



RESPONSE TO REQUEST FOR COMMENT: SAVING LIVES WITH CONNECTIVITY: A PLAN TO ACCELERATE V2X DEPLOYMENT

Submitted to:

U.S. Department of Transportation
V2XDeploymentPlan@dot.gov

Submitted by:

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INTRODUCTION

The U.S. Department of Transportation's (USDOT) Saving Lives with Connectivity: A Plan to Accelerate V2X Deployment, hereafter referred to as The Plan, comes at an important time for the transportation industry. Promising technologies are entering the market while infrastructure funding is flowing to communities through grant programs established by the Bipartisan Infrastructure Law. Advanced technologies and operating practices have the potential to improve safety, efficiency, resilience, and equitable mobility. However, the availability of technology does not translate into benefits without a nationally coordinated program to integrate operational deployments among stakeholders with diverse, or even conflicting, objectives. The USDOT can provide leadership and vision but cannot realize these transformational improvements alone.

As a national resource, MITRE is pleased to submit this response to the USDOT's Request for Comment and stands ready to build the partnerships needed to achieve the milestones established in The Plan.

The MITRE Corporation

As a non-profit, MITRE works in the public interest to integrate government, industry, and academia and transform disruptive technologies into practical solutions. Our work is objective, free from commercial bias, and spans sectors including transportation safety, data management and analytics, artificial intelligence and autonomy, spectrum management, cybersecurity, policy and economic analysis, and human-machine teaming.

Through our six Federally Funded Research and Development Centers (FFRDCs), we tackle the nation's toughest challenges, assisting over 90 percent of federal agencies, which fosters a culture of cross-agency knowledge sharing. Our diverse workforce thrives in our collaborative environment, applying lessons learned from one project to similar challenges in other agencies.

For the past 50 years, we've partnered with the Federal Aviation Administration (FAA) and the aviation community to create the world's safest, most efficient aerospace system. This work has expanded to other transportation modes in the last decade, including highway, automotive, maritime, transit, and rail sectors.

Our internal research and development (R&D) programs address our government sponsors' critical problems. Since we don't sell commercial services or products, we can partner with government labs, academia, and industry, serving as a trusted bridge between government requirements and commercial innovations.

Public Interest Research

MITRE has been at the forefront of research on many topics critical to nationwide vehicle-to-everything (V2X) deployment, including:

- Transportation Safety Analytics
- Digital Infrastructure and Architecture
- Cyber Security and Privacy
- Spectrum Sharing, RF and Cellular Communications

This response details our recommendations for USDOT to consider as they refine The Plan and transition to execution.

QUESTION 1: WHAT IS YOUR REACTION TO THE PLAN?

MITRE enthusiastically supports The Plan and has motivated internal resource alignment and external coordination on a topic where MITRE can contribute significant impact.

National V2X deployment demands coordinated evolution of technology, policy, social and business incentives, budgets, and system operations among diverse stakeholders. The potential consequences of failure, including lives lost, economic inefficiency, inadequate national resilience, and lost industrial leadership, underscore the urgency of The Plan as a catalyst for action.

The Plan appropriately asserts the USDOT's leadership position by initiating a collaborative approach to "enable interoperability through coordination with stakeholder groups and standards-related activities." It emphasizes the stakeholder cohesion needed for this multidisciplinary program and establishes a V2X deployment framework. MITRE believes The Plan is achievable with trusted cooperation to address key challenges promptly.

Specifically, MITRE has identified capabilities critical to USDOT's success in response to The Plan, such as:

- Procedures, practices, and tools to establish and operate Public Private Partnerships. (<https://www.mitre.org/our-impact/partnerships>)
- V2X laboratory capabilities to objectively evaluate the maturity of commercial technologies.
- Open and distributed simulation capabilities leveraging USDOT's Virtual Open Innovation Collaborative Environment for Safety (VOICES) and MITRE's Digital Proving Ground. ([MITRE to Operate U.S. Department of Transportation's VOICES Platform](#))
- MITRE Adversarial Tactics, Techniques, and Common Knowledge (ATT@CK[®]) and EMB3D[™] cybersecurity evaluation tools. (<https://attack.mitre.org/> and <https://www.mitre.org/news-insights/news-release/mitre-red-balloon-security-and-narf-announce-emb3d>)
- Radio Frequency (RF) spectrum and cellular analysis platforms.

