NGMN Submission to US Department of Transportation during NPRM Process

by NGMN Alliance

Version:	**1.0**
Date:	**12-April-2017**
Document Type:	**Final Deliverable (approved)**
Confidentiality Class:	**P - Public**
Authorised Recipients: (for CR documents only)	

Project:	**Project V2X**
Approved by / Date:	**NGMN Board, 11th April 2017**

Commercial Address:
ngmn Ltd.,
Großer Hasenpfad 30 • 60598 Frankfurt • Germany

Phone +49 69/9 07 49 98-04 • Fax +49 69/9 07 49 98-41

Registered Office:
ngmn Ltd.,
Reading Bridge House • George Street • Reading • Berkshire RG1 8LS • UK
Company registered in England and Wales n. 5932387, VAT Number: GB 918713901

Abstract:

In the following sections, the NGMN V2X Task-Force team has outlined its feedback on the 'Notice of Proposed Rule Making of US Department of Transportation / NHTSA'. This feedback provides information on elements of NHTSA's proposed rules that are supported by NGMN as well as improvements and changes to other elements of the proposed rules.

As elaborated in the following sections, the NGMN V2X Task Force recommends USDOT be technology neutral in the rule making as cellular technologies beginning with 3GPP Release 14 could offer a technical and market-driven solution with a clear evolution path. We view this capability as a technology option that could be deployed well within the deployment horizon envisioned in NHTSA's proposal and also be compatible with 5G as that deployment matures. This solution appears preferable by many measures including better technical performance, improved cost-efficiencies, and its flexibility to adapt to a variety of business models.

Commercial Address:
ngmn Ltd.,
Großer Hasenpfad 30 • 60598 Frankfurt • Germany

Phone +49 69/9 07 49 98-04 • Fax +49 69/9 07 49 98-41

Registered Office:
ngmn Ltd.,
Reading Bridge House • George Street • Reading • Berkshire RG1 8LS • UK
Company registered in England and Wales n. 5932387, VAT Number: GB 918713901

Before the
Department of Transportation
Washington, DC 20590

Federal Motor Vehicle Safety Standards;	)	
V2V Communications	)	Docket No. NHTSA–2016–0126
	)	

COMMENTS OF NGMN

The Next Generation Mobile Networks Ltd (NGMN) hereby submits the following comments in response to the National Highway Traffic Safety Administration's Notice of Proposed Rulemaking in the above captioned proceeding.[1]

Respectfully submitted,

By: ngmn Ltd., Grosser Hasenpfad 30 • 60598 Frankfurt • Germany

Philipp Deibert
General Manager
Phone : +49 69/9 07 49 98-27
Email: philipp.deibert@ngmn.org

April 11, 2017

[1] Federal Motor Vehicle Safety Standards; V2V Communications, 82 Fed. Reg. 8 (proposed Jan 12, 2017) (to be codified at 49 CFR pt. 571). ("NPRM").

1 Introduction

The NGMN Alliance (see www.ngmn.org) was founded by leading international network operators in 2006. Its objective is to ensure that the functionality and performance of next generation mobile network infrastructure, service platforms and devices will meet the requirements of operators and, ultimately, will satisfy end user demand and expectations. NGMN is currently supported by more than 90 partners including the following US operators as NGMN Board Members: AT&T, Sprint, T-Mobile, US Cellular, Verizon, and Ligado Networks.

NGMN drives and guides the development of all future mobile broadband technology enhancements, focusing on 5G. Our activities are supported by the strong and well-established partnership of worldwide leading operators, vendors, universities, other industry players and by successful cooperations with industry organizations.

In 2016, NGMN extended its ongoing 5G-focused work program to include the development of a V2X Task Force, whose objective is evaluating V2X technologies and business opportunities and driving their adoption and success. V2X Task Force produced these comments below.

NGMN recognizes the work done by NHTSA, the automotive OEMs, research and standardization communities to invent, develop, test, trial (to scale) and ultimately standardize V2V safety communications. For over a decade, these organizations have worked to develop an end-to-end V2X solution based on DSRC with the goal to significantly improve motor vehicle safety and reduce fatalities, and have developed supporting USDOT sponsored Connected Vehicle pilots.

