

Vehicle-to-Everything (V2X) Communications Summit:

Detailed Meeting Summary: Preparing for Connected,
Interoperable Deployment Nationwide



U.S. Department of Transportation

Contents

Meeting Summary V2X Communications Summit: Preparing for V2X Deployment	1
Synopsis	1
Results of the V2X Communications Summit	2
Background	2
Event Purpose	2
Overview of the Three Paths to V2X Deployment	3
Path to Technology Advancement	3
Path to Using the 30 MHz	4
Path to V2X Deployment	4
Panel Session Recap	4
V2X Grant Opportunities Panel	4
V2X Communications Deployer Panel	5
U.S. DOT LTE-V2X Testing Observations & Test Certification Panel	5
ITS America Panel - V2X Survey Results Overview	6
Industry Leadership Panel	6
National Telecommunications & Information Agency (NTIA) Remarks	6
National Transportation Safety Board (NTSB) Remarks	6
Key Issues and Challenges to Deployment	7
Challenges to Deployment and Use of the 30MHz	7
Next Steps	8
Additional Short-term Priority Actions (0 to 12 months)	9
Establish regular coordination discussions with NTIA and FCC	9
Complete examination and testing of UNII interference	9
Further engage U.S. DOT political leadership on importance of V2X to the nation	9
Conduct a V2X Communications Summit 2.0	9
Prioritize funding for V2X	9

Longer-term Priority Actions (1 to 5 years)	10
Mature the SCMS—a key aspect of interoperability	10
Establish a Day-One LTE-V2X Application Inventory	10
Develop technical LTE-V2X installation guidance and education	10
Ensure that standards and test procedures are complete for LTE-V2X	10
Identify V2X applications that can use non-dedicated spectrum to realize additional V2X benefits	10
Establish a public adoption campaign to communicate benefits to a broader set of decision-makers	10
Conclusion	11

Appendix A: Summit Agenda **12**

Appendix B: Breakout Session Summaries **16**

Breakout Session Summaries, Needs, & Actions	16
Path to Using the 30 MHz / Spectrum Band Plan	18
The Path to Technology Advancement	20
The Path to V2X Deployment	22
Establishing Certainty	23
Breakout Session #2—Industry Discussions	24
Federal Government Participants	27
State Government Participants	27
Infrastructure Deployer Participants	28
Standards Organizations Participants	29
Vehicle Manufacturers/Suppliers/ Technology and Device manufacturers/ Chip Maker Participants	30

Appendix C: Grant Opportunities for Incorporating V2X Communications **31**

Meeting Summary V2X Communications Summit: Preparing for V2X Deployment

Synopsis

Since 1999, the U.S. Department of Transportation (U.S. DOT) has pursued efforts to advance the deployment of connected vehicle (CV) technologies, which use vehicle-to-everything (V2X) communications on spectrum known as the 5.9 Gigahertz (GHz) Safety Band (the Safety Band). The Safety Band is dedicated spectrum, which helps assure users that their communications remain free from harmful interference, which is critical for safety-of-life communications.

V2X communications enable a real-time data exchange among vehicles, infrastructure, and traveler/road users' personal devices. These data enable transformative applications and services that are designed to prevent crashes and improve mobility and environmental performance, and are available to all users without a subscription fee. Over time, the U.S. DOT, industry partners, and State and local agencies have invested over \$800 million to research, test, demonstrate, evaluate, and deploy V2X technologies. As of September 2022, transportation agencies in 38 States held licenses from the Federal Communications Commission (FCC), the agency responsible for regulating, allocating, and assigning spectrum.

In 2020, the FCC repurposed 60 percent of the spectrum in this band to unlicensed Wi-Fi and other wireless uses. The FCC also mandated the use of a different V2X communications technology/protocol than the one deployed and in use. These changes have created uncertainty within the transportation industry and stalled investments over the past three years. During this time, the U.S. DOT and industry partners have taken steps to respond to these spectrum changes, including assessing whether the new V2X communications protocol can provide safety benefits.

On August 24 and 25, 2022, the U.S. DOT hosted a V2X Communications Summit at U.S. DOT headquarters in Washington, DC, with over 600 in-person and virtual attendees. At the event, the U.S. DOT and industry leaders and stakeholders met to review the technology test results and discuss a path forward for using the Safety Band.

Results of the V2X Communications Summit

For the promise of interoperable, cybersecure V2X communications to realize its full potential, summit participants called upon the U.S. DOT to facilitate industry adoption of integrated, interoperable, subscription-free, technical solutions in the buildout of connected, automated, and digital transportation systems. These systems aim to push the boundaries for transportation to achieve and surpass our shared safety, equity, climate, and economic development goals. Connected systems must reflect safe, transformative ideas that our nation needs to combat the increase in fatalities, injuries, and property damage; remove barriers to mobility and accessibility; protect vulnerable road users; and address other challenges on our nation's roadways. Among other priority actions, stakeholders called on the U.S. DOT to focus first on:

1. Partnering with the FCC and the National Telecommunications and Information Administration (NTIA) to resolve issues remaining with the 30 megahertz (MHz) allocation, including granting pending waivers to permit deployment of Long-Term Evolution (LTE)-V2X technology immediately and issuing the Second Report and Order (R&O) on final licensing rules and technical and operational service rules that incorporate results from testing.
2. Working within existing partnerships with original equipment manufacturers (OEMs) for both vehicles and devices, infrastructure owners and operators (IOOs), V2X technology companies, ITS America, the American Association of State Highway Transportation Officials (AASHTO), the Institute of Transportation Engineers (ITE), and others to develop a unified vision and comprehensive plan for interoperable, cybersecure, connected deployments nationwide.

Background

The U.S. DOT's mission is to deliver the world's leading transportation system, serving the American people and economy through the safe, efficient, sustainable, and equitable movement of people and goods.

With the rapid advancement of technologies and the emergence of advanced communication concepts and approaches, the V2X Communications Summit focused on charting a successful path forward for connected vehicle deployments and facilitating transportation system connectivity, including automated vehicles and emerging digital infrastructure, within the dedicated 30 MHz of radio frequency spectrum in the 5.9 GHz Safety Band. With an anticipated need for more spectrum, the summit also focused on approaches to leverage other available and emerging communications options to optimize the public benefits of V2X communications and interoperability.

Summit participants noted that addressing these topics requires a continual and inclusive engagement process, thoughtful strategic planning, and an impacts-oriented model for equitably advancing safety through programs, policies, funding strategies, and regulatory actions.

Event Purpose

Objective

Convene ITS community stakeholders to provide information to U.S. DOT to support development of a U.S. DOT V2X deployment action plan that optimizes V2X benefits for the Nation.

The purpose of the V2X Communications Summit was to convene a broad array of intelligent transportation system (ITS) community stakeholders to brief them on the U.S. DOT's recent 4G LTE-V2X testing. The summit aimed to advance the

dialogue on the short- and long-term, high-priority actions necessary to move V2X deployment forward, given changes to the spectrum allocation, band plan, and approved technology.

This hybrid virtual event was hosted by the U.S. DOT's Deputy Assistant Secretary for Research and Technology and Chief Science Officer Dr. Robert C. Hampshire. The event featured remarks by National Transportation Safety Board (NTSB) Member, the Honorable Michael E. Graham, and NTIA Office of Spectrum Management Associate Administrator, Charles Cooper.

Representatives from NTIA and NTSB were joined by officials and participants from the FCC, State and local IOOs, ITS America, the Alliance for Automotive Innovation, AASHTO, automotive manufacturers, chipset and device manufacturers, system integrators, standards developers, academia, and more. These industry leaders both attended and served as speakers and panelists.

Throughout the two-day event, attendees heard updates on U.S. DOT V2X testing; received an overview of V2X grant opportunities from Departmental leadership; heard from a panel of industry experts on what is needed to further U.S. V2X deployment; and received project updates from leading-edge V2X deployers.

Meeting participants also took part in robust breakout sessions (both live and virtually). The first set of breakout sessions focused on examining a series of key topics:

- The **path forward to establishing a new channelization plan with the remaining 30 MHz** of spectrum in the 5.9 GHz Safety Band
- The **path forward to advance V2X technologies** for safe and consistent performance
- The **path to broader V2X deployment**
- The need for **establishing greater regulatory, policy, and market certainty** in support of V2X deployment.

The second set of breakout sessions placed attendees in groups by industry (Federal government, State government, infrastructure deployers, standards organizations, vehicle manufacturers, suppliers, technology and device manufacturers, and chip suppliers). In the second session, these groups discussed what their and other industries can do to advance V2X deployments. A detailed summary of each breakout session is provided in Appendix B.

Overview of the Three Paths to V2X Deployment

The summit agenda focused on three paths towards furthering V2X deployment. These three paths served as underlying themes throughout the summit and were the focus of several of the breakout sessions.



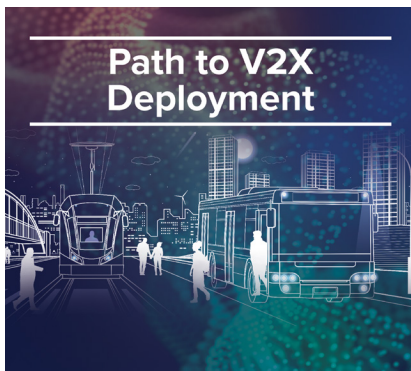
Path to Technology Advancement

The **Path to Technology Advancement** centered on the V2X communications technology, expanding beyond discussion of maturing the LTE-V2X technology to look at how other enabling technologies and advanced communications might play a role in delivering the V2X benefits that may not be realized in the available 30 MHz. This path was the focus of Breakout Session 1, Topic #2, which intended to build on the results of the U.S. DOT's presentation on the issues identified with the LTE-V2X devices during testing and what needs to occur to mature the devices. For further details on this breakout group discussion, please see Appendix B.



