State of Utah

GARY R. HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

DEPARTMENT OF TRANSPORTATION

CARLOS M. BRACERAS, P.E.
Executive Director

JASON E. DAVIS, P.E.
Deputy Director of Engineering and Operations

TERIANNE S. NEWELL, P.E.
Deputy Director of Planning and Investment

February 23, 2019

The Honorable Finch Fulton
Deputy Assistant Secretary for Transportation Policy
Office of the Secretary (OST)
U.S. Department of Transportation (DOT)
1200 New Jersey Avenue, S.E.
Washington, DC 20590

Dear Deputy Assistant Secretary Fulton:

SUBJECT: Docket No. DOT-OST-2018-0210

The Utah Department of Transportation (UDOT) is pleased to provide comments on the U.S. Department of Transportation's "V2X Communications" Notice of Request for Comments (Docket Number DOT-OST-2018-0210), issued in Washington, D.C. on December 26, 2018.

UDOT is committed to a transportation system that is safe, efficient, and serves the public need. Safety is one of our primary goals, specifically reducing roadway fatalities, injuries and crashes to zero. We fully support the USDOT's view that connected vehicle (CV) technology, enabled by vehicle-to-everything (V2X) technology, coupled with advancements in sensor-based vehicle automation, will yield significant benefits in both safety and mobility. In fact, we believe that these technologies are the primary path to meeting the Zero Fatalities goal. UDOT also applauds the USDOT efforts over many years to advance this technology.

For over ten years, UDOT has invested effort and resources to plan, develop and deploy connected vehicle technology, primarily through vehicle-to-infrastructure (V2I) systems. Over the past four years, we have invested $2.2 million in the deployment of dedicated short range communication (DSRC) systems and applications in the 5.9 GHz band, and have recently committed another $8 million in the first phase of a multi-year project to expand our connected vehicle infrastructure ecosystem. We currently have 72 intersections and 35 fleet vehicles with DSRC equipment installed and operating, and another 55 intersections and 47 vehicles slated for operation in the next 45 days. These are not pilot deployments, but are in a full operational environment. UDOT is also a leader in the national Signal Phase and Timing (SPaT) Challenge, an effort to deploy DSRC roadside units in every state in the country. We regularly interact with colleagues in other states and local jurisdictions who are deploying and operating DSRC systems in the 5.9 GHz band. DSRC technology is developed, available, and in active use in our system, and in many jurisdictions around the United States. It meets the needs of our applications. UDOT believes that this available technology should continue to be deployed now toward our goal of saving lives, and that federal standards should be put in place to accelerate the installation of these interoperable systems, rather than delay the benefits of connectivity while we wait for the development of other technologies.

In the Request for Comments, the USDOT asks whether stakeholders believe that "focusing on DSRC as the primary means of V2V communications is consistent with recent technological developments" and whether such a choice is consistent with the USDOT's "general desire to remain technologically neutral". To the first question, as will be explained in our detailed responses to the questions posed, UDOT believes that focusing on DSRC as the primary means of V2V and other V2X applications, particularly safety-critical applications, is appropriate. DSRC is the only available technology which can meet this need today, and waiting for other technologies, which do not promise any advantages over DSRC, will delay the life-saving benefits of connectivity. To the second question, UDOT believes that designation of DSRC as a required V2V and V2X standard is consistent with a technologically neutral approach. When the 5.9GHz band was designated for traffic safety use by the FCC, the intent was to promote technology interoperability and robust safety communication with equipment that had limited cost, which would encourage deployment. Based on this intent, the industry developed, through a consensus process, the DSRC standards. The government did not select a communication technology, the government established the criteria for interoperable communication, and the industry developed a technology to meet those criteria. The expectation of neutrality has already been met, and the realization of the anticipated benefits now requires the consensus-developed standard and technology to be built into regulation.

The USDOT has requested comments on nine specific questions related to the V2X environment. UDOT offers our comments on those questions, as follows:

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.*

   Currently, the only existing technology ready for deployment to enable V2X communications is DSRC. As noted above, UDOT has been deploying DSRC for four years and currently has 72 intersections and 35 fleet vehicles with DSRC equipment installed and operating, and another 55 intersections and 47 vehicles slated for operation in the next 45 days. The advantages of DSRC include: 1) it has well-established standards for the equipment and messages, 2) it has been tested in robust environments for a decade, 3) it has a dedicated spectrum, 4) it communicates messages with very low latency, 5) certification bodies are involved in verifying the performance of the devices, 6) there is a large pool of experienced agencies and individuals who are sharing best practices, 7) the transmissions do not require any subscription fees, and 8) it is commercially available and in active use, which no other technology can claim. Nearly all of these advantages are unique to this technology.

While there are disadvantages to DSRC technology, none of the disadvantages are unique. Many agencies are still unfamiliar with the deployment and operation of DSRC, roadside deployment relies on hundreds of independent agencies, the development of specific message sets and applications require some effort, and very few off-the-shelf applications exist. However, DSRC is ahead of any other technology in all of these aspects. And, as will be described in our response to Question 4, the next evolution of DSRC technology, "next generation V2X" (NGV), is being developed. NGV will provide a seamless path forward with complete interoperability, coexistence, and backward compatibility with our current DSRC devices.

Other emerging and planned technologies, including C-V2X and 5G NR, promise to provide the same advantages as DSRC, but none have been developed or tested adequately to support any of those claims. The real question is, even if these other technologies eventually can demonstrate the same advantages as DSRC, what will we gain with these technologies that we don't already have? Will there be any unique advantages that would justify replacing the demonstrated value of DSRC with another technology. No such unique advantages have yet been defined.

The primary disadvantage of these emerging technologies is that they are not ready for deployment today. Considering that standards, spectrum, certification, and robust testing will take significant time to develop, it is only logical that we deploy proven technology now to save lives. In 2018, researchers at the University of Michigan Transportation Research Institute completed a study (Sayer, Flannagan, and Leslie, "The Cost in Fatalities, Injuries, and Crashes Associated with Waiting to Deploy Vehicle-to-Vehicle Communication") which quantified the costs of delaying deployment of safety-critical applications. Specifically, they evaluated the cumulative number of lives which will be lost if we wait even three or five years for a new technology to be developed and proven. They concluded that tens of thousands of lives can be saved by deploying DSRC now, instead of waiting. While some assert that C-V2X may be ready for use within the next year, the intense, iterative testing, standard development and real-world piloting that will be necessary for this technology to be reliably introduced into our transportation systems for safety-critical use will take much longer. As an agency responsible to save lives, we believe it is harmful to the public interest to delay deployment of proven technologies while we wait for something better to come along. This is especially true when the cost is tens of thousands of human lives.

Another potential disadvantage of cellular-based technologies, like LTE C-V2X and 5G NR is the potential subscription fees needed to make the system operational. Based on evidence of the very small percentage of vehicle owners who pay for on-board, cellular, vehicle-to-cloud services today (such as GM's On-Star system), it is unlikely that many vehicle owners will subscribe to similar systems to get V2I safety benefits. Even if V2V systems can operate without subscription fees, V2I applications, system updates, and security certificate downloads will likely require subscriptions. A safety system based on subscription fees has no equity and limited chance of wide adoption.

A third potential disadvantage to 5G NR is potential message clutter. The telecommunications industry is promising that 5G will facilitate the "internet of everything". It is possible that hundreds and possibly thousands of wireless devices will be sending and receiving messages simultaneously in very limited geographic areas. This will prove to have huge benefits to consumers in many respects. However, until there is significant and thorough testing, we will have no confidence that safety-critical messages will not get lost in this crowded message environment with hundreds of other non-critical transactions. Safety-critical messages should be confined to an uncluttered, dedicated technology and spectrum.

Further definition of the advantages and disadvantages of the emerging and planned technologies will require rigorous, robust and independent testing, as has been performed for DSRC. The extensive testing performed by the USDOT Connected Vehicle Safety Pilot Program in Ann Arbor, Michigan, where dozens of roadside units and hundreds of moving on-board units were evaluated to ensure that packets of data could be sent and received reliably and consistently in a live environment, is a model for the testing that will be needed before these new technologies can be used in life-safety applications. This process will take several years, and we encourage it to be performed. In the meantime, we should continue to deploy the available and proven DSRC technology.

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?*

   At this time it is unknown to what extent, or whether at all, C-V2X or 5G NR could operate in the same band simultaneously with DSRC or whether DSRC could effectively be operated with a reduced spectrum. UDOT has significant concern about having multiple CV technologies operating in the same spectrum with the same goals but without a good understanding of how the different technologies will interact with each other. The 5.9 GHz band is currently the subject of comprehensive testing to evaluate the impacts of sharing DSRC devices with unlicensed Wi-Fi devices. Phase I of this testing has been completed, and

Phase II, which will involve basic field tests with a few vehicles is still pending. Phase III will follow with additional testing. Until such time as these real-world tests are undertaken and completed, and only if Phase III involves numerous devices and multiple, moving vehicles, we will not know conclusively to what extent, or whether at all, DSRC and other technologies could operate together without interference. In addition, the 5G Automotive Association (5GAA) has petitioned to operate C-V2X in a portion of the 5.9GHz spectrum. (GN Docket 18-357) Broad, independent testing will also be needed to determine whether C-V2X can operate adjacent to DSRC without harmful interference. Any claims otherwise should be dismissed until suitable testing is completed.