Likewise, public and private stakeholders in many countries are pushing to develop connected vehicle technologies, which align on similar principles to provide significant social,

industrial, and economic benefits. For example, DSRC based V2X trials are underway in Europe and Japan. It is important to highlight that no other government has established a V2V technology safety mandate at this point. In addition to the review of DSRC, many governments have recognized the continued development of cellular-V2X technologies (to be referenced as **C-V2X**), which include V2N, V2I, V2P, and V2V communications. C-V2X is a set of features currently supported by LTE, and is part of a clear and seamless evolution path into 5G. A USDOT mandate for specific V2V technology could prevent the US from benefitting from future auto safety and automated vehicle solutions.

3GPP (**3rd Generation Partnership Project, www.3gpp.org**), a collaboration established between global telecommunications standards development organizations, has developed C-V2X based on the device-to-device communication modes already available in 3GPP Release 12 for public safety services. In Release 14, 3GPP defines specifications for the C-V2X radio link (denoted as PC5 interface) performance that is superior relative to the DSRC/pWLAN specifications.

In the following sections, the NGMN V2X Task-Force team has outlined its feedback on the 'Notice of Proposed Rule Making of US Department of Transportation / NHTSA'. This feedback provides information on elements of NHTSA's proposed rules that are supported by NGMN as well as improvements and changes to other elements of the proposed rules.

As elaborated in the following sections, the NGMN V2X Task Force recommends USDOT be technology neutral in the rule making as cellular technologies beginning with 3GPP Release 14 could offer a technical and market-driven solution with a clear evolution path. We view this capability as a technology option that could be deployed well within the deployment horizon envisioned in NHTSA's proposal and also be compatible with 5G as that deployment matures. This

solution appears preferable by many measures including better technical performance, improved cost-efficiencies, and its flexibility to adapt to a variety of business models.

2 Use cases, proposal of applications

NGMN has carefully analyzed the applications developed and tested as part of the Safety Pilot Model Deployment and related standards (SAE 2945/1 and normative references to other IEEE and other SAE). To baseline, for all safety warning applications described in the SAE J2945/1, especially for the two applications IMA and LTA mentioned in the NPRM, the requirements were matched against the technical standards of 3GPP Release 14 for direct communication between vehicles. As a result, NGMN believes that all the referenced use cases can be implemented by using either DSRC or C-V2X/PC5 based connectivity [3GPP TR 22.885].

NGMN recognizes that during the past ten years substantial efforts were taken to develop and test these use cases based on DSRC technology, however we would like to note that cellular-based communication technology already has been widely deployed within vehicles (and is increasing in adoption), not only for information and entertainment purposes but also for the purpose of maintaining and increasing safety and security including software updates. We note that the cellular attach rate for newly manufactured vehicles in the North America market already has line-of-sight to achieving nearly 100% penetration. This includes a present state where automotive OEMs are effectively and increasingly leveraging cellular connectivity for updates ranging in size from 5 MB to 1 GB.

Furthermore, NGMN has already identified that some of the proposed V2V safety applications cannot be implemented effectively with DSRC technology. For instance, the DNPW application may require a higher distance range than what will be supported for DSRC BSMs (300 m), when vehicles are travelling at high speeds. As described in Chapter 5, C-V2X nearly doubles the communication range which can better address the DNPW at high speeds. It can also be

expected that currently proposed and future V2X applications may be implemented with significantly higher performance standards and would allow for a better experience if using C-V2X.

In addition, today's market has shown that some safety use cases have been already implemented utilizing cellular connectivity and related backend services. Examples in this area include, forward collision warnings based on crowd sourced sensor information of location and the speed of multiple vehicles (see for example commercial services at HERE, TomTom, Inrix et al.), and hazardous location warnings emanating from a backend service based on emergency brake lights or blocked lanes indicated by crowd sourced vehicle sensor information (see e.g. Daimler, V2X series product).

Those kinds of applications and their market success can be even accelerated and widened by a mandate. From the customer's perspective, the benefit of using cellular technology and backend services for safety applications in parallel to direct V2V communication may be achieved from day one, because the service is not strictly dependent on the availability of other cars as direct communication partners. As a result, the benefit of some use cases with regard to safety mentioned in the planed mandate, (1) FCW, and (2) EEBL, can be achieved much earlier if cellular technology is utilized.

Based on the continued penetration of cellular technology in vehicles, NGMN believes that V2X capabilities will naturally be introduced due to market forces, but would be accelerated by a mandate to increase the overall safety benefits. Therefore, NGMN recommends that the USDOT to mandate V2V communication, but no particular communication technology.

3 Privacy, security, and associated governance

Privacy and security are major components of the proposed V2V communication rule. Two major requirements have to be fulfilled, (1) integrity between the communicating vehicles or traffic infrastructure components, and (2) ensuring privacy which consists mainly of pseudo anonymization and non-traceability. The proposed SCMS relies on a PKI infrastructure.