Path to Using the 30 MHz

The **Path to Using the 30 MHz** focused on how the ITS community envisions using the 30 MHz and the necessary steps to ensure efficient use of the remaining allocated spectrum. This topic area also explored what is needed to establish an effective band plan, how to attain more regulatory certainty, and how to gain a broader understanding and share knowledge of which proven Day-One applications can be used within this spectrum. This path was the focus of Breakout Session 1, Topic #1. For further details on this breakout group discussion, please see Appendix B .



Path to V2X Deployment

The **Path to V2X Deployment** examined how agencies and organizations transition, fund, implement, and operate with V2X communications (and in doing so, help establish a foundation to support digital infrastructure, Internet of Things, and automation, among other emerging innovations). Breakout Session 1, Topic #3 focused on the challenges, opportunities, and lessons learned associated with what is needed for broader U.S. adoption of V2X communications. For further details on this breakout group discussion, please see Appendix B.

Panel Session Recap

The summit included several panel sessions and key remarks by Federal agency and industry leaders in the areas of spectrum management, policy, and transportation safety. Key points from each panel session presentations are summarized below. Presentation materials for many of these sessions are available on the ITS Joint Program Office (JPO) Emerging and Enabling Technologies program’s V2X Communications [website](#).

V2X Grant Opportunities Panel

Panelists highlighted the various grant programs that offer potential opportunities to include V2X.

- [Advanced Transportation Technologies and Innovative Mobility Deployment \(ATTIMD\)/Advanced Transportation Technologies and Innovation \(ATTAIN\)](#) grants will offer opportunities for transitioning Dedicated Short-Range Communications (DSRC) to LTE-V2X for use in the 30 MHz. Automated Vehicle (AV) and Vehicle-to-Pedestrian (V2P) implementations are also eligible. The maximum award for grants is \$12 million. A [Notice of Funding Opportunity](#) was released on **September 19, 2022 and closed on November 18, 2022**.
- [Strengthening Mobility and Revolutionizing Transportation \(SMART\)](#) is a discretionary grant program established under the Bipartisan Infrastructure Law (BIL) with \$100 million appropriated annually for fiscal years 2022-2026. The [Notice of Funding Opportunity](#) closed on **November 18, 2022**. The SMART program is comprised of two stages: 1) Planning and Prototyping, and 2) Implementation. The SMART program was established to provide grants to eligible public sector agencies to conduct demonstration projects focused on advanced smart community technologies and systems in order to improve transportation efficiency and safety. CV is one of eight technical areas approved for the SMART Program.

- [Safe Streets and Roads for All \(SS4A\)](#) was established under the BIL with \$5 billion in appropriated funds over the next five years. In fiscal year 2022, up to \$1 billion is available. The SS4A program funds regional, local, and Tribal initiatives through grants to prevent roadway deaths and serious injuries. The SS4A program supports Secretary of Transportation Pete Buttigieg's [National Roadway Safety Strategy](#) and the Department's goal of zero deaths and serious injuries on our nation's roadways. The fiscal year 2022 Notice of Funding Opportunity closed in mid-September.
- [Advanced Research Projects Agency – Infrastructure \(ARPA-I\)](#) is authorized under the BIL to invest in innovative technology research projects that industry is unlikely to conduct due to technical and financial uncertainty. ARPA-I will collaborate with forward-looking researchers and technology innovators in the public, private, academic and non-profit sectors. Once funded, ARPA-I intends to advance the transportation infrastructure of the United States by developing innovative science and technology solutions that—lower the long-term costs of infrastructure development, reduce the life cycle impacts of transportation infrastructure on the environment, contribute significantly to improving the safe, secure, and efficient movement of goods and people, and promote the resilience of infrastructure from physical and cyber threats; and ensure that the United States is a global leader in developing and deploying advanced transportation infrastructure technologies and materials.

V2X Communications Deployer Panel

Several transportation experts from leading edge deployers across the U.S. participated in person, virtually, and by video recording to provide an overview of their respective organization's experiences in deploying V2X technologies (communications and applications). Several themes that resonated through each of the panelist's remarks include the need for the FCC to grant pending LTE-V2X waiver requests, establish a licensing system with corresponding procedures and rules, and issue the final R&O; the need to have a commitment from automakers on integration of V2X technology within their production vehicles; and the desire to have the U.S. DOT establish a national plan for deployment. Each panelist noted the opportunity to save more lives with V2X and emphasized the need for further coordination among all stakeholders. For more specifics on panelist presentations, please see the V2X Communications [website](#).

U.S. DOT LTE-V2X Testing Observations & Test Certification Panel

The U.S. DOT LTE-V2X Test team presented an overview of their test approach and goals, the laboratory device characterization process, controlled-track testing parameters and scenarios, and the small-scale, large-scale, and real-world environment testing conducted between July 2021 and July 2022. Definitions for performance/assessment metrics were provided to support an understanding of the test results and observations from testing LTE-V2X:

- As individual devices (laboratory characterization)
- As part of small- and large-scale ad hoc V2X communications environments
- In the presence of Unlicensed National Information Infrastructure (UNII) interference, with and without congestion
- In non-congested and congested environments to understand the impact of density on scalability
- Investigation of the use of Global Positioning Systems (GPS).

The presentation provided instructions on how to access the test data, both as small sets of analyzed data and the entire raw data set. The test data may be accessed [here](#). The panelists emphasized that analysis is ongoing and that key results regarding UNII in-vehicle interference on LTE-V2X communications has not yet been completed.

The industry's ability to test devices before vehicle installation and with the infrastructure is an important step in creating certainty with any new technology. In addition to the test team overview, [OmniAir's](#) Executive Director Jason M. Conley provided an overview of the organization's certification programs, test procedures that are used in support of certification and how those procedures will adapt to the LTE-V2X test results, and upcoming Plugfest activities. Future cooperation areas that were highlighted include security, congestion control, interoperability, and interference.

ITS America Panel - V2X Survey Results Overview

Tim Drake, ITS America Vice President of Public Policy and Regulatory Affairs, provided an overview of the recent ITS America "Future of V2X Survey" results. Sixty-four responses were received representing input from IOOs, OEMs, and industry stakeholders. Detailed information on the survey and subsequent analysis may be reviewed [here](#). Future activities and next steps include continued research and analysis on defining the 30 MHz uses, work to define what constitutes "core" safety applications, and further examination of interference issues.

Industry Leadership Panel

Collectively, panelists emphasized the need for more regulatory certainty, strong leadership from the U.S. DOT, and the development of a National V2X Deployment Plan. AASHTO noted that States understand the safety benefits and are investing in infrastructure but desire a commitment from the OEMs. The Alliance for Automotive Innovation stated that progress should be much further along in V2X deployment, but seven years of regulatory uncertainty and changes in the Safety Band plan and technology have posed significant challenges to automakers. Several panelists noted that their organizations question where the U.S. DOT stands on V2X as no clear public statement has been made by the Secretary and/or Department on V2X. ITS America stated that the current approach to road safety is not working and stressed that furthering connectivity is essential to saving lives. All panelists emphasized that an official government strategy that includes a clear national strategy/framework for V2X is necessary. This framework was discussed as one of the key ways to advance the future of V2X deployment in the U.S., along with a clear policy statement on V2X from the U.S. DOT, and a list of proven Day-One applications.

National Telecommunications & Information Agency (NTIA) Remarks

On the first day of the summit, **Mr. Charles Cooper**, Associate Administrator, Office of Spectrum Management (OSM), NTIA, offered remarks to the audience, first noting that NTIA OSM experts have been working with the U.S. DOT's Spectrum Team to review and validate the V2X test results.

Mr. Cooper also presented important additional Federal efforts that offer new opportunities for further coordination on spectrum policy and spectrum management among Federal agencies. Mr. Cooper highlighted activities with the new Spectrum Coordination Initiative, the new Memoranda of Understanding (MOU) between the NTIA and FCC, and a new initiative to develop a National Spectrum Strategy.

National Transportation Safety Board (NTSB) Remarks

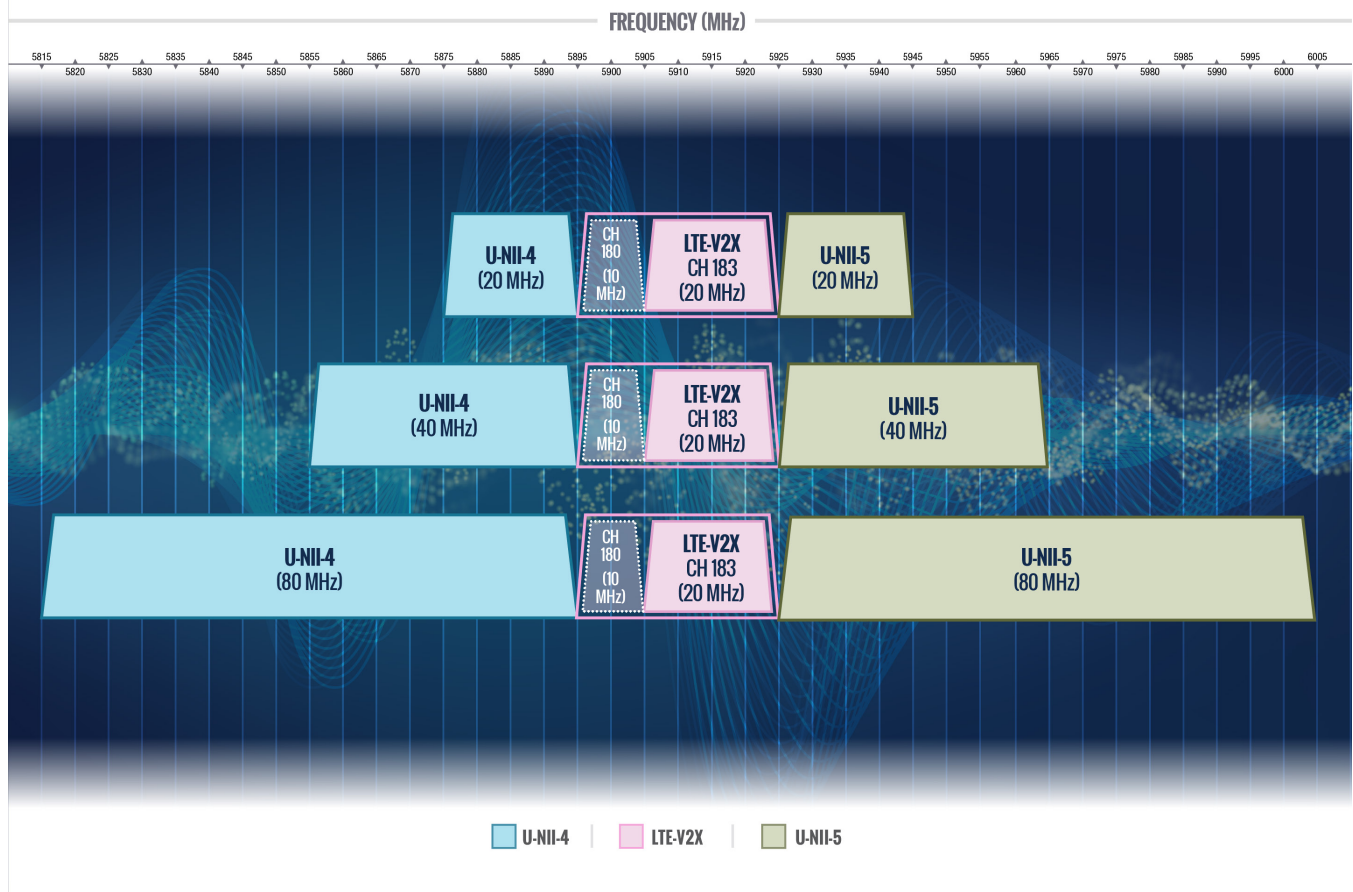
To open the second day of the summit, the **Honorable Michael E. Graham**, Member, NTSB [delivered a presentation](#) on the importance of V2X to transportation safety. Member Graham emphasized that with the nation's roadway fatalities continuing to increase, further enhancements to safety are critical and that V2X communications can offer layers of

additional protection. Member Graham highlighted several significant historical crashes that could have been mitigated or prevented if V2X communications and applications had been deployed. Member Graham also echoed other meeting participant remarks and emphasized the need for regulatory certainty, further coordination among OEMs, IOOs, and the Federal government, and a National V2X Deployment Plan.

Key Issues and Challenges to Deployment

The presentations, panelist discussions, audience question and answer, and breakout session discussions served as important inputs in framing a series of key issues that remain obstacles to stakeholders deciding to invest in and plan for V2X deployments. The issues and barriers discussed by summit participants are organized and summarized below.

Current V2X Band Plan



Challenges to Deployment and Use of the 30MHz

- **Regulatory Uncertainty:** Meeting participants emphasized that the FCC “needs to finish the job” and approve pending waiver requests, establish a licensing system and technical and operational rules of service for LTE-V2X, and issue the Second R&O so that the technical and operational rules for LTE-V2X may be understood.
- **Absence of OEM Deployment:** The lack of deployment by the OEMs was emphasized by many public sector attendees as a key hurdle to planning for future V2X investments.

- **Perceived Lack of Senior U.S. DOT Leadership Engagement:** Meeting participants urged the U.S. DOT to show more leadership in resolving the many conflicts and challenges that remain in enabling nationwide V2X deployment, including issuing a public statement that “V2X is a Departmental priority.”
- **Absence of a Suite of Proven Day-One Applications:** Participants noted that testing needs to be done to establish a set of core priority safety messages proven to work with the LTE-V2X technology and effective and safe for use within the 30 MHz.
- **Interference Risks from Unlicensed Users in Adjacent Channels:** Any potential risk of harmful interference from unlicensed users in adjacent channels must be thoroughly examined and tested, as these results will form a key part of the FCC’s Second R&O rules.
- **Misaligned Adoption Lifecycle between Telecommunications Technologies and Transportation Technologies:** Participants noted that the lifecycle for a new technology to be incorporated into U.S. production vehicles takes over 5 years and tends to last 17 years on average. IOOs noted the same issue with their capital planning and investment timeframes. However, new telecommunications technologies emerge every three years with each next generation of a telecommunication technology emerging approximately every decade. If communications technologies are not backward compatible, this creates significant investment and operations risks for transportation investments and operations.
- **Gaps in Supporting Technologies:** Gaps remain in supporting technologies such as the Security Credential Management System (SCMS) and other core elements. In addition, it is important to stakeholders to ensure that: certification test procedures and standards are comprehensive; and installation and validation tools and reference materials are available. Stakeholders discussed these gaps and turned to the U.S. DOT to identify how to facilitate completion.

Next Steps

Throughout the summit, U.S. DOT leadership and its technical team heard stakeholders discuss key actions needed by the Federal government to alleviate the current stalemate in investments and deployments by both the public and private sectors. Using many of the key issues and challenges identified during the breakout sessions and panelist discussions, the U.S. DOT has developed a preliminary list of actionable short- and long-term activities intended to address some of the key needs, gaps, and concerns. This list will be socialized with the stakeholder community for comment.

There are two, key, immediate actions called for by summit participants that the U.S. DOT will focus on first with industry partners:

1. Partnering with the FCC and the NTIA to resolve issues remaining with the 30 MHz allocation, including granting pending waivers to permit deployment of LTE-V2X technology immediately and issuing the Second R&O on final licensing rules that incorporate results from testing.
2. Working within existing partnerships with OEMs for both vehicles and devices, IOOs, V2X technology companies, ITS America, the Alliance for Automotive Innovation, AASHTO, ITE, and others to develop a unified vision and comprehensive plan for interoperable, cybersecure, connected deployments nationwide.

Additional Short-term Priority Actions (0 to 12 months)

Stakeholders requested additional short-term actions that U.S. DOT anticipates planning for and/or initiating within the next several months once feedback from industry partners has been received on this Summary document.

- **Establish regular coordination discussions with NTIA and FCC**

A uniform, whole of government strategy will continue to be fostered as a mechanism of trust that will aid in advancing future adoption and acceptance of V2X. To achieve this, U.S. DOT will work with NTIA and the FCC to foster greater regulatory certainty. This activity will include scheduling regular discussions with FCC on status of granting pending/future waivers, understanding the timing for when the second FCC Second R&O will be issued and conveying that to stakeholders, and articulating the need for establishing an online licensing system for LTE-V2X.

- **Complete examination and testing of UNII interference**

Results are needed to ensure that FCC Second R&O rules are protective of V2X in the 30 MHz.

- **Further engage U.S. DOT political leadership on importance of V2X to the nation**

U.S. DOT political leadership will be briefed about the stakeholders' need for the Department to issue a public statement on the importance of V2X to road safety and that V2X is a high priority within the Department.

- **Conduct a V2X Communications Summit 2.0**

The U.S. DOT will reconvene this summit group with a regular cadence to discuss and make progress on resolving issues and obtaining input on actions. This activity will also align with the development of a V2X Vision and the Comprehensive Plan.

- **Prioritize funding for V2X**

During the Summit, the U.S. DOT [presented on available options](#) including [grant funding](#) and formula funding opportunities.

Longer-term Priority Actions (1 to 5 years)

The longer-term actions detailed below were articulated by summit participants and represent current unmet needs and gaps which create further hurdles for V2X deployments. These activities may be considered for funding in future research program activities.

- **Mature the SCMS—a key aspect of interoperability**

Meeting participants pointed to the need for further evolution and maturing of the security credential management system. Participants stressed the importance of the existing system and emphasized a need to build from the current foundation. They also highlighted additional needs including governance and security policies (such as criteria for security being enabled to receive certificates), processes for how to construct the certificates or refresh certificate batches, a crosswalk of the policies/processes with standards (including work on 1609.2 processing), guidance on co-mingling test certificates with production/commercial certificates, misbehavior detection, and demonstrations of the Day One applications with properly vetted certificates going through the entire certification process.

- **Establish a Day-One LTE-V2X Application Inventory**

A major concern of IOOs was the lack of commercially available V2X applications that are proven to be effective at improving safety and work with LTE-V2X technologies.

- **Develop technical LTE-V2X installation guidance and education**

Many IOOs and other stakeholders need further guidance for technical staff on installation of devices, including validation of the installations.

- **Ensure that standards and test procedures are complete for LTE-V2X**

Stakeholders requested U.S. DOT ensure that standards and test procedures are complete and comprehensive to support LTE-V2X deployments. They called for deployment test tools that can validate conformance and interoperability in both device and system levels. Additional recommendations included minimum device requirements for on-board units (OBUs) and assurance of devices with the latest global navigation satellite systems/ GPS technologies.

- **Identify V2X applications that can use non-dedicated spectrum to realize additional V2X benefits**

Stakeholders were excited to learn about potential methods for V2X applications and services to work outside of the 30 MHz dedicated spectrum, but they recognized that additional technological development may be needed to assure interoperability. Stakeholders discussed the value of testing and demonstration of V2X applications in non-dedicated spectrum once the technical issues are resolved.

- **Establish a public adoption campaign to communicate benefits to a broader set of decision-makers**

As V2X deployments move forward, meeting participants urged the U.S. DOT to establish a public adoption campaign. This campaign would reinforce the message of safety for all road users including groups not typically engaged in the V2X discussions, such as bicycle and pedestrian safety advocacy groups, among others. It could also create interest from users who might deploy more quickly than OEMs or IOOs (e.g., vehicle fleet owners).

Conclusion

V2X represents a transformative opportunity to reduce the number of lives lost on our nation's roadways (both in-vehicle and pedestrian), but all parties must work together under the current regulatory framework to rethink our approach to road safety so that we can advance V2X deployment. As Deputy Assistant Secretary Hampshire said in his closing remarks, **this serves as “our call to action.”**

While there appears to be universal agreement among all stakeholders that safety is paramount and that connectivity plays a vital role in furthering future safety advances, many issues still remain to determine how the 30 MHz will be most effectively used.

After enduring seven years of regulatory uncertainty, this community acknowledges that **the time is now and that we need to “use it or we will lose it”** – otherwise we face the risk that the 30 MHz spectrum currently allocated to ITS applications will be repurposed.

One of the key takeaways from this two-day summit was the desire for the U.S. DOT – in partnership with others in the ITS community – to develop a vision for nationwide interoperable and cybersecure V2X-based CV deployments. Attendees' expectations are for the U.S. DOT to work in an open, collaborative, and transparent manner with the FCC and NTIA to resolve any remaining issues to achieve interoperable connectivity (including addressing in-vehicle interference).

Over the next several months, the U.S. DOT will facilitate development of this vision that will serve as a key element of a national V2X Deployment Plan. This plan will be developed in a collaborative, transparent manner with engagement and input from all interested stakeholders.

Additionally, the U.S. DOT will establish a series of meetings in the coming year that will build from the discussions that took place during the summit. These meetings will be held regularly and used to further the V2X Deployment Plan and address/resolve short- and long-term priorities.

Information on all these activities will be posted in the coming months on the new [ITS/V2X Communications website](#).

Appendix A: Summit Agenda

Agenda for August 24* Identifying a Path Forward for V2X Deployment	
8:00 to 8:45 am	Event Registration/Launch of Virtual Platform
8:45 to 8:55 am	Housekeeping Items <ul style="list-style-type: none"> Suzanne Sloan, Technology Policy Advisor, Volpe National Transportation Systems Center, U.S. DOT
8:55 to 9:00 am	Welcome <ul style="list-style-type: none"> Egan Smith, Acting Director, ITS JPO, U.S. DOT
9:00 to 9:15 am	Setting the Stage for the Summit: Deploying V2X <ul style="list-style-type: none"> Dr. Robert C. Hampshire, Deputy Assistant Secretary for Research & Technology and Chief Science Officer, U.S. DOT/ OST-R
9:15 to 9:55 am	U.S. DOT Grants with V2X Opportunities <ul style="list-style-type: none"> David Harris, Program Manager, Federal Highway Administration (U.S. DOT/ FHWA): ATTIMD Ben Levine, Senior Advisor for Research and Technology, Office of the Assistant Secretary for Research and Technology (U.S. DOT/ OST-R): (SMART) Mike Griffith, Director of the Office of Safety Programs (U.S. DOT/ FHWA): (SSA4) Chris Atkinson, Deputy Director for Advanced Research (U.S. DOT/ OST-R): (ARPA-I)
9:55 to 11:30 am	V2X Deployer Panel <ul style="list-style-type: none"> Steve Kuciemba (Panel Moderator), WSP, Chair of the ITS America Standing Committee on V2X and Connected Communications, Introductions Brian Cronin, Director, Office of Safety and Operations Research and Development, U.S. DOT/ FHWA, Connectivity for a Safe, Efficient, Equitable, and Resilient Transportation System Blaine Leonard, Transportation Technology Engineer, Utah DOT (pre-recorded), Deploying Connected Vehicle Systems: Utah's Experience John Hibbard, Operations Division Director, Georgia DOT, Georgia Connected Vehicles Ashley Nysten, Assistant Director for Mobility Technology, Colorado DOT (pre-recorded), Colorado DOT Connected Vehicle Program – Deployer Experiences Debra Bezzina, Managing Director, Center for Connected and Automated Transportation & Senior Program Manager, Ann Arbor Connected Vehicle Test Environment, University of Michigan, The Ann Arbor Connected Environment Audience Q & A

Agenda for August 24* | Identifying a Path Forward for V2X Deployment

11:30 to 11:45 am	BREAK
11:45 am to 1:15 pm	<p>U.S. DOT LTE-CV2X Testing: Data Analysis and Observations on Technology Performance, Interference Performance, and Adequacy of the 30 MHz</p> <ul style="list-style-type: none"> • Dr. Jonathan Walker (Panel Moderator), Division Chief, Policy, Architecture, and Knowledge Transfer, U.S. DOT/ ITS JPO • Jeff Bellone, Economist/Systems Engineer, U.S. DOT/ Volpe Center • Tom Schaffnit, Operations Research Analyst, U.S. DOT/ Volpe Center • Walt Fehr, Principal Technical Advisor, U.S. DOT/ Volpe Center • Jason Conley, Executive Director, OmniAir, OmniAir’s Readiness Program • Audience Q&A
1:15 to 2:15 pm	LUNCH BREAK
2:15 to 2:20 pm	<p>Welcome</p> <ul style="list-style-type: none"> • Karen Van Dyke, Director, Office of Positioning, Navigation, and Timing & Spectrum Management, U.S. DOT/ OST-R
2:20 to 2:30 pm	<p>National Telecommunications and Information Administration (NTIA)</p> <ul style="list-style-type: none"> • Charles Cooper, Associate Administrator, Office of Spectrum Management, NTIA
2:30 to 3:30 pm	<p>Initial Thoughts on V2X Deployment within 30 MHz: ITS America Survey Results</p> <ul style="list-style-type: none"> • Tim Drake, Vice President, Public Policy and Regulatory Affairs, ITS America • Audience Q&A
3:30 to 3:45 pm	BREAK
3:45 to 4:30 pm	<p>A “Thought-Vision Panel” Broadening ITS Communications to Optimize Public Benefits of V2X</p> <ul style="list-style-type: none"> • Suzanne Sloan (Panel Moderator), Technology Policy Advisor, U.S. DOT/ Volpe Center • John Harding, Team Leader Connected Vehicles & Emerging Technologies, U.S. DOT/ FHWA • Steve Sill, Architecture, Standards, and Cybersecurity Program Manager, U.S. DOT/ ITS JPO, System of Systems Architecture Perspective: Concepts for Optimizing Public Benefits from V2X Communications • Audience Q&A
4:30 to 4:45 pm	<p>Summary of Day One + Agenda for Day Two: Near-Term Actions & Requirements and Future a Vision</p> <ul style="list-style-type: none"> • Suzanne Sloan, Technology Policy Advisor, U.S. DOT / Volpe Center
4:45 PM	Conclude Day One

Agenda for August 25* | Stakeholder Forum: The Future of V2X

8:00 to 8:45 am	Event Registration/Launch of Virtual Platform
8:45 to 8:55 am	Introduction/Housekeeping Items <ul style="list-style-type: none"> • Suzanne Sloan, Technology Policy Advisor, U.S. DOT/ Volpe Center
8:55 to 9:00 am	Welcome <ul style="list-style-type: none"> • Dr. Robert C. Hampshire, Deputy Assistant Secretary for Research & Technology and Chief Science Officer, U.S. DOT/ OST-R
9:00 to 9:30 am	National Transportation Safety Board: The Safety Promise of V2X <ul style="list-style-type: none"> • The Honorable Michael E. Graham, NTSB Member
9:30 to 9:40 am	Audience Engagement on Day One Topics: Breakout Session Instructions Suzanne Sloan, Technology Policy Advisor, U.S. DOT/ Volpe Center
9:40 to 11:00 am	Breakout Session #1: Four Topics to Discuss Challenges and Near-Term / Longer-Term Needed Actions <ol style="list-style-type: none"> 1. Path to Using the 30 MHz 2. Technology Advancement 3. Path to V2X Deployment 4. Establishing Certainty
11:00 to 11:15 am	BREAK
11:15 am to 12:00 pm	Breakout Summaries
12:00 to 1:15 pm	LUNCH
1:15 to 2:00 pm	Industry Panel: The Path to Deployment <ul style="list-style-type: none"> • Chris Armstrong (Panel Moderator), Vice President, Smart Mobility Office, Panasonic Corporation of North America • Laura Chace, President and CEO of ITS America • Jim Tymon, Executive Director, American Association of State Highway and Transportation Officials (AASHTO) • Hilary Cain, Vice President of Technology, Innovation, and Mobility Policy, Alliance for Automotive Innovation