Consideration should also be given to whether other alternatives for available spectrum, such as the 6.0 GHz spectrum or higher frequencies currently being anticipated for 5G use are more suitable for these emerging technologies. Until reasonable alternative frequency options are identified and evaluated, it is inappropriate to consider cluttering or reducing the spectrum that is currently being used for transportation safety and mobility by DSRC.

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?*

Currently, there is no evidence, or even a claim, that the emerging, cell-based technologies will be interoperable with currently available technology, DSRC. To make them interoperable, the standards and systems would need to incorporate those interoperability characteristics from the ground up.

In addition, until these various technologies are designed, developed and tested together, it is not possible to know whether these different technologies will interfere with each other. UDOT is aware of recent experiences by colleagues where the FCC's decision to allow cellular communications belonging to Sprint-Nextel to operate in the 800 MHz Public-Safety spectrum resulted in harmful interference to safety critical communications. We are also aware of a scenario where secondary users in the 5.9 GHz band created significant interference with the operation of DSRC on at least one channel. As indicated above, testing is underway to evaluate the potential interference between DSRC and unlicensed Wi-Fi. Similar testing will be needed to evaluate DSRC against other, emerging and planned technologies. This testing, to be conclusive, will need to be done using multiple devices and moving vehicles, at a scale similar to the USDOT Connected Vehicle Safety Pilot Program in Ann Arbor, Michigan.

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?*

   New generations of a given V2X communications technology can be backwards compatible and interoperable if they are designed to be such. We witness this in cell phones, computer printers, and other household technologies. The standards must incorporate these requirements, and the developers must adhere to these standards.

   We are learning about just such an advancement in DSRC technology. DSRC conforms to the 802.11 consensus-based standard published by the Institute of Electrical and Electronics Engineers (IEEE). Anticipating the next evolution of this technology, IEEE is proposing a "next generation V2X" (NGV) standard, to be called 801.11bd. This standard will provide interoperability, coexistence, and backward compatibility with our current DSRC devices. Unlike cell-based technologies currently being discussed, the NGV devices will provide a seamless evolution path forward for the DSRC devices that we are now using, likely at a lower cost. When developed, it will meet the performance requirements for our safety-critical applications, and, because of its backwards compatibility requirement, should fit within a normal end-of-life equipment replacement plan.

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 clear advantage to using a single communications protocol for V2V is the lives that will be saved. To accomplish this, each vehicle, across all brands, must be able to hear and understand very other vehicle. Interoperable communications, on a single protocol, is critical to realizing the full benefits of V2V, and, by extension, V2X. And, given the life-cycle of vehicle-based technology, these interoperable protocols must be consistent over a long period of time.

   Currently, there is no evidence, or even a claim, that the emerging, cell-based technologies will be interoperable with currently available technology, DSRC. In the absence of a federal regulation, we are now observing that various automakers (specifically Toyota, GM, and Ford) are moving toward two different communications technologies. Two technologies, with two protocols, will result in incompatible systems that will not save lives to the extent that a single, interoperable system will. The National Highway Traffic Safety Administration

(NHTSA), as a result of the extensive testing performed by the USDOT Connected Vehicle Safety Pilot Program in Ann Arbor, Michigan, concluded that DSRC technology has the potential to address nearly "80 percent of the crash scenarios involving non-impaired drivers". DSRC is still the only proven communications technology available today to begin reducing the nearly 40,000 traffic fatalities in the U.S. every year. Having two non-compatible systems operating in the vehicles on our highways will certainly reduce that "80 percent" mitigation, potentially by half.

For V2I and V2P safety applications, the argument for a single, interoperable system remains. If a vehicle is going to avoid a pedestrian by receiving a timely message, for instance, it must be received by the system which is resident on that vehicle. If two systems exist, only half of the vehicles would receive the safety message.

For non-safety V2I and V2P applications, specific use cases may justify disparate technologies. UDOT fully anticipates that the automakers will continue to employ cell-based systems for infotainment, navigation, and other uses, but believes that safety-critical systems should not be intermingled with these other cell-based uses. If non-safety applications use technologies other than DSRC, we will be faced with installing roadside systems that incorporate multiple technologies. This approach will certainly be feasible in the future, but will likely be more costly for us to deploy and more challenging to integrate with our safety-based systems.

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?*

As indicated in our response to Question 5, use cases for non-safety V2I and V2P applications may justify disparate technologies. However, UDOT believes that safety-critical systems should remain on interoperable, low-latency systems. If non-safety applications use technologies other than DSRC, infrastructure agencies will be faced with installing roadside systems that incorporate multiple technologies. This approach will certainly be feasible in the future, but will likely be more costly for us to deploy and more challenging to integrate with our safety-based systems.

There is a clear benefit to have all V2V, V2I and V2P applications use consistent and interoperable communications technologies. Even if different technologies are used for different use cases, each of those technologies should evolve in ways that ensure coexistence and backwards-compatibility.

