Before the

Department of Transportation

Office of the Secretary

In the Matter of

[Docket No. DOT-OST-2018-0210]

Notice of Request for Comments: V2X Communications

COMMENTS OF u-blox America Inc.

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I. Executive Summary

The Department of Transportation issued a request for comment regarding Vehicle-to-Everything (V2X) communications technologies, the recent development in the core aspects of V2X communication technologies and how these development will impact both V2X in general and the Department ‘s role in encouraging the integration of V2X for saving millions of lives.

u-blox expresses its gratitude to the Department of Transportation for this opportunity to share its comments.

u-blox is strongly committed to public traffic safety through developing the appropriate technologies and contributing to enforce a rapid deployment of such technologies in order to improve the safety of road users, hence saving lives.

DSRC has undergone a decade of extensive pilot programs, field trials, multiple vendor interoperability tests, before the first commercial deployments. Further deployments are on

the near horizon, namely from General Motors, Toyota and others. As such imminent deployments will have a direct positive impact on the safety of millions of road users and will enable saving lives**,** u-blox encourages the Department's to remain committed to a rapid deployment of DSRC and to not entertain any non-mature solutions that will disrupt such deployment.

u-blox is currently working on the evolution of DSRC, namely Next Generation V2X (NGV), which is currently being specified under the IEEE802.11bd umbrella. Such evolution path will provide a seamless interoperable, co-existent, backward compatible path between DSRC and NGV, while efficiently using the same 5.9 GHz spectrum resources.

II. Introduction

u-blox' answers to the nine questions raised by the Department of Transportation are detailed below.

Question 1:
Please provide information on what existing or future technologies could be used for V2X communications, including, but not limited to, DSRC, LTE C-V2X and 5G New Radio. What are the advantages and disadvantages of each technology? What is the timeframe for deployment of technologies not yet in production? Please provide data supporting your position.

DSRC is a technology designed and developed to support all V2X applications, including V2V, V2I, V2P, as well as other cooperative ITS (C-ITS) applications paving the way towards complete cooperative automated driving [Ref: 1]. DSRC is well established for many years now with a lot of both experimental and commercial roll-outs around the globe and is backed by well-tested and mature in-vehicle and roadside systems.

IEEE 802.11bd comprise the next generation of DSRC that provides a seamless interoperable and compatible evolutionary path on the same spectrum without any fragmentation while supporting brand new capabilities - like advanced positioning or enhanced receiver sensitivity among others - aiming at facilitating future use cases.

LTE-V2X – based on 3GPP Rel. 14 and/or on 3GPP Rel. 15 is foreseen as an emerging compelling technology, however it is not mature despite the claims of superiority [Ref: 2] that u-blox review has seriously challenged [Ref: 3]. It is also not interoperable in anyway with existing DSRC nor with forthcoming 802.11bd. On top there is no compatibility yet even in its sequential releases (Rel. 14 and Rel. 15).

5G NR-V2X is a future evolution path of LTE-V2X under the umbrella of 5G (3GPP Rel. 16). It does not provide yet an interoperable path from LTE-V2X and it clearly remains backward incompatible with that. This results to:

- Spectrum needs to be fragmented as LTE-V2X cannot operate on the same channels as 5G NR-V2X

- Spectrum needs to be twice fragmented as DSRC (or 802.11bd) as well cannot operate on the same channels as 5G NR-V2X

u-blox strongly believes that DSRC is the technology that i) meets the demanding active traffic safety requirements, ii) has gone through an well-established maturity path which led to early deployments by many OEMs.

Question 2:
Of the V2X communications technologies previously discussed, at present only DSRC is permitted to be used in the 5.9 GHz spectrum band for transportation applications. If that allocation were to be changed to allow any communication technology for transportation applications, could DSRC and other technologies (e.g., C-V2X, 5G or any future technology) operate in the same spectrum band or even the same channel without interference? Why or why not? If there are any technical challenges to achieving this goal, what are they and how can they be overcome?