Agenda for August 25* | Stakeholder Forum: The Future of V2X

2:00 to 3:30 pm	<p>Breakout Session #2: Industry Sector Discussions</p> <ul style="list-style-type: none"> • Federal Government • State Departments of Transportation • Infrastructure • Vehicle Manufacturers, Suppliers, Device Manufacturers, Chip Makers • Standards • Associations/Advocacy Organizations
3:30 to 3:45 pm	<p>BREAK</p>
3:45 to 4:45 pm	<p>Reconvene Industry Panel</p> <ul style="list-style-type: none"> • Chris Armstrong (Panel Moderator), Vice President, Smart Mobility Office, Panasonic Corporation of North America • Laura Chace, President and CEO, ITS America • King Gee, Director of Safety and Mobility, AASHTO • Hilary Cain, Vice President of Technology, Innovation, and Mobility Policy, Alliance for Automotive Innovation • Egan Smith, Acting Director, U.S. DOT/ ITS JPO
4:45 to 5:00 pm	<p>Closing Remarks</p> <ul style="list-style-type: none"> • Dr. Robert C. Hampshire, Deputy Assistant Secretary for Research & Technology and Chief Science Officer, U.S. DOT/ OST-R
5:00 pm	<p>Conclude Day Two</p>

Appendix B: Breakout Session Summaries

Breakout Session Summaries, Needs, & Actions

The following table lists the summit’s breakout sessions’ action items, summaries, and associated needs articulated by meeting participants. To keep this document concise, the summaries do not include redundant needs across breakout groups in the short-and long-term actions.

Breakout Session #1: Stakeholder Identified Short-term Action Items	
Proposed Action Items	Notes/Dependencies
Approve pending FCC waivers	Stakeholders recognized a reliance on FCC to take action to grant waivers. Noted that it needed to be the first step.
Prioritize basic safety messages (BSM), signal phase and timing (SPaT), and MAP messages	Stakeholders noted an issue about consensus among IOOs on prioritization of message types that will work within 30 MHz. Stakeholders recognized a need to establish consensus on what message types are high priority with IOOs and how those priorities will work within the new band plan. Some IOOs want more flexibility than others.
Develop tools and documentation guidance to support aftermarket installation of OBUs	Stakeholders identified a need for deeper technical guidance with device and system implementation that goes beyond the technical guidance provided by LTE-V2X vendor/suppliers; asked U.S. DOT to consider establishing a research project and identify funding to develop such technical guidance.
Develop Federal interagency level leadership and mandates, especially from U.S. DOT and FCC	Stakeholders requested that the Federal agencies form a transparent, working relationship to move V2X deployment forward.
Increase senior Federal leadership, including revision or removal of the National Highway Traffic Safety Administration (NHTSA) Notice of Proposed Rulemaking (NPRM)	Stakeholders asked that NHTSA take action to revise or remove the NPRM.
Improve the FCC’s waiver approval process	Stakeholders requested the streamlining of the FCC waiver process, including the ability to track a waiver request through to its completion.
Increase communication to the public, law makers, and automotive executives	Stakeholders asked for a public education campaign to incorporate other stakeholders and key decision-makers into the movement of nationwide V2X deployment. Stakeholders noted that it may require U.S. DOT support of the scope, cost, and outreach.
Establish an IOO Community of Practice	Stakeholders made the request that the U.S. DOT facilitate and support the establishment of a community of practice whereby results from planning, implementing, testing, and operating with V2X technologies can be shared among public sector agencies.

Breakout Session #1: Stakeholder Identified Long-term Action Items

Proposed Action Items	Notes/Dependencies
<p>Coordinate technical activities between OEMs and IOOs to ensure interoperability across the nation</p>	<p>How to establish and confirm true national interoperability was recognized as a priority but also a very broad need that will require discussion and consensus building within and among two groups. Stakeholders desire U.S. DOT leadership to facilitate coordination as well as to identify the technical steps required for this interoperability, the gaps remaining, and plans for how to address those gaps.</p>
<p>Establish a certification and testing process for deployers, not just devices; advance the SCMS and its components</p>	<p>Stakeholder discussed the existing certification and testing processes that deployers rely upon to ensure that their deployments are performing properly and are safe, secure, and interoperable. Stakeholders identified gaps and requested that plans include activities to address these gaps. Gaps include, among others:</p> <ul style="list-style-type: none"> • Ensuring the integrity V2X data so that both OEMs and IOOs can rely upon the data • Supporting the move from test security credentials to production security credentials—including new tests that ensure that the credentials perform properly and are secure • Establishing a more complete SCMS manager capability by working on the policy/governance associated with the granting of security credentials to ensure that if vehicles request and are granted unique permissions (i.e., signal preemption for emergency response vehicles), that the credentials are supplied to the appropriate agencies with the authority to use those permissions. • Maturing the misbehavior detection capabilities. • Working to improve the testing processes to include baseline test parameters, encourage more testing nationwide, and establishing a platform to share test results.
<p>Ensure adequacy of the 30 MHz spectrum and realization of more V2X benefits outside of the 30 MHz spectrum</p>	<p>Stakeholders discussed use cases that can be supported outside of dedicated spectrum, such as using existing unlicensed Wi-Fi, cellular networks, or IP-based communications. If possible, stakeholders requested analysis on which applications could work effectively and safely outside of the dedicated spectrum, demonstrations, and test results on how they perform to identify constraints and updating of the National ITS Architecture reference to reflect these new use cases.</p>

Breakout Session #1: Stakeholder Identified Long-term Action Items

Proposed Action Items	Notes/Dependencies
<p>Develop Day-One Application Inventory</p>	<p>Stakeholders recognized that developing a proven Day-One Application Inventory depends on applications IOOs and OEMs desire to see in use first, followed by addressing the remaining gaps, including national interoperability.</p> <p>Stakeholders pointed to the prioritization of delivery fleets because they offer a win-win situation (improved safety and improved logistics), noting that commercial vehicle applications could establish robust nationwide use of the spectrum earlier than other applications.</p>
<p>Incorporate more vulnerable road user (VRU) applications</p>	<p>Stakeholders requested more research into the challenges associated with VRU applications noting that there is a reliance on cell phones that can be leveraged, but also noting that VRU applications are challenging given unpredictable movements. Stakeholders discussed how geofencing sidewalks and other locations could be done to indicate to portable V2X devices (e.g., a V2X radio in a smart phone) that an area might or might not indicate a hazard.</p>
<p>Develop backward compatibility with future generations of V2X technologies</p>	<p>Stakeholders are cautious about implementation plans and the potential for the 4G-based LTE-V2X technology to be taken out of use before nationwide deployment is realized. They discussed the need for backward compatibility with future cellular generation versions (5G/6G/7G) because vehicles and infrastructure equipment have a longer useful life than communications technologies. Some stakeholders identified that some work was ongoing within standards communities, but that it applied more to the 5G+ networked communications versus the V2X broadcasts.</p>
<p>Incorporate V2X into NHTSA's New Car Assessment Program or a future Federal Motor Vehicle Safety Standard</p>	<p>Stakeholders recognized a dependency on NHTSA to decide what actions make most sense for these programs.</p>
<p>Regulate the inclusion of V2X connectivity technology in all vehicles</p>	<p>Given the complexity of national deployment and interoperability, some stakeholders questioned whether a regulatory or legislative action was needed to ensure that V2X connectivity can become a reality. To enact this option, actions would be needed by NHTSA or Congress. Stakeholder recognized that in lieu of these types of governmental mandates, it may be possible to form an industry consortium to advance deployment. Stakeholders requested U.S. DOT facilitation and coordination to help form a consortium.</p>

Path to Using the 30 MHz / Spectrum Band Plan

The **Path to Using the 30 MHz** session's goal was for participants to discuss how they envision using the 30 MHz, and what needs to happen to ensure the use of the 30 MHz. This breakout session followed an ITS America presentation on its recent survey. The presentation focused on how best to use the 30 MHz and uncovered areas of consensus and uncertainty. The survey's goal was to gain consensus around some key issues such as whether the spectrum use should be the same across the U.S. or whether it can/should be flexible. Other discussion topics included priority applications for the 20 MHz and 10 MHz channels. Moderators received the following prompt questions for this session:

- What are the needs/requirements for using the 30 MHz?
- Are there a minimum set of messages that should always be supported in the 30 MHz (BSM, SPaT, MAP, etc.), both in the 20 MHz channel and 10 MHz channel? Should this set of messages be dependent on the specific geographic location (urban intersection, rural highway, etc.)?
- Are there specific applications that should be prioritized (vehicle interaction/safety, work zone, emergency vehicle, etc.) in the 30 MHz spectrum or the 20 MHz channel? What other types of applications should be prioritized?
- Should we define what constitutes "core safety" applications? If so, who should be responsible for establishing those definitions and what factors should be considered?
- Should deployers, specifically IOOs, be provided the flexibility to determine what is supported beyond the BSM types? Is it possible to have differences in different geographic areas?
- What are issues that need to be addressed with the use of the 10 MHz Channel 180 in advancing V2X?

Session participants discussed prioritization of SPaT and MAP messages in addition to BSM. Secondary priorities would include traffic signal prioritization and freight prioritization. However, participants noted that it is important to begin work on deploying safety messages while continuing to prioritize. There was some disagreement about whether to include VRUs when designing BSMs, or whether BSM should only refer to the actions needed to be taken by a driver or vehicle. The group also discussed the need for the FCC to approve existing waivers in order to allow the industry to move forward as well as the need to move from pilots to deployment. Much of the time was spent discussing which messages should go on which channel and how to best allocate the spectrum.

Consistent themes heard throughout this session included the need for:

- Prioritization of BSM, SPaT, and MAP messages
- Approval of FCC waivers
- Coordination between OEMs and IOOs to ensure interoperability across the nation
- A certification and testing process for deployers
 - A "DMV for connectivity" that establishes the basis for issuing security credentials, managing applications, and performing operations
- Improvement in testing processes including more testing nationwide, a platform to share test results, and baseline test parameters
- A method to drive adoption, which could take the form of a standard or an economic incentive (possibly through insurance).

Unique themes heard throughout this session included the need for:

- A better understanding of whether 30 MHz is enough to handle all the use cases with reference to the recently released ITS America findings that suggest it may not be
- A better understanding of whether one radio will be enough to receive information from both channels at the same time
 - A participant clarified that second radio does not double the cost, but is an incremental cost increase for a specific part
- Investigation of the possibility for MAP and SPaT messages to be transferred over Wi-Fi channels, since they are not necessarily safety critical
 - This could negatively affect pedestrians and cyclists
- Allowing IOOs the flexibility to determine what messages to support (beyond BSM)
- Looking to Europe and China who have already implemented the technology
- Prioritization of delivery fleets since they offer a win-win situation (improved safety and improved logistics)
- Research into the challenges associated with VRUs such as equity due to reliance on cell phones, unpredictable movements, and a need for geofencing sidewalks and other locations that do not indicate a hazard.

The Path to Technology Advancement

The **Path to Technology Advancement** session's goal was to have participants discuss the results of the V2X Spectrum Team's presentation on the issues with the devices and how to mature them. Moderators received the following prompt questions for this session:

- What are needs/requirements for evolving LTE-V2X technology to put into use on a large-scale?
- What are near-term and longer-term actions needed in evolving the technology?
- Did the LTE-V2X testing provide enough insight into how the LTE-V2X signal is employed within ad hoc environments? Is there anything stakeholders perceive to be missing?
- Do we need to revisit the new LTE-V2X standards, algorithms, and rules to ensure that the LTE-V2X technology is as effective as it can be given that the technology is based on revised/repurposed DSRC standards, algorithms, and rules?
- What other standards or test procedures might be needed?
- Is there anything else that stakeholders want to test or retest?
- How do we think about 5G and 5G-V2X?

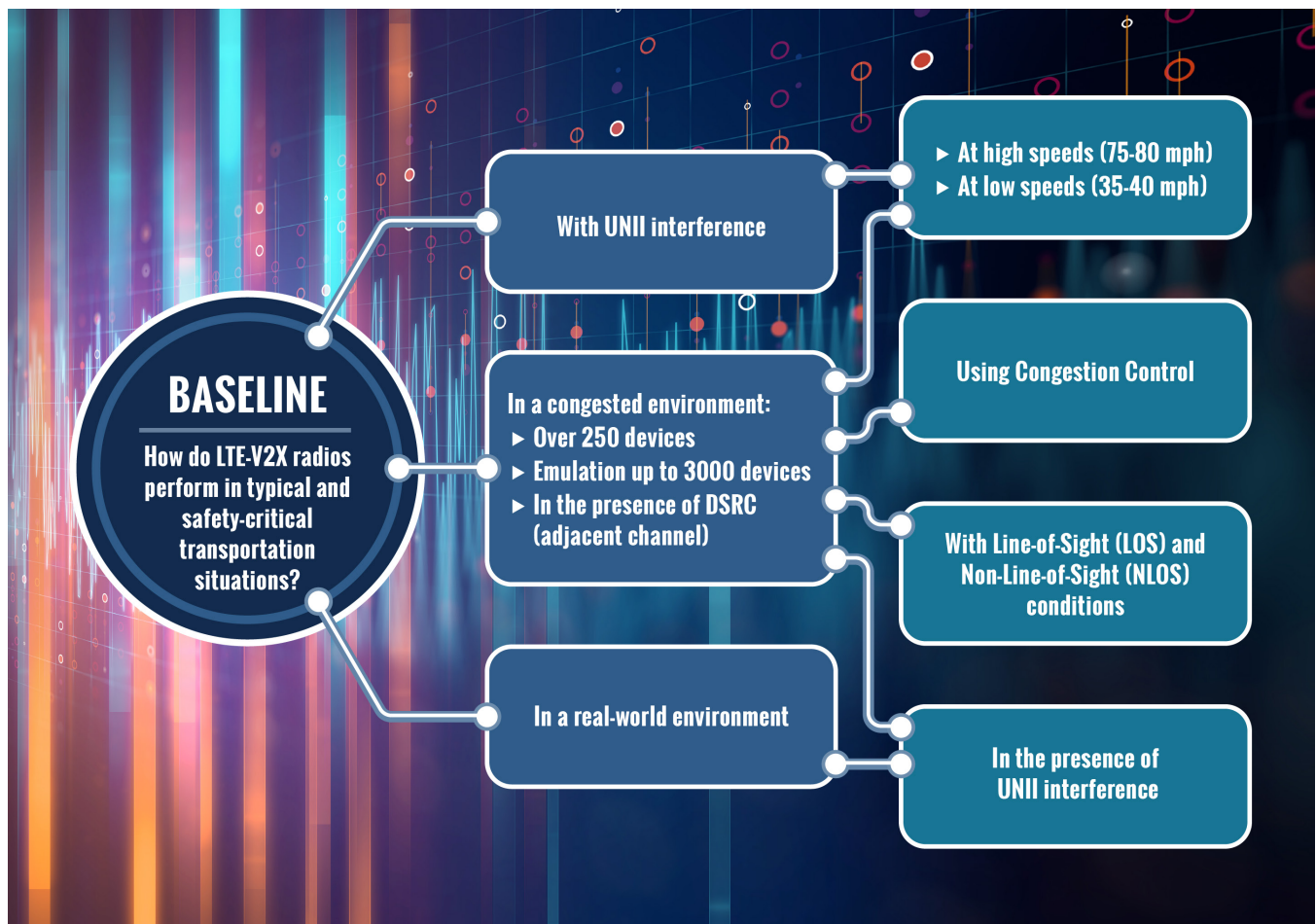
Session attendees included representatives from device OEMs, cellular networks, vehicle/device certifiers, and researchers. A major theme discussed was how to continue and expand active deployments of V2X technology to achieve more adoption. Discussion revolved around additional and/or more flexible funding for IOOs and better technical support for OBU. Another key topic was lingering concerns about scaling LTE-V2X and further testing that could be done to understand future performance constraints. Participants highlighted high vehicle densities, network topology, and security credentials as additional use cases worth testing. Additionally, device testing through OmniAir could address concerns about GPS accuracy. Lastly, participants generally agreed that many V2X use cases do not require the latency provided by LTE-V2X and could instead be satisfied by other spectrum or the existing cellular network.

Consistent themes heard throughout the sessions included the need for:

- Consideration of uses cases that can be supported outside of dedicated spectrum, such as using LTE/4G cellular networks, and clarity on which applications should use dedicated spectrum
- Deployers to move forward with projects based on what technology is currently available
- Tools and documentation to support aftermarket installation of OBUs
- Business models which can maintain and support technology into the future
- Long-term support of LTE-V2X through backward compatibility with future versions (5G/6G/7G) because vehicles have a longer useful life than other technology
- Incorporating V2X into the New Car Assessment Program or a future Federal Motor Vehicle Safety Standard
- Worldwide perspective in choosing a preferred technology.

Unique themes heard throughout the session included the need for:

- Devices (OBUs and RSUs) to support multiple communication interfaces
- Certification and testing to verify SPaT and other information coming from infrastructure
- Defining 5G's role in current technology landscape
- Continued use of DSRC because of the amount of prior work with it and existing deployments.



The Path to V2X Deployment

The **Path to V2X Deployment** session's goal was to have participants discuss the challenges, opportunities, and lessons learned associated with LTE-V2X deployment, and what is needed for them to move forward. Moderators received the following prompt questions for this session:

- What hinders deployment? What is needed or required from an OEM perspective? From an IOO perspective? From a device manufacture perspective?
- How do we move forward collectively?
- What are the risks that need to be minimized?
- How do we think about technology lifecycle concerns?
- What is the role of no-5.9 GHz communications? How do we ensure interoperability?
- What processes/procedures are needed to move forward with deployment?
- Has the definition of “no-regrets elements of V2X infrastructure” been helpful to moving forward to use the 30 MHz? What else is needed?
- Can grants/challenges and other incentives be helpful in accelerating deployment?
- Other standards needed?