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?*

   UDOT believes that federal regulation should ensure that safety is enhanced and not compromised as a result of any decisions made on future communications protocols and cybersecurity requirements. Each communication technology will offer a new attack vector and another way in which security and privacy can be compromised. These will have to be carefully considered during system design and deployment. The technologies should be designed with security in mind from the inception.

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?*

   Cooperative systems achieved through communication between vehicles, infrastructure, and other users will provide an enhanced and complementary layer of safety for automated vehicles. This ability to communicate will be essential for extending the range of vehicle-based sensing and confirming sensor based information. The full potential of safety benefits envisioned for future transportation systems will require both connectivity and automation.

   Vehicle-based sensors detect information in the short range, within line of sight. Short range V2X systems, such as DSRC, provide information in the medium range, including information that is not visible, such as signal phase data, or is not within a direct line of sight. Cell-based technologies are well suited to transmit longer range data, such as information from a traffic queue or work zone well ahead of the vehicle. Each technology fills a useful role. As emerging and planned technologies, such as C-V2X and 5G NR, claim to fill the medium-range role currently being filled by DSRC, it is important to ask, as in our response to Question 1, what will we gain with these technologies that we don't already have?

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?*

   First, UDOT believes that we should deploy technologies that are currently available in order to reduce fatalities and improve mobility. The comparison of technologies, often referred to as the "VHS vs Betamax" scenario of several decades ago, is not realistic. DSRC is available now, and other technologies are not.

> As emerging and planned technologies develop, standards should be developed, and these technologies should be tested and validated in the lab, in the field, and in large-scale, independent, and realistic scenarios. Potential interoperability should be evaluated and demonstrated. Then, existing deployments can be a proving ground to determine how those new technologies can best be used to improve our transportation safety and mobility systems in a complementary, interoperable and cost-effective way.

UDOT appreciates the USDOT's continued leadership and support of the safe and timely adoption of cooperative automation. More specifically, we applaud USDOT's decade's long investment in the development of DSRC and new efforts to further explore emerging V2X development and technology compatibility issues. We appreciate the opportunity to contribute to those efforts, including through this response.

UDOT is a member of the Connected Vehicle Pooled Fund Study (CV PFS). Along with 25 other state and local transportation agencies from around the United States and Canada, and the FHWA, we provide funding for research and development of connected vehicle technologies and applications. Our efforts are led by the Virginia DOT. To date, our collective resources have funded $8 million worth of deployment-focused projects. A complete list of CV PFS research projects is available at http://www.cts.virginia.edu/cvpfs_research. CV PFS members understand that a connected vehicle environment holds the potential to support a fundamental advance in surface transportation, providing the potential for reduction in congestion, safety improvements, and improved traveler services. Our investments in these critical CV developments are because of this unprecedented promise of safety and mobility improvement. As members of the CV PFS we support the CV PFS position (as stated in the Virginia DOT response to this USDOT RFC) that DSRC is the only low-latency technology that is available now, and that it can be used almost immediately to begin saving lives. We also support the CV PFS position that the uncertainty caused by a lack of endorsement of DSRC by the USDOT has caused unnecessary delays in the deployment of this life-saving technology by many agencies.

UDOT is also a member of the American Association of State Highway Transportation Officials (AASHTO), and is fully engaged in AASHTO's proactive efforts to advance and deploy V2X technology. In addition to the points raised in our response, UDOT supports the response filed by AASHTO relative to this waiver request.

UDOT reiterates our belief that DSRC is the only viable and mature technology available to support connected vehicle applications at this time. We recognize that future technologies may become available to support a CV environment, and that the industry must stay flexible to evaluate, consider and adopt these technologies as appropriate. We further submit that adoption must follow rigorous, independent testing, performance demonstrations, and the development of consensus standards, and must be interoperable and compatible with existing systems. We must also consider the unique benefits, economic impacts, life cycle costs, and availability of the new technology for wide scale deployment. In order to accelerate and maximize the benefits of connectivity and cooperative automation today, broad interoperability requires that a single communication system be used. Over the last decade, the industry has developed and chosen DSRC technology to meet this need, and UDOT requests that the USDOT standardize the requirement for this technology.

We appreciate the opportunity to provide these comments. If you would like to discuss the issues raised in this letter, please contact me, or Blaine Leonard, P.E., F.ASCE, UDOT's Transportation Technology Engineer at bleonard@utah.gov or (801) 887-3723.

Sincerely,

Carlos M. Braceras, P.E.
Executive Director

CMB/BL/dej

Cc: Jason Davis, UDOT Deputy Director of Engineering and Operations
Rob Wight, UDOT Director of Operations
Troy Peterson, UDOT Director of Traffic Operations
Blaine Leonard, UDOT Transportation Technology Engineer