The full 75MHz band assigned for DSRC is anticipated to be fully utilized in the short term as reported by both the US-DoT [Ref: 4] and the Car2Car Communication Consortium [Ref: 5]. The latter analysis predicts that there will be a need to extend this spectrum for future use cases that will build upon day-1 applications

DSRC and its evolution path 802.11bd will be able to co-exist on the same channel without interference, thus the currently DSRC allocated spectrum will be efficiently used to serve all V2X applications.

LTE-V2X not only cannot co-exist with DSRC on the 5.9 GHz spectrum band, but is also unable to co-exist with its own evolution path 5G NR C-V2X. Thus resulting in an efficient usage of the spectrum, which would limit existing technologies as well as future technologies.

There is no benefit in duplicating technologies serving the same V2X use cases, especially when such technologies will lead to a fragmentation of the spectrum.

DSRC is able to support all existing V2X application as well as all new additional use cases as per the Car2Car Communication Consortium roadmap [Ref: 1]

Question 3:
To what extent is it technically feasible for multiple V2X communications technologies and protocols to be interoperable with one another? Why or why not? Can this be done in a way that meets the performance requirements for safety of life applications, as they were discussed in the V2V NPRM? What additional equipment would be needed to achieve interoperability or changes in standards and specifications? What is the projected cost of any necessary changes? How soon can these changes and equipment prototypes be available for testing?

Meeting the performance requirements for safety of life applications necessitates an efficient usage of the 75 MHz spectrum allocated. In other words, adopting two technologies to serve the same applications in the same spectrum without been able to communicate between each

other will certainly not allow any of the two technologies to meet the performance requirements as discussed in the V2V NPRM.

Vehicles equipped with DSRC are already deployed in the US on the 5.9 GHz spectrum band. Any other vehicle equipped with LTE-V2X shall be able to communicate with DSRC equipped vehicles on the same channel without interferences and with the latency requirements for mission critical applications.

The other aspect is interoperability. As highlighted above, while DSRC equipped vehicles and future 802.11bd equipped vehicles will be interoperable using the same spectrum, a vehicle equipped with LTE-V2X will not be able to communicate with any of the aforementioned vehicles, it will also not be able to communicate with a future 5G NR C-V2X equipped vehicle.

While the impact on DSRC adopters moving towards 802.11bd is cost efficient as they will not need to equip their platforms with two radios (DSRC and 802.11bd), it will be far more expensive and not optimal if they were to deploy LTE-V2X in the upcoming years and transition towards 5G NR C-V2X as they will need to equip also their vehicles with LTE-V2X as well. Another aspect of the problem is that currently, there remain still unsolvable challenges in terms of how to provide an automotive grade LTE-V2X solution that will meet the temperature mission profiles, the requirements on time synchronization in the absence of a GNSS signal, and cryptography hardware solution.

Question 4:
To what extent is it technically feasible for different generations of the same V2X communications technologies and protocols to be interoperable with one another? Why or why not? Can this be done in a way that meets the performance requirements for safety of life applications? What additional equipment or changes in standards and specifications would be needed to achieve interoperability? What is the projected cost of any necessary changes?

Interoperability between different generations of the same V2X communication can be achieved either at a low layer, namely radio layer, or a higher layer, namely application layer. While the former is the efficient way to guarantee interoperability between different V2X generations, the latter is achieved at the expense of an efficient usage of the spectrum resources, higher cost solution, performance as there will be redundant sub-systems

An efficient interoperability scheme between different generations of V2X is achievable if and only if both generations are able to co-exist on the same channel while meeting the performance requirements for safety of life applications. This is the interoperability and co-existence that DSRC and 802.11bd will achieve: seamless interoperability and co-existence on the radio layer.

LTE-V2X and 5G NR C-V2X, on the other hand will use different access layers which will not allow them to co-exist on the same channel, therefore interoperability will be achieved if and only if a 5G NR C-V2X vehicle will also be equipped with an LTE-V2X radio and if the spectrum is fragmented in a way to enable both technologies. This is an inefficient way of ensuring interoperability between different generations of V2X.