This session received participants from automotive OEMs, OEM industry groups, university researchers, State DOTs, interdisciplinary engineering and transportation consultants, software-as-service (SaaS) providers, wireless providers, ITS professional groups, and VRU interest groups.

Participants discussed V2X commercialization and its associated challenges, risks, and rewards. Participants largely agreed that mandates are recognized as effective pathways for the deployment and commercialization of any vehicle technology. The lack of a mandate and work at the State-by-State level may have fragmented and undermined DSRC deployment. The FCC may interpret Federal operations on the bandwidth differently than State operations on the bandwidth.

V2X commercialization may be an effective pathway for V2X but regulatory uncertainty disincentivizes private industry to make major research, development, and deployment investments. One participant suggested that many OEMs have stopped V2X development (to a degree) because highly anticipated DSRC technologies never deployed. Deployment likely remained slow in later years without a mandate or unified vision. There was recognition that the 2008 to 2009 financial crisis hindered DSRC deployment efforts.

Federal leadership could address these and additional deployment and risk mitigation needs. For instance, OEMs (and IOOs) feel pressure to spearhead V2X deployment in a market with already existing challenges, such as electrification and supply-chain concerns. Furthermore, a federated approach may be in the nation's own economic self-interest. The U.S. relinquishes economic influence without serious consideration for V2X standards and the discipline will continue to advance in nations that have executive leadership support. This would require the U.S. DOT, FCC, and other Federal agencies to work together.

The discipline should meanwhile focus on technical certifications, as these will encourage interoperability and a sense of trust among stakeholders. The discipline should expand its pool of stakeholders. It's possible that current stakeholders have now exhausted the utility of their partnerships. Incorporating V2X beneficiary groups and new key decision-makers may unleash new opportunities for V2X deployment. New stakeholders should include the public at-large, consumers, and uncontacted advocacy groups.

Consistent themes heard throughout this session include the need for:

- Federal interagency level leadership and mandates, especially from the U.S. DOT and FCC
- A collective strategy among current and new stakeholders for V2X deployment
- Commercialization of V2X technology
- Certifications, testing, validation, and trust, which are all critical to commercialization
- Recruitment and engagement with new stakeholders.

Unique themes heard throughout this session include the need for:

- FCC approval of pending waivers
- FCC finalization of 30 MHz spectrum rules
- Awareness that vehicle ownership trends may change over the next several decades, with some consumers demonstrating preference for Mobility-as-a-Service (MaaS) trips and subscriptions
- Awareness that wireless technology lifecycles are relatively short compared to the generation lifecycle of a typical consumer vehicle
- Consistent V2X experience for end users (noting that commercialization may fail without it)
- Recognition that V2V deployment opportunities may be reconsidered with V2I commercialization (practitioners may want to conceptualize V2X in deployment phases)
- Expansion of fleet owner Federal recruitment efforts (especially traffic incident management related vehicles, such as towing and fire, that may still offer new areas for V2X deployment)
- Fewer V2X pilots and demonstrations that may be redundant at this point.

Establishing Certainty

The **Establishing Certainty** session's goal was to have participants discuss the policy and other issues that need to be addressed for LTE-V2X deployment to move forward. Moderators received the following prompt questions for this session:

- What are the needs and requirements for establishing certainty and stability to achieve wide-scale deployment?
- What are the needs/requirements that may not be met through FNPRM, Second R&O and waivers?
- Are other standards needed to support transition?
- Did the U.S. DOT's LTE-V2X testing give enough insight into how the LTE-V2X signal is employed within ad hoc environments? Is there anything stakeholders perceive to be missing?
- What does connectivity mean for transportation, both in the near-term or for the future?
- What does connectivity mean for automation? For digital infrastructure? What are needs/requirements?

This session's participants primarily represented the automotive industry and associations/advocacy groups. A major discussion theme was the need for a national unified vision and strong Federal leadership, primarily from NHTSA. The group discussed the industry's wariness to take the lead on deployment due to the changes in technology, reduction of the spectrum, and fear of losing the remaining spectrum. The auto industry explained the importance of a mandate requiring the implementation of connectivity technology. A mandate would level the playing field, allowing companies to skip a benefit/cost analysis and move straight into implementation. Another challenge discussed was the long lifespan of vehicles compared to the much shorter lifespan of technology. The group discussed the need for increased communication with the public, law makers, and automotive executives. These stakeholder groups should be better educated to understand the technology and its benefits to drive demand. IOOs expressed challenges with securing

funding for technologies and cyber security, noting that leveraging grants and establishing a community of practice would be helpful.

Consistent themes heard throughout this session included the need for:

- Federal leadership, including revision or removal of the NHTSA NPRM
- Improvement in the FCC's waiver approval process
- Interoperability between manufacturers and across jurisdictions
- A regulation requiring the inclusion of connectivity technology in all vehicles
- Increased communication to the public, law makers, and automotive executives
- Establishment of a more comprehensive SCMS Manager
- Reconciling long lifecycle of vehicles with much shorter lifespan of technology
- Establishing an IOO Community of Practice.

Unique themes heard throughout this session included the need for:

- Infrastructure investment (e.g., signal countdown) to provide immediate benefits to connected vehicles while awaiting mass penetration
- An industry consortium to advance deployment in the absence of a NHTSA mandate
- Clarity around industry terminology to prevent experiencing the issues previously faced by the Advanced Driver Assistance Systems industry
- Public education regarding Federal funding opportunities for CV2X technology.

Breakout Session #2—Industry Discussions

In the second breakout session, participants were grouped by industry to discuss what advancements can be made in their respective industry and what they would like to see from other industries. The industry groupings were as follows:

- Federal Government
- State Government
- Infrastructure Deployers
- Standards Organizations
- Vehicle Manufacturers/Suppliers/ Technology and Device Manufacturers/Chip Makers.

Moderators received a list of questions to guide the hour-long discussion. The action items discussed in the sessions are listed below.

Moderators for all of the sessions received the same prompts:

- Having gone through the summit discussions, what does “certainty” look like? What needs to happen to establish “certainty”?
- If we had “certainty”, what would our industry sector do with it?
- What can this industry sector commit to doing? What are 3 to 4 actions that the “we” (the industry sector) might be able to take?
- What are 3 to 4 actions “we” need other industry sectors to take so that our industry can perform its role?

The following summary of proposed action items and notes/dependencies highlights additional items that were either not highlighted in Breakout Session #1 or where Breakout Session #2 added more details..

Breakout Session #2: Summary of Proposed Short-term Action Items

Proposed Action Items	Notes/Dependencies
<p>Ensure Federal leadership, including a national plan with a timeframe and targets</p>	<p>Stakeholders pointed to senior U.S. DOT staff to engage political leadership on the importance of V2X for connectivity and safety, and establish a National plan with commitments from the modes that identify the number and types of deployments that they can/will commit to making happen with State and local agencies and industry. Some stakeholders noted that this type of document would be similar to the 2012 Footprint Analysis written for DSRC deployments.</p>
<p>Establish a working group between U.S. DOT, FCC, and NTIA</p>	<p>Stakeholders noted the importance of seeing that these three agencies are working in sync to ensure nationwide V2X deployment happens. They noted that some mechanisms are in place that can be leveraged to form a working group that meets regularly and reports out progress. Stakeholders noted that this would help in establishing certainty for their deployments.</p>
<p>Ensure Federal leadership and a national strategy that ensures nationwide interoperability</p>	<p>Stakeholders discussed the value of a national vision and roadmap that identifies key deployment targets and milestones for deployments. A comprehensive plan would help to set expectations and metrics to help measure performance on a regular basis.</p>
<p>Gather support for V2X adoption by State and local agencies and industry partners</p>	<p>Stakeholders noted that many V2X organizations and companies are struggling both with decision-making and finances, given the uncertainty of the last decade. Stakeholders asked for renewed work on business models and additional messaging on the value of V2X for crash prevention in order to encourage adoption. Stakeholders noted the need for more materials on the benefits of V2X to tell the story to decisionmakers and the public (safety benefits, environmental benefits).</p> <p>These materials can also encourage accelerated use of the 30 MHz spectrum to ensure that this spectrum is also not taken away from the transportation industry.</p>
<p>Develop Deployment guides (different from a standard)</p>	<p>As noted in the summary from Breakout Session #1, IOOs desire more technical materials to support deployment planning, implementation, testing, operations, and maintenance. Session #2 discussions noted a need for including “work-flow” descriptions to help implementers better understand design and testing of their deployments.</p>

Breakout Session #2: Summary of Proposed Long-term Action Items

Need	Notes/Dependencies
Address NTSB recommendations	Stakeholders found that the NTSB recommendations resonated with the reasons for their deployments; and they requested that U.S. DOT conduct a thorough review of the recommendations to determine feasibility of acting upon and implementing them.
Establish a national roadway digital infrastructure strategy that can serve V2X and V2I applications	Stakeholders identified that V2X communications are a critical enabling element of a broader digital infrastructure strategy. There is a need to identify and describe the role of V2X communications technologies and applications in this broader digital goal. Thus, the request was made for U.S. DOT to establish a national roadway digital infrastructure strategy.
Develop a licensing process for the 30 MHz	Stakeholders recognize that once the LTE-V2X waivers are granted, that the FCC will need to describe and implement a clear licensing process for the 30 MHz.
Grant funding to signal support for V2X deployment as well as increased integration of V2X into other U.S. DOT funding (not just “innovation” programs)	Stakeholders supported the U.S. DOT’s presentation on upcoming grants that can support V2X and requested that U.S. DOT ensure that V2X can be supported by all (or a greater subset) of Federal funding opportunities, recognizing that this will require U.S. DOT to identify and scope these opportunities.
Education and further standardization around which message sets are supported by the remaining 30 MHz	Once analysis is complete and consensus is reached by stakeholders about the 30 MHz Spectrum band plan, further work will be needed on the agreed-upon message sets to ensure consistency in implementation on a nationwide scale. Stakeholders noted the importance of revisiting the existing standards to evolve them to meet these needs as well as identify and address any gaps.

