ITS AMERICA

DEPLOYING AND LEVERAGING NETWORK V2X FOR EXPANDED USE CASES

This guide was developed by ITS America's Beyond 5.9 Working Group.

TABLE OF CONTENTS

ITS AMERICA

EXECUTIVE SUMMARY

Networked V2X—vehicle-to-everything (V2X) communications delivered via commercial cellular and Internet Protocol (IP) based networks and cloud platforms— is rapidly gaining traction as a viable and scalable method for delivering roadway safety alerts. Today, Departments of Transportation (DOTs), infrastructure owner-operators (IOOs), public safety agencies, and public fleets are deploying networked V2X to deliver real-time roadway safety alerts at scale. Today's deployments commonly focus on proactive hazard notifications (e.g., work zones, roadway hazards, emergency vehicles, and traffic signal information) delivered to drivers through connected vehicles and widely used navigation applications—leveraging existing connectivity rather than requiring specialized short-range roadside infrastructure.

The core safety function of providing proactive, real-time hazard alerts is often the entry point into networked V2X adoption. However, equipping vehicles and infrastructure with the connectivity necessary to power these alerts also opens the door to a wide range of additional capabilities and operational benefits for deployers across the transportation ecosystem.

This guide, developed by ITS America's Beyond 5.9 Working Group, outlines how the same networked V2X foundation used for safety alerting can also serve as a strategic layer connecting vehicles, people, infrastructure, and agency systems. By viewing networked V2X as both a safety capability and a data-and-integration platform, agencies can unlock additional operational benefits, improve coordination, and increase return on investment while future-proofing deployments as connected and automated vehicle capabilities evolve.

The use cases highlighted in this document offer stakeholders new opportunities to enhance operations and maximize the value of connected infrastructure. These include:

FLEET TRACKING AND AUTOMATED VEHICLE LOCATION (AVL)

Use V2X-connected devices for real-time fleet visibility and more efficient dispatch, maintenance, and operations.

HAZARD AND INCIDENT DATA AGGREGATION

Turn alert activity into analyzable datasets that support proactive safety planning, performance reporting, and more complete project analysis and justification using data.

INTEROPERABLE VEHICLE AND SYSTEM COMMUNICATION

Bridge data silos across jurisdictions and systems (e.g., CAD, ATMS/TMC platforms, work zone tools) to improve coordination and shared situational awareness.

ENHANCED TRAVELER INFORMATION

Deliver more targeted, actionable guidance (beyond basic alerts) through geofencing and integration with traveler-facing platforms.

SYSTEM DIAGNOSTICS AND REMOTE MONITORING

Reduce operational burden with remote configuration, health monitoring, and fewer field visits.

DATA FOR RESEARCH AND POLICY DEVELOPMENT

Support evidence-based planning and privacy-conscious data sharing with research and planning partners.

The document also highlights key decision points for agencies—including cost-effectiveness and scalability, leveraging cellular networks and cloud platforms, security architecture considerations, and practical integration pathways with existing IT and transportation systems—and concludes with recommended next steps to help organizations assess current capabilities, engage cross-functional stakeholders, pilot high-value applications, and establish data governance that enables safe, sustainable expansion.

This working document is designed to provide ITS professionals, transportation planners, public safety officials, and fleet operators with a broader understanding of the expanded value proposition of networked V2X beyond its core safety function. By exploring a spectrum of expanded use cases, this resource aims to help public agencies and IOOs unlock additional return on investment, future-proof deployments, and improve operational efficiency through the same connected infrastructure already being deployed for roadway safety.

Through this document, we aim to reframe networked V2X not just as a tool for delivering alerts, but as a strategic component of the digital infrastructure layer that connects people, vehicles, infrastructure, and systems, thus enabling new insights, greater resilience, and smarter transportation networks.

RECAP: THE CORE USE CASE FOR NETWORKED V2X

OVERVIEW OF NETWORKED V2X FOR AUTOMOTIVE SAFETY

Networked V2X leverages existing commercial cellular networks and cloud-based platforms to deliver safety information to vehicles and represents a pragmatic and immediately deployable approach to connected vehicle communications. This approach enables rapid, wide-area deployment without extensive new infrastructure investment, making connected vehicle services accessible to agencies of all sizes.

The foundational use case for networked V2X centers on broadcasting digital alerts about roadway hazards to drivers through their connected vehicles or navigation applications. These systems can utilize standardized message concepts for consistency across platforms.

COMMON ALERT TYPES INCLUDE:

- **WORK ZONE ALERTS:**
  Construction zone warnings, lane closures, and worker presence notifications that provide advance warning to approaching vehicles.
- **ROADSIDE HAZARD WARNINGS:**
  Immediate alerts for debris in roadway, wrong-way drivers, disabled vehicles, or sudden incidents.
- **EMERGENCY VEHICLE ALERTS:**
  Real-time notifications of emergency vehicle location and trajectory to facilitate right-of-way clearing.
- **TRAFFIC SIGNAL INFORMATION:**
  Traffic signal status information delivered over the network to support advanced driver assistance applications.

The strength of networked V2X lies in its ability to reach vehicles wherever cellular coverage exists. Modern vehicles increasingly come equipped with embedded cellular modems for infotainment, telematics, and over-the-air updates. Navigation applications used by millions of drivers daily already maintain persistent network connections. Networked V2X harnesses this existing connectivity infrastructure, allowing agencies to reach a broad and growing audience without waiting for specialized V2X hardware deployment.

TYPICAL STARTING POINTS

Most agencies and IOOs begin their networked V2X deployments by addressing their most pressing safety and operational challenges.

Three use cases have emerged as the most common and impactful entry points:

EMERGENCY AND SPECIALTY VEHICLE ALERTING: 1

Emergency response effectiveness depends critically on the ability of emergency vehicles to navigate through traffic safely and quickly. Networked V2X enables emergency vehicles—police, fire, and EMS—as well as specialty vehicles such as school buses, snowplows, street sweepers, and roadside assistance vehicles to broadcast safety warnings to approaching drivers over connected systems. This capability addresses multiple safety and operational challenges simultaneously, from reducing response times and risk-exposure for roadside workers, operators, or emergency responders to reducing the overall risk of collision.

EMERGENCY VEHICLE PREEMPTION (EVP): 2

Building on basic emergency vehicle alerting, networked V2X enables sophisticated traffic signal preemption systems that clear intersