vehicular traffic and communication conditions and used in different traffic situations together with the mandatory and already deployed Day 1 service called Cooperative Awareness (CA) [4]. Our simulation results are focused on the Channel Busy Ratio (CBR), and showed that the quality of the provided CPS service degraded significantly when the two services were used simultaneously on the same channel, therefore motivating deployment efforts of the more sophisticated multichannel V2X operation. The diagrams below show CBR-Time values and boxplots about CBR values when only CA or CA and CP are used together modelling different V2X applications in scenarios with increasing number of vehicles.



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