Federal Government Participants

The **Federal Government** session included participants from the U.S. DOT, NTSB, FCC, the National Institute of Standards and Technology, and the U.S. Navy. Participants discussed the lack of senior-level leadership, particularly from non-career staff, and considered ways to present this topic in a non-political way to avoid being impacted by administration changes. This was tied to the importance of sharing a unified vision and working collaboratively across agencies (particularly U.S. DOT, FCC, and NTIA). Participants questioned whether there is an industry consensus that V2X is necessary for safety, and whether such a consensus is needed to move forward. They discussed differing viewpoints on whether it was better to start with infrastructure or vehicles but agreed that a focus on deployment is crucial.

Consistent themes heard throughout this session included the need for:

- Federal leadership which would include a National plan with a timeframe and targets
- Establishment of a working group between the U.S. DOT, FCC, and NTIA
- Undertaking NTSB recommendations
- Establishment of a national roadway digital infrastructure strategy that can serve V2X and V2I applications
- Establishment of a licensing process for the 30 MHz
- An accelerated timeframe for U.S. DOT leadership to emphasize the importance of connectivity.

Unique themes heard throughout this session included the need for:

- Transitioning the Spectrum Working Group into a “Deployment” group
- NEVI Program (which focuses on electric vehicle chargers) replication for RSUs
- Establishment of a database to share information and data on recent grantees and their results
- Removal of the NHTSA NPRM.

State Government Participants

The **State Government** session was a small group composed of representatives from State DOTs who requested to be placed in the government session instead of the infrastructure deployers session. Participants discussed the need for Federal leadership and a national strategy to ensure cybersecurity and interoperability across the country, which aligns with the role played by the National ITS Architecture. The group discussed that Federal leadership does not need to come from U.S. DOT but could instead come from the Society of Automotive Engineers or the International Organization of Standards in the form of a standard. A Federal commitment would also reassure States (and OEMs) that have been burned in the past by the change in technology. The group discussed the need for better communication between State DOTs and OEMs to understand when OEMs plan to deploy the technology. This will allow States to plan a timeline and budget. The group discussed various options for spurring adoption which could include framing it as a safety critical technology (to bolster consumer demand) or developing a business model (such as tolling uses).

Consistent themes heard throughout this session included the need for:

- Federal leadership and a national strategy to ensure interoperability
- Standards or architecture to ensure interoperability
- Improved communication between State DOTs and OEMs
- A business model or safety critical messaging to encourage adoption.

Unique themes heard throughout this session included the need for:

- Establishment of a certification or training program (possibly through AASHTO)
- Cooperation between State DOTs and local governments since most equipment is owned and operated by local governments, which can pose a challenge for State DOTs.

Infrastructure Deployer Participants

The **Infrastructure Deployment** session's goal was to discuss the challenges that IOOs face in deploying V2X technologies and the opportunities that this technology can provide for IOOs. The session's participants included IOOs, OEMs, and vehicle manufacturers. Participants described the need for U.S. DOT leadership on V2X deployment, which could come in the form of a roadmap, a vision document, communication channels, convenings, and/or a mandate. Without clear U.S. DOT support, IOOs, OEMs, and vehicle manufacturers noted that it is difficult to secure buy-in from decisionmakers in their organizations. Furthermore, IOOs noted that developing standards would increase IOO confidence and address concerns about deploying technologies that could quickly become obsolete. OEMs explained that standards may also promote interoperability between States, which is a critical component for private sector adoption. Additionally, some IOOs stated that they have limited funding and expertise to deploy and maintain V2X technology, highlighting the need for workforce capacity improvements. There was also discussion about how grant funding, including funding from new BIL programs, could be used to promote V2X adoption. However, participants also stated that only encouraging V2X in a small set of programs (e.g., "innovation" programs) will not promote deployment at the pace that is needed.

Consistent themes heard throughout this session included the need for:

- U.S. DOT leadership and direction which could take the form of a roadmap, vision, V2X mandate, or stakeholder convenings
- Addressing the delay between when OEMs decide to deploy and when the technology is in vehicles
- Standards to help IOOs feel confident that they will not deploy soon-to-be obsolete technology
- Increased funding and education for IOOs on deploying and maintaining technology
- Addressing concerns about technology shifting over time
- A plan and leadership for interoperability between States
- Marketing/communications materials to tell the story to decisionmakers and the public (safety benefits, environmental benefits)
- Grant funding to signal support for V2X deployment as well as increased integration of V2X into other U.S. DOT funding (not just "innovation" programs).

Unique themes heard throughout this session included the need for:

- [Highway Safety Improvement Program](#) (HSIP) and other safety funding for V2X
- More chip suppliers
- Investigation into "edge" equipment that addresses low latency
- Investigation into aftermarket solutions
- Making use of the data that already exists (e.g., broadcast, TSMO)
- Stakeholder authority to create a coalition/communication channel (include more than researchers)
- Desire from IOOs for known entity, not interested in the "cutting edge"
- Infrastructure standards to be updated (e.g., road design, impacts on traffic conditions)
- Determination of who is liable if the technology "fails."

Standards Organizations Participants

The **Standards Organizations** session included discussion on what actions are needed to facilitate deployment. In addition to standards, the participants agreed there is a need for a deployment guideline and a plan for testing. In contrast to many other sessions, the participants thought there was a need for increased pilots and testing to gather and exchange data in order to build more robust standards. The session focused on what various stakeholders could do to spur the industry. Participants thought that IOOs and OEMs should coordinate on technology rollout and establish a practitioner group to share knowledge and ensure that standards are deployed properly. Consistent themes heard throughout this session included the need for:

- Agreement between IOOs and OEMs about the rollout including coordination to spur regulatory action
- A deployment guide (different from a standard)
- A plan/workflow for testing and deployment
- Exchange of data and incorporation of findings into development for standards to be successful
- Education around which message sets are supported by the remaining 30 MHz
- Backwards compatible updates to standards
- FCC action on the waivers
- A practitioner group of people who understand the standards and can deploy them properly
- Establishment of certification programs
- Consolidation of standards efforts under joint leadership
- Increased pilots to use data and findings for development of a standard.

Unique themes heard throughout this session included the need for:

- Ending lingering discussion of DSRC
- Building library of common interfaces
- Evaluation of whether information on VRUs can be included in BSM.

Vehicle Manufacturers/Suppliers/ Technology and Device manufacturers/Chip Maker Participants

Discussions in the **Vehicle Manufacturers/Suppliers/ Technology and Device manufacturers/Chip Maker** session had a large focus on certainty. All represented industries agreed that national leadership is necessary for deployment, which could take the shape of a roadmap, a mandate, standards, or others. Additionally, movement from the FCC on the waivers is critical. Companies are risk averse and hesitant to spend money on development or deployment without a national strategy in place. Collaboration between stakeholder groups could help to establish timelines for deployment. Consistent themes heard throughout this session included the need for:

- Developing a business model to facilitate a stable and profitable marketplace
 - Clear messaging of value statement to the public
- Standards to ensure interoperability between device manufacturers and deployers for a seamless driver experience across the country
- U.S. DOT leadership in developing a national deployment plan
 - Neutralizing political interference and variation
 - Establishing policy or mandates for deployment
 - Long term planning for the future of the spectrum
- Consistency and approval of FCC waivers
- Focus on deployments, not pilots
- Making use of the existing spectrum before it is taken away
- Collaboration between stakeholder groups.

Unique themes heard throughout this session included the need for:

- Identification of gaps that would be served by V2X
- “National” leadership that is not limited to U.S. DOT, but could also include AASHTO, NEMA, etc.
- Addressing the issue that everyone in the industry is waiting for someone else
- Co-existence of cellular DSRC in parallel with V2X
- Consistency and reliability of the network
 - Need a quality, seamless application running
 - More discussion of position and accuracy
- Mature security certificates and SCMS policies.

Appendix C: Grant Opportunities for Incorporating V2X Communications

The U.S. Department of Transportation provides grants to help build and maintain a fast, safe, efficient, accessible, and convenient transportation system for the American people, today and into the future.

- [Grant Opportunities](#)
 - [Advanced Transportation Technologies and Innovative Mobility Deployment \(ATTIMD\)/Advanced Transportation Technologies and Innovation \(ATTAIN\)](#)
 - [Bipartisan Infrastructure Law Grant Programs](#)
 - [Rebuilding American Infrastructure with Sustainability and Equity \(RAISE\)](#)
 - [Strengthening Mobility and Revolutionizing Transportation \(SMART\) Grants Program](#)
 - [Safe Streets and Roads for All \(SS4A\) Grant Program](#)
 - [Other Grants](#)



U.S. Department of Transportation