Three aspects about the communication network are essential: (1) the availability / coverage of the network which makes sure that a vehicle receives data on time (2) the security of the underlying network itself, and (3) the capacity, cost and performance of the network. Cellular networks address all three of these major aspects today. In the US, more than 90% of major highways & roads are already covered by cellular network infrastructure. These cellular networks were built with the understanding of the critical nature of this infrastructure including awareness of needing the highest security standards. In addition, cellular network operators are continuously investing to improve capacity and coverage, ensuring both greater breadth and less network bottlenecks.

Developed by security experts over several years, the SCMS has managed to strike a good balance between various requirements [5G Americas, 2016, p. 21] and NGMN supports the approach as proposed. Cellular networks can be used to securely upload misbehavior reports and distribute certificates and Certification Revocation List (CRLs) in an efficient, reliable and cost effective manner without having the need to build out vast networks of DSRC based RSUs. V2V communications can also be secured by layering the IEEE 1609.2 standard on top of PC5 communications supported in 3GPP Release 14.

4 Rollout timeline

Tests with the pre-standard versions of the C-V2X modems have already been performed by OEMs, operators and vendors e.g. in the UK, Germany, China, and Hong Kong [2] [3] [4] [5].

These pre-standard version tests have already shown the effectiveness of C-V2X. These trials have used most of the applications developed for 802.11p/DSRC based communication, leveraging shim concepts, an abstraction of the communication stack technology used.

C-V2X supports different modes for V2V communications when in and out of network coverage. Like DSRC, Mode 4 of C-V2X enables vehicles to communicate with each other at low latency and over short distances without any network/operator involvement using the PC5 interface in the 5.9 GHz ITS band. Mode 3 leverages the capabilities of efficient spectrum management by one or multiple operators to improve system performance during traffic jam situations and inner-city rush hour traffic. With the growing number of vehicles to be equipped with cellular technology, one can expect to experience growing data traffic, and Mode 3 may offer additional benefits (see chapter 5).

With the final version of the standard released in March 2017, the modems that support C-V2X will become available in 4Q 2017. OEMs, operators, equipment suppliers and chipset providers, are actively developing roadmaps for testing & deployment of C-V2X including:

- Tests of first prototype implementations in vehicles and other equipment will begin in Q1/2018.

[2] https://www.telekom.com/en/media/media-information/archive/connected-cars-meet-next-generation-communications-tech-436104
[3] https://www.telecompaper.com/news/huawei-vodafone-demonstrate-cellular-v2x-with-audi--1186144
[4] http://www.huawei.com/minisite/hwmbbf15/en/lte-v.html
[5] ASTRI, HKT, Huawei and Qualcomm Technologies work together to build a smart mobility system for Hong Kong using Cellular-V2X technologies / http://www.huawei.com/en/news/2017/3/smart-mobility-system-HK-Cellular-V2X-technologies

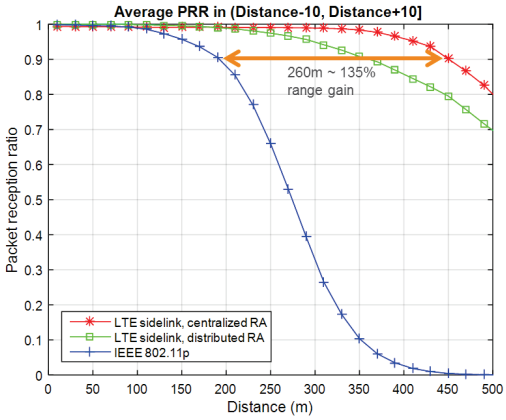
- After pre-deployment tests in 2018, C-V2X technology will be included into the development of vehicles from Q4/2018 on.
- Including two years of intensive testing of released technology, it can be expected that market deployment is realistic in model year 2020/21.

5 C-V2X evolution compared to DSRC-only solutions

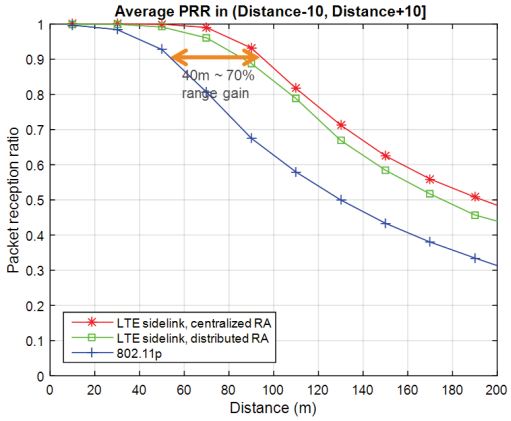
NGMN sees a lot of advantages in using C-V2X based communication technology for V2X. As C-V2X is based on the standardization activities for D2D since 3GPP, R12, it can be also adapted to a large number of V2X applications.