Question 5:
Even if they are interoperable across different technologies and generations of the same technology, would there be advantages if a single communications protocol were to be used for V2V safety communications? What about other V2X safety applications, such as those involving V2I and V2P communications?

The selection of a single protocol for a particular set of V2X applications has the clear advantage of avoiding increased complexity and cost to the consumer. On the other end, introducing multiple protocols to support the same applications under a voluntary V2X introduction model such as the one adopted in Europe and the US creates confusion, increases complexity and in turn, has a direct impact on the safety of human lives on the road.

The argument above does not exclude the introduction of new protocols or evolution of existing ones. However, these should fulfil the following requirements:

- Backward compatibility and coexistence with existing protocols when operating on the same frequency band
- Focus on the provision of new services which cannot be satisfied by the capabilities of existing protocols

Question 6:
How would the development of alternative communication technologies affect other V2I and V2P communications, such as those supporting mobility or environmental applications? Do these applications have the same or different interoperability issues as V2V safety communications? Do different V2X applications (e.g., platooning) have different communication needs, particularly latency?

The existing DSRC technology is capable of satisfying the needs of all V2I and V2P use cases. V2I and V2P use cases share in general the same interoperability requirements. V2I use cases have typically less stringent requirements on latency except for the red light violation warning. V2P has high requirements on precise localization of pedestrians. The issue of location accuracy hinders today's implementation of V2X into mobile devices more than the choice of a specific communication technology. DSRC as well as LTE C-V2X could be integrated into today's smart phones.

Question 7:
Do different communication technologies present different issues concerning physical security (i.e., how to integrate alternative communication technologies into vehicle systems), message security (i.e., SCMS design or other approaches), or other issues such as cybersecurity or privacy? Would these concerns be affected if multiple but still interoperable communication technologies are used rather than one?

Currently the only two V2X materialized technologies namely the DSRC and C-V2X are enabling the exact same V2X security layer and profile (mostly prescribed by 1609.2). As every V2X security implied processing and prerequisite refer to layers above the radio access one cybersecurity or privacy could be preserved equally for any radio access technology. Interoperability at higher layers (e.g. application) is enough for serving this purpose.

Question 8:
How could communications technologies (DSRC, C-V2X, 5G or some other technology) be leveraged to support current and emerging automated vehicle applications? Will different communication technologies be used in different ways? How?

The DSRC technology can support all current V2X applications as well as potential future applications: All V2X applications foreseen to support automated driving vehicles.

The Next Generation V2X (NGV) Task Group of IEEE 802.11 (NGV V2X) is currently developing the 802.11bd specification. The goal of this upcoming amendment is to allow a seamless evolution of DSRC using the same frequency resources in a fair and interoperable manner[1] and making full use of latest technology innovations.
V2X communication technologies are essential for the introduction of automated driving. As automation increases, V2X-equipped road users can generate information about local status, detections, as well as intention and coordination data. Exchanging this information allows intelligent interaction between vehicles and with the infrastructure to coordinate their movements and behavior even in complex traffic situations like urban scenarios.

Question 9:
How could deployments, both existing and planned, assess communications needs and determine which technologies are most appropriate and whether and how interoperability could be achieved?

We are convinced that a fast, successful and wide-scale deployment of V2X in the US and the EU is key for reducing the number of fatal accidents and supporting cooperative automated driving to reach the goal of zero fatalities from vehicle collisions.

Existing deployments in Europe and US are based on strong cooperation between vehicle manufacturer, road operators (cities, states) and public authorities. Maturity of technologies – for example the ability to cope with congested driving scenarios - needed to be proved beforehand taking real world testing with large field operational tests into account. Compliance assessment testing and interoperability testing based on standards (SAE, ETSI test specifications, and ETSI plug tests) ensures that all deployed devices interoperate with each other in the field.

III. Conclusion

In light of the facts discussed above, we urge the Department of Transportation to remain committed to DSRC as the technology to be deployed to enhance the safety of road users.

[1] 802.11bd - Amendment: Next Generation V2X (https://mentor.ieee.org/802.11/dcn/18/11-18-0861-08-0ngv-ieee-802-11-ngv-sg-proposed-par.docx)