In addition, MITRE has discussed the implications of a national V2X deployment effort with industry and government partners concerned about issues, such as:

- Transportation logistics and resilience
- AV safety assurance
- Critical infrastructure protection
- Military mobilization and logistics
- Disaster response

- Law enforcement

QUESTION 2: WHAT DO YOU LIKE ABOUT IT?

There are many aspects of The Plan that MITRE endorses. Specifically, The Plan acknowledges National V2X deployment is fundamentally a multi-stakeholder activity that must be actively coordinated and will not happen organically under current industry dynamics, business models, and local DOT capabilities. Second, The Plan demonstrates USDOT energy, commitment, and willingness to take risks that stakeholders must see to make investments with confidence. Third, the Plan identifies many of the considerations that must be explicitly managed throughout the deployment:

- Scalability and interoperability of solutions across geographic regions
- Impartiality of analysis and validation tools
- Assurance of safety
- Flexibility with respect to changing spectrum requirements and solution options
- Persistent management of cybersecurity risk
- Maintenance of trusted data sharing among stakeholders

Finally, The Plan reflects best practices in large scale technology migrations:

- Employing a cohort-based approach to achieve deployment efficiencies, promote interoperability, and establish peer support networks
- Demonstrating openness to feedback and making provisions for capturing and sharing lessons learned
- Fostering trust among stakeholders through mutual accountability
- The specification of short-, mid-, and long-term goals that enable early success and the use of that momentum to achieve increasingly challenging goals over time
- A thorough identification and definition of roles of stakeholders

QUESTION 3: WHAT IS MISSING OR WHAT WOULD YOU CHANGE?

Based on the current state of V2X technology, industry dynamics, and the goals outlined in The Plan, MITRE suggests the following enhancements be made to The Plan to ensure success.

Recommendation 1: Promote public demand for V2X operations.

The public often remains unaware and skeptical of V2X applications due to safety and privacy concerns. To gain trust, we must demonstrate V2X's effectiveness in reducing accidents caused by driver behavior.

Promoting low-risk pedestrian-to-infrastructure (P2I) applications can help build this trust. By experiencing the benefits of P2I through personal devices, stakeholders can become accustomed to and understand the value of similar vehicle-based capabilities. Similarly, retrofitting

government fleets to benefit from Signal Phase and Timing (SPaT)-based applications is another low-risk way to introduce beneficial V2X into communities.

Part of the public's hesitancy to embrace V2X-enabled products is the belief that it enables government tracking. To address privacy concerns, a Privacy Team could collect lessons from similar deployments and recommend system configurations to prevent misuse. Specifically, this Program could learn from the tolling industry's experience in maintaining user privacy while tracking similar data. An industry outreach program to the media, entertainment industry, or direct to the public can counter negative portrayals of V2X, showcasing how these technologies improve quality of life.

Recommendation 2: Clarify OEM equipment incentives.

The Plan's goal for two original equipment manufacturers (OEMs) to adopt by 2027 may face industry skepticism due to the current lukewarm reception of 5.9 GHz hardware. However, once a compelling value proposition is demonstrated, more OEMs are likely to adopt quickly. MITRE suggests building a stronger benefits case beyond the three listed on Page 10. This may require refining the OEM incentive structures on Pages 13 and 14 and linking them to specific outcomes.

New Car Assessment Programs (NCAPs) rate new vehicles on a variety of metrics, including safety. The inclusion of V2X into NCAP rating criteria incentivizes automakers to equip new models with V2X capability, and Europe and China have experienced large increases in V2X manufacturing after commitments were made to add V2X to their NCAPs. China intends to officially expand NCAP to include V2X in 2024 whereas the US has no specific plans – we recommend USDOT commit to updating the NCAP within 5 years.

Finally, a method for objectively quantifying and demonstrating benefits must be articulated to increase OEM confidence they can meet the conditions for successful adoption and build the demand for V2X across all critical stakeholders—consumers, OEMs, and operators.

Recommendation 3: Establish a durable and persistent coordination function.

A critical component in the success of V2X is maintaining stakeholder trust throughout the deployment period. Stakeholders must trust each other to make enabling investments, and in the ability of the USDOT and its technical partners to orchestrate a successful program. Past examples of uncoordinated industry and government action have made stakeholders reluctant to accept additional risk. Specifically, federal decisions about spectrum allocation and safety must be stringently coordinated across government. The deployment stakeholder community must speak with a unified voice and have a mechanism to establish effective coordination with FCC and NHTSA, in particular.

Another threat to stakeholder trust is associated with Presidential Administration changes and the potential for Federal commitments made under one administration to be ignored by the next. The Plan must mitigate this risk by transitioning critical coordination functions to a trusted party with a self-sustaining business model to fund its operations for at least 10 years.

Recommendation 4: Define validation processes for new solutions.

Stakeholder trust requires an unbiased validation framework for technical solutions. The plan should specifically identify the need for independent third-party validation to prevent self-validation and failed deployments. This framework must ensure solutions are effective, safe,

interoperable, and secure, with clear definitions of key criteria like "cybersecure" and "interoperable."

The USDOT should publish test protocols or best practices to evaluate compliance with specifications, addressing the interoperability goal on Page 8. The document should also mention a safety assurance framework to alleviate concerns among stakeholders unable to make a safety case. Defining the role of safety management systems (SMS) within infrastructure owners and operators (IOOs) could address this.

Technical solutions must be efficient, scalable, and shareable, allowing stakeholders to build upon each other's work, meet deployment targets, and minimize cost and risk. For example, states attempting to modernize legacy ITS systems need standardized, interoperable, and affordable cloud environments. The USDOT should provide programming for access to and independent testing and validation of deployment data, including data sharing with OEMs for collective feedback and technical guidance to deploying agencies.

Recommendation 5: Enabling the efficient and scalable reuse of solutions.

Enhancing technical solution development efficiency requires the ability to "templatize" success. Current feedback opportunities and knowledge management approaches in V2X stakeholder conferences lack efficiency. A platform for sharing learned lessons is necessary, allowing stakeholders to transition from piecing together strategies from research papers and presentations. A technologically advanced method, such as a shared database of reusable scenarios, templates, and digital infrastructure, would consolidate individual lessons for entire cohorts, speeding up the transition from pilot programs to nationwide deployment.

An outcome-based template would also enable deployers to use data to better comprehend roadway conditions, inform new strategies for managing problem areas, and communicate safety-critical information to V2X travelers. This template could then set nationwide deployment goals. For instance, data from MITRE's roadside unit (RSU) installations revealed unexpected road use hotspots, informing roadway redesign.

Recommendation 6: Broaden consideration of long-term spectrum solutions.

The future feasibility of 5.9 GHz is uncertain, leading MITRE to back USDOT's recognition of other potential communication networks for V2X safety and operations. To address this, The Plan's Spectrum Use section should consider spectrum sharing as outlined in the National Spectrum Strategy and by agencies like the FAA, U.S. Air Force (USAF), and U.S. Department of Defense (DOD). Such an expansion could include their willingness to share, tools used, and projected timelines. Emerging options beyond 5.9 GHz in other sectors suggest that committing to 5.9 GHz now could limit future solutions and encourage allocation of other spectrum bands to less critical uses. MITRE advises implementing a Reference Implementation Architecture earlier and expanding Spectrum Use consideration to include technology and models from other domains. While utilizing allocated spectrum is important in the short term to guard against further loss, long-term goals should be articulated as function- or outcome-based goals rather than 5.9 GHz specific.

Similarly, technologies linked to the 5.9 GHz spectrum may also be unfeasible in 10 years. MITRE suggests specifying deployment scale, market penetration, or performance thresholds rather than a specific technology for use cases by 2034. A public method to track progress

towards milestones is needed to assess each goal's feasibility. For instance, the National Operations Center of Excellence (NOCoE) Signal Phase and Timing (SPaT) Challenge brought some V2X technology online, but without a tracker, the community wouldn't know the effort needed to enable V2X in 25 percent of all traffic signals in the top 75 metro areas by 2026.

Recommendation 7: Establish participation requirements for BIL grant programs.

The Plan recognizes the opportunity for Bipartisan Infrastructure Law (BIL) grant programs to provide the resources needed for the envisioned deployments when it states: "Promote use of discretionary grant programs like ATTAIN, SMART, and SS4A grants to launch V2X deployments." However, this language will not address the risk of needed funding going to local pilots rather than the coordinated operational deployments described in The Plan. The USDOT should modify grant proposal selection criteria to prefer applicants participating in formal Plan-endorsed stakeholder coordination programs described earlier.

Recommendation 8: Adopt stakeholder-developed outcomes.

The Plan sets milestones for nationwide V2X deployment, but stakeholders must define common goals and operational outcomes. This ownership is crucial for stakeholder commitment. Using The Plan's milestones, stakeholders must agree on success criteria and tangible results. For instance, they must define "deployment" based on operational benefits. Achieving consensus on such issues is challenging, but necessary for successful nationwide deployment. Government incentives should align with progress endorsed by incentive recipients.

Stakeholder definitions of operational success and expected benefits will determine the participation needed to achieve them. Understanding the required number of vehicles, infrastructure assets, and successful interactions will clarify the scale and costs of the deployment program.

The Plan should include a provision for stakeholder consensus on assessing deployment success. Currently, there are no adequate venues for State DOT coordination with OEMs and V2X infrastructure providers. MITRE's approach, proven in 13 public/private partnerships, allows industry partners to co-create solutions to our nation's greatest challenges. For example, at the start of the COVID-19 pandemic, industry leaders asked MITRE to convene stakeholders to maximize the success of our healthcare system. The COVID-19 Healthcare Coalition was born, co-chaired with our partner, Mayo Clinic. This public-private sector collaboration brought together 1,000+ companies in a non-competitive way to work together toward common goals. Under other circumstances, many of the coalition members would compete. But to join the coalition, we made sure members cooperated and shared openly—and exclusively for the country's benefit.

Recommendation 9: Establish safety data monitoring.

As a national-level USDOT-led program with a primary goal of improving traffic and vulnerable road user (VRU) safety, The Plan must include the monitoring of safety metrics throughout the deployment program. This is necessary not only to track progress towards goals but also to swiftly identify and mitigate risks.

A program as large and complex as this will undoubtedly see individual deployments encounter vehicle and pedestrian injuries and fatalities regardless of whether they are related to V2X. The

Program must ensure it has done everything possible with the data at its disposal to identify and mitigate risk. Ideally, the safety data monitoring activity would compile mandatory safety data from deployment sites as close to real-time as possible and apply analytics to identify emerging safety risk precursors. This effort should have the resources to identify risk and suggest mitigations, and the authority to pause deployments in cases of significant concern.

Recommendation 10: Establish cyber threat monitoring and intelligence sharing.

Like safety data, The Plan must include the monitoring of cybersecurity threats throughout the deployment program. This is needed to ensure the Program does not inadvertently introduce unmitigated cyber vulnerabilities into the nation's critical infrastructure. It is well known that individual deployment sites will generally lack the resources for effective cyber threat management of these complex new systems. As individual deployments discover vulnerabilities or experience attacks, this information must be shared quickly with others. Similarly, a single national-level interface with existing federal-level cyber threat intelligence programs would efficiently convey insight from other domains to the affected deployments. This effort should have the resources to identify cyber risk and suggest mitigations, and the authority to pause deployments in cases of significant concern.

QUESTION 4: WHAT RESOURCES DO YOU FEEL ARE NEEDED TO HELP SCALE AND DEPLOY V2X TECHNOLOGY?

Publishing The Plan positions the USDOT as a leader in the nation's transition to V2X-based operations. Under USDOT's guidance, The Plan can stimulate stakeholder collaboration for an interoperable, effective system. However, it also highlights the need for unbiased national technical support to tackle technical issues, ensure safety and security, foster collaboration, and uphold transparency and trust. Fortunately, the USDOT has resources to meet this need. This national-level, unbiased technical support should offer the following resources to deployment stakeholders:

Resource 1: Public/Private Partnership

Deployment stakeholders will need a well-governed public/private partnership program including a secure and trusted collaboration portal and data sharing platform.

Continued collaboration between stakeholders is essential for establishing and maintaining buy-in of V2X deployment. To maintain the necessary trust, it is necessary for the USDOT and its technical partners to establish public-private partnerships, maintain and use collaboration spaces, create equitable governance models, initiate trusted data stewardship, maintain a source of independent advice, influence government decision makers, and broker industry commitments. The technical partners tapped by the USDOT in this space must be also trusted across the industry as a third-party collaborator with no stake in private sector outcomes, with experience aiding the technological developments of each stakeholder as necessary to advance V2X innovation.

Resource 2: Open and distributed simulation and laboratory capabilities.

Deployment stakeholders will need access to trusted and distributed simulation capabilities (e.g., USDOT's VOICES) to provide unbiased validation of technical solutions to protect from self-validation and failed deployments. Along with the technical capability, an associated method to validate technical solutions as effective, safe, interoperable, and secure is needed. Such an environment will support solution evaluation, training, oversight of SMS and Safety Assurance programs, and cyber security risk assessment and mitigation.

Analysis resources must not be restricted to simulation but must also address traditional laboratory research needs. Stakeholders will need efficient access to existing research or laboratory capabilities to objectively evaluate the maturity of commercial V2X technologies, RF spectrum, and cellular system options and performance under V2X use cases.

Also required is knowledge management resource to enable efficient, scalable, and easily sharable solutions, so that stakeholders can collectively build upon each other's work at the pace needed to hit the deployment targets, while also minimizing cost and risk exposure. Such work would be expedited by common experimentation, knowledge management solutions, secure portals, a shared data security program, and an ability to contract quickly with stakeholders.

Resource 3: Cybersecurity resources

Deployment stakeholders will need cyber threat intelligence and industry standard evaluation tools and practices. For example, MITRE ATT&CK® is a globally-accessible knowledge base of adversary tactics and techniques based on real-world observations. Such a knowledge base is used as a foundation for the development of specific threat models and methodologies in the private sector, in government, and in the cybersecurity product and service community. Shared cybersecurity resources provide a common language for defenders to have conversations about emerging threats and develop effective defensive strategies and can support a community of cyber professionals who contribute real-world observations and learn from the tactics and techniques.

Resource 4: Persistent real-time cyber threat and safety data monitoring

A safety analytics resource must be provisioned to collect mandatory safety data from deployment sites as close to real-time as possible and apply analytics to identify emerging safety risk precursors. This effort should have the resources to identify risk and suggest mitigations, and the authority to pause deployments in cases of significant concern.

Similarly, monitoring is needed for cybersecurity threats throughout the deployment program to ensure the Program does not inadvertently introduce unmitigated cyber vulnerabilities into the nation's critical infrastructure. Since individual deployment sites generally lack the resources for cyber threat management of emerging V2X systems, a national-level resource is needed to discover vulnerabilities and share information among stakeholders. This resource would interface with existing federal-level cyber threat intelligence programs and convey newly identified risks and mitigation approaches to the affected deployments. This effort should have the resources to identify cyber risk and suggest mitigations, and the authority to pause deployments in cases of significant concern.

