5GAA

Automotive Association

Roadmap of monetisable features and business models for LTE V2X – timeline for introduction of LTE V2X (V2V)

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1. "Timeline for deployment of LTE-V2X (V2V/V2I)"

The inclusion of cellular communication technologies (V2N) into vehicles (i.e. "Connected Cars") has been extremely successful, and since early deployments in the last couple of decades, we continue to see an expansion of how these technologies can deliver benefits for the vehicle, the driver, and other participants in the transportation ecosystem.

At present, the automotive manufacturing members of 5GAA operate more than 20 million Connected Cars that have the ability to connect to cellular networks (V2N). This V2N connection is used for a wide variety of application domains including telematics, infotainment, traffic optimization, as well as for safety applications like the recognition of slow or stationary vehicle(s) and warnings for such events as traffic jam ahead, road works and other traffic infrastructure related information, inclement weather conditions, emergency brake light and other hazard warnings. The current understanding, also based on the European C-ITS Platform Final Report, is that the nature of these warning messages is informational and the driver is responsible at all times.

As defined in the approved 3GPP Release 14 in March 2017, cellular networks are able to take another evolutionary step in the pathway to broaden the reach and applicability of benefits. In particular, this release addresses the challenges of delivering increased data volume, managing greater scale in connected devices, significantly reduced latency and providing higher levels of reliability. These defined attributes and an advanced architecture provide unprecedented support for the support of safety-critical communications, referred to as Cellular Vehicle to Everything (Cellular-V2X or C-V2X). In addition to such V2N enhancements, which rely on existing cellular networks, 3GPP Release-14 introduces the ability to support short-range communications between vehicles (V2V) and vehicle and road side infrastructure (V2I and I2V) without requiring any cellular network coverage.

3GPP Release 14 including C-V2X is also a key step to the next generation of cellular technology, 5G, which includes support for vertical industries including automotive. Naturally C-V2X is already on a backwards compatible evolution path with enhancements being specified beginning with 3GPP Release 15.

As a whole, the members of 5GAA are committed to collaborating to ensure that the potential of the C-V2X technology is realized. This includes leading efforts to address key technical and regulatory issues, as well as integrating vehicle platforms with advanced cellular connectivity, networking and computing solutions.

It is with this cooperation, collaboration, and commitment that 5GAA members continue to work to ensure that C-V2X technology is tested, validated, and commercially available for vehicles beginning in 2021.

Because the C-V2X functionality can and will be included as part of the cellular chipsets embedded into vehicles for their V2N communications, we expect that there will be approximately 120 million connected vehicles on the road globally[1] that will be able to benefit from the higher level of traffic safety enabled by supporting the direct communication between vehicles (V2V), in addition to communication with road infrastructure and cloud ITS services (V2I, V2N) using a combination of short-range (LTE-V2X) and cellular technology. In addition to the benefit that the inclusion of C-V2X is evolutionary to the updating of cellular chipsets, there are also cost synergies that will ease the barrier to deployment.

As presently understood, we have included the timeline for the progression of the components of C-V2V in the picture below.
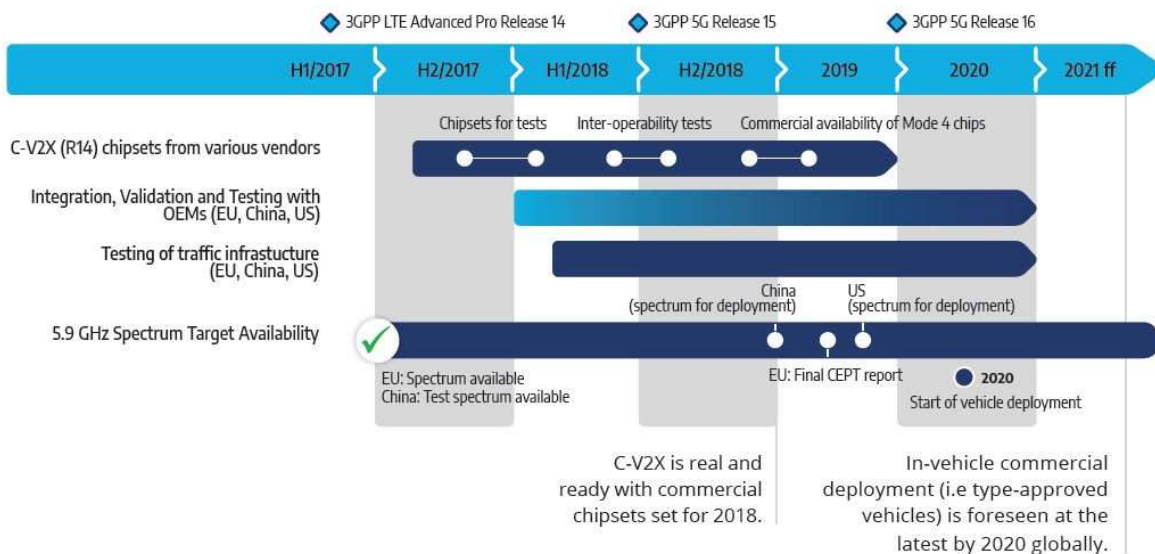
The 5 major chipset vendors CATT, Huawei, Intel, Qualcomm and Samsung which are members of 5GAA provide nearly all communication chipsets used in connected cars on our roads today. These vendors are committed to provide C-V2X chipsets. The new 3GPP rel. 14 chipsets will be made available for first tests by the end of 2017.

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The availability of these chipsets will coincide with planned validation and testing of the communication modules by vehicle manufacturers including supportive vendors Audi, CATT, Continental, Ford, SAIC, etc.[2][3] [4][5] Further testing including interoperability tests among chipset manufacturers and across vehicle manufacturers are targeted to be conducted by mid-2018.

The focus of this testing and validation aims to confirm the functional capabilities of C-V2X, and V2V communications in particular. These production oriented chipsets look to build on the successfully tested pre-standard versions in 2015 and 2016, which showed a measured technical advantage in all safety relevant parameters including speed, distance, scalability and reliability when compared to similar tests performed across V2V and V2I use cases over Wireless Access for Vehicular Environment (WAVE) / Direct Short Range Communication (DSRC) protocols (US), ETSI-ITS (EU) and CEN/ISO protocols.

These validation tests are an essential prerequisite to ensure a successful launch of the first commercial chipsets in the second half of 2018, which would coincide with the announcements made by Qualcomm[6] and Rohde&Schwarz[7].

To ensure that the chipsets can enable V2I and I2V communications, as well as the aforementioned V2V, we expect the parallel testing for the deployment of traffic related roadside units (RSUs) in Q1 2018. This will be driven in parallel with elaborating together with the road operators the benefits of the transmission of road operator relevant information via cellular networks to the drivers/vehicles; this would result in an immediate benefit for all traffic participants using cellular infrastructure, regardless whether it is fixed installed in the vehicle, or via smartphone, or aftermarket devices.

Vehicle manufacturers forecast starting production tests with the C-V2X V2V commercial chipsets and communication modules in 2019 to enable them to be on track for commercial deployments beginning of 2021.

In terms of regional deployments, 5GAA expects that the first commercial deployments will occur in China and Europe, but that deployments in the US and other parts of the Asia will follow.

5GAA would like to reinforce that C-V2X short-range communications for V2V and V2I will be first deployed in Mode 4, which will not require cellular network coverage to transmit or receive V2V or V2I communications. In commercial deployment, the combination of C-V2X short-range communication and long-range communication will maximize the benefit for ITS safety applications.

By deploying the communication stack of C-V2X instead of DSRC/802.11p the well-developed C-ITS framework will be reused maximising synergies. This also includes the Security Credential Management

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[2] https://www.qualcomm.com/news/releases/2017/09/01/qualcomm-announces-groundbreaking-cellular-v2x-solution-support-automotive

[3] https://www.qualcomm.com/news/releases/2017/10/31/att-ford-nokia-and-qualcomm-launch-cellular-v2x-connected-car-technology

[4] https://www.continental-corporation.com/en/press/press-releases/continental-invests-in-cellular-v2x-technology-and-announces-c-v2x-trials-96140

[5] http://www.datanggroup.cn/templates/T_NewContent/index.aspx?nodeid=51&page=ContentPage&contentid=6710

[6] http://www.prnewswire.com/news-releases/qualcomm-announces-groundbreaking-cellular-v2x-solution-to-support-automotive-road-safety-helping-to-pave-a-path-for-the-future-of-autonomous-driving-300512693.html

[7] https://www.rohde-schwarz.com/de/news-und-presse/pressebereich/pressemitteilungen-detailseiten/rohde-schwarz-supports-3gpp-cellular-v2x-device-testing-for-vehicle-to-vehicle-connectivity-pressemitteilungen-detailseite_229356-505411.html

System (SCMS) which will especially benefit from C-V2X including the distribution of security credentials, profiles and Certificate Revocation Lists (CRL) which will be available to be distributed via cellular networks.

One additional safety benefit of C-V2X is the additional support for Vulnerable Road User (VRU) collision avoidance. Due to the integration of V2N and V2P (vehicle to pedestrian) functionality. This ensures that a VRU can become visible to vehicles in a first step via V2N utilizing standard smart phone applications carried by the VRU (and will not require the integration of smartphones with C-V2X functionality) and potentially later, in a second step, via direct V2P communication between vehicles and VRUs.

C-V2X also has distinct capabilities that can be complementary to automated vehicle technologies and enable an enhanced experience and improved safety of highly automated driving. C-V2X offers a path in further 5G standardization to support significant increases in acceptable data transmission sizes that are paramount to automated vehicle technologies including the support for the exchange of:

- o Sensor data for collective perception (e.g., video data)
- o Control information for platoons from very close driving vehicles (only a few feet gap)
- o Vehicle trajectories to prevent collisions (cooperative decision making).

These enhancements are not possible in other V2V and V2I technologies such as DSRC.

5GAA notes that several regulatory decisions need to be made in order to start a commercial deployment of C-V2X, in particular, decisions around the use of the ITS or 5.9GHz spectrum. These decisions requested by region are:

- Europe: There needs to be an agreement on how the 5.9GHz band can be shared amongst technologies designed for the same purpose. These technologies will need to ensure that they can coexist in a technology neutral way as stipulated in the EU directives and described in the 5GAA safe harbour proposal
- China: The 5.9GHz spectrum allocated for testing needs to be extended to include commercial use and deployment which is expected during first half of 2018
- United States: The 5.9GHz spectrum which has been allocated to be used for DSRC needs to be made available for C-V2X traffic safety applications in alignment with the technology approach requested and supported by a large subset of the transportation ecosystem.

These changes when made will help ensure a smooth transition to 5G including the ability to leverage the benefits of C-V2X in scale, as early as possible. It also allows for further enhancements by future architecture and design decisions including network slicing, quality of service, edge clouds, and a plethora of innovation leveraging the C-V2X foundation.

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