C-V2X can be also adapted to V2I and V2P applications, which include the protection of other traffic participants including pedestrians and cyclists. It therefore has the potential to increase safety not only for vehicle users but for all participants of the traffic system. The cellular network can also leverage information coming from smartphones and IoT devices to extend the range and participation of safety applications..

Several studies [e.g. Blasco, 2016, Appendix 7.2] have been published that show the benefits of C-V2X compared to 802.11p standards. The benefits in terms of higher communication range are worked out in both operational modes, centralized resource allocation (mode 3) as well as decentralized resource allocation (mode 4).



Highway fast scenario, PRR vs. distance of two enhanced PC5 schemes (based on centralized and distributed resource allocation) in comparison with that of a scheme using IEEE 802.11p.



Urban slow scenario, PRR vs. distance of two enhanced PC5 schemes (based on centralized and distributed resource allocation) in comparison with that of a scheme using IEEE 802.11p.

Figure 1: 3GPP C-V2X compared to IEEE 802.11p [Blasco, 2016].

In DOT-Report about SPaT (SPaT Report 2012), it was clearly stated in chapter 2.3.5.2 (Basic Safety Message Load), that "in cities with 2 or more lanes in each direction and during major congestion, BSM messages will consume most of the channel bandwidth, and are likely to disrupt SPaT message transmission, thus impacting the quality of service below an acceptable limit." Due to the technical advantages of C-V2X, it is expected that the limitations foreseen for DSRC based technology, which includes such use cases as SPaT (which is not in the scope of the NPRM), will not be effective for C-V2X based connectivity.

Following Release 14, 3GPP has approved a work item to develop standards for the Enhancement of 3GPP support for V2X scenarios (enhanced V2X) in Release15 for both LTE and the 5G new radio specifications. The focus has been to expand use cases to include those that require even more advanced, critical communication technology solutions such as platooning, automated driving and remote driving. 3GPP has also initiated a study to review the security

aspects for cellular support of V2X services. C-V2X will therefore benefit from the continuous enhancements and improvements of the 3GPP standards.

These enhancements would be additions to the current releases hence Release 14 features and interoperability can remain maintaining backward-compatibility.

6 Conclusions

NGMN supports NHTSA's position to mandate the deployment of V2V communications for safety, but we believe that the choice of technology should (and will) be driven by market forces and therefore the mandate has to be technology neutral.

NGMN believes that all the goals of the mandate including supporting security and privacy requirements can be reached in a more cost efficient way, with higher performance and faster penetration, by utilizing cellular technology (e.g. C-V2X). NGMN points out, that a C-V2X mode 4 operation works regardless of cellular coverage in the ITS 5.9 GHz band for the safety use cases and has the same operational characteristics as DSRC with no operator involvement. Cellular technologies will also enable a more efficient and cost effective distribution of credentials, misbehavior reports, and the CRL.

NGMN is confident that the automotive eco-system would benefit from the evolution, innovation and investments made by the cellular eco-system so that V2V safety solutions will be implemented in a cost-effective manner and within the timeframe proposed by NHTSA.

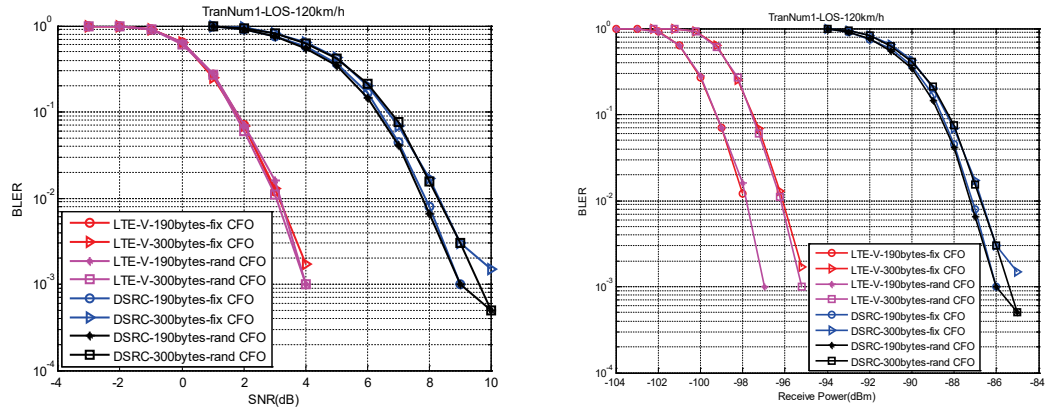
7 Appendix

7.1 List of Acronyms

BSM	Basic Safety Message
BS/LCW	Blind Spot/Lane Change Warning
CAM	Cooperative Awareness Message
CRL	Certificate Revocation List
DNPW	Do Not Pass Warning
DSRC	Dedicated Short-Range Communications
EEBL	Emergency Brake Light
FCW	Forward Collision Warning
IMA	Intersection Move Assist
LTA	Left Turn Assist
SCMS	Security Credential Management System
SPaT	Signal Phase and Timing Message
V2I	Vehicle to Infrastructure
V2N	Vehicle to Network
V2P	Vehicle to Pedestrian
V2V	Vehicle to Vehicle
V2X	Vehicle to Anything

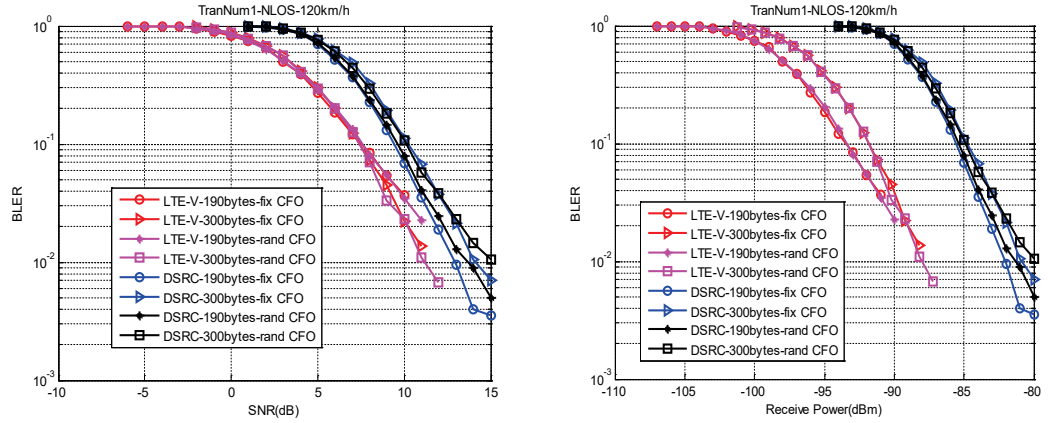
7.2 NGMN comparison between C-V2X and DSRC

NGMN has performed technology evaluation of C-V2X and DSRC. It is observed in various situations (at various speed levels, NLOS/LOS, urban/freeway as in simulation settings also defined in 3GPP TR 36.885) that C-V2X demonstrated superior performance compared to DSRC. The followings are some of the simulation results from NGMN.



(a) SNR-BLER (b) Receiving Power-BLER

Figure 2: Link level performance comparison between LTE V2X and DSRC (MCS comparison 1: Urban case: LOS; Relative speed 75mph)



(a) SNR-BLER (b) Receiving Power-BLER

Figure 3: Link level performance comparison between LTE V2X and DSRC (MCS comparison 1: Urban case: NLOS; Relative speed 75mph)

7.3 References

5G Americas (October 2016)
V2X Cellular Solutions White Paper
http://www.4gamericas.org/files/2914/7769/1296/5GA_V2X_Report_FINAL_for_upload.pdf

Blasco, Ricardo; Do, Hieu; Serveh, Shalmashi; Stefano; Sorrentino; Zang, Yunpeng: 3GPP LTE Enhancements for V2V and Comparison to IEEE 802.11p, Paper number EU-SP0264, 11th ITS European Congress, Glasgow, Scotland, 6-9 June 2016

SAE Standard: J2945/1_201603: On-Board System Requirements for V2V Safety Communications, http://standards.sae.org/j2945/1_201603/

SPaT Report (April 2012)
Signal Phase and Timing (SPaT): Applications, communication requirements, communications technology potential solutions, issues and recommendations, DOT Report FHWA-JPO-13-002
https://ntl.bts.gov/lib/42000/42400/42468/FHWA-JPO-13-002_Final_Pkg.pdf