Resource 5: National clearinghouse for Use Case benefits

Another valuable resource is an objective method to quantify and showcase V2X benefits, stimulating demand from key stakeholders like IOOs, OEMs, and the public. The USDOT requires independent, multi-stakeholder benefit analyses using objective capabilities, based on collaboratively designed scenarios. A trusted third-party could unite stakeholders, analyze data from an unbiased perspective, and distribute personalized reports. This approach aggregates and analyzes V2X data, ensuring goals are met and enhancing value for individual OEMs by providing competitive standing insights without breaching privacy. Demonstrating V2X value could also involve literature reviews, empirical data analysis, fast-time and human-in-the-loop modeling, table-top exercises, role-playing, lab-based hardware testing, and cyber and privacy red-teaming. This process necessitates a third-party with technical expertise, a collaborative history, and stakeholder trust.

Resource 6: Program of peer training and sharing of lessons learned

Previously in this response, MITRE mentioned the value of creating templates to better share successes across the V2X field. Another role of the USDOT and its trusted technical partner would be to lift and shift lessons learned and share insights across deployments. Currently missing is the ability to share those translatable lessons learned. For example, it would be difficult for the USDOT to find a cybersecurity solution that suits everyone, but more feasible to create a function which aggregates and shares solutions in a manner digestible to all.

QUESTION 5: WHAT WOULD YOU LIKE TO SEE IN THE SHORT TERM (NEXT 2-3 YEARS) FROM OTHER STAKEHOLDERS, INCLUDING FROM USDOT OR FROM THE PUBLIC/PRIVATE SECTORS?

V2X must be a priority coordination topic among USDOT modal agencies. Specifically, USDOT should secure an on-going engagement between FHWA and NHTSA to ensure V2X operations will satisfy safety requirements. The risk of deployments and operations potentially judged as unsafe will slow progress dramatically. In addition, to provide a needed incentive for OEM's to accelerate inclusion of V2X capability in their new model automobiles, a commitment is needed to include V2X capability in the NCAP.

Citing The Plan's focus on multi-stakeholder cooperation, an urgent priority is to establish and support a trust-based stakeholder community. The Plan is an excellent first step, and this momentum must now shift to enabling the community to establish mutual accountability, set specific goals, and act. The stakeholder community should be confident that they are supported by a third-party organization with technical depth, objectivity, experience managing public/private partnerships, and a history of problem-solving in the transportation domain. USDOT should identify and fund an organization to facilitate the deployment community by brokering consensus on implementation plans, performing or overseeing key technical analyses, and handling sensitive deployment and operations data.

An initial task for the community would be to author an OEM-sanctioned market analysis demonstrating the demand for V2X applications, and a USDOT-endorsed strategy that reflects that market-driven path. Another early task for the community to develop is a detailed roadmap

with community-defined common SMART (Specific, Measurable, Achievable, Relevant, and Time-Bound) goals. Finally, the community should pursue an initial nationwide V2X deployment that has low risk and cost, and reliable and relatively high benefit: fleet vehicle retrofit for SPaT. A federal incentive to local governments to retrofit government vehicles and signals could be done quickly, provide fuel savings and public safety benefits, and educate the public in a way to increase demand for such technology.

CONCLUSION

The Accelerate V2X Deployment Plan emphasizes multi-stakeholder cooperation for nationwide technology evolution. MITRE supports The Plan and recognizes opportunities for success in proven approaches and existing capabilities.

The USDOT must persist as an industry leader, advancing V2X development and fostering trusted collaboration. MITRE advocates for a trusted third-party organization with expertise in public/private partnerships, transportation simulation, cybersecurity, empirical data analysis, and technology migration. Additionally, continuous monitoring for cybersecurity threats throughout the deployment program is crucial to prevent unmitigated cyber vulnerabilities in the nation's critical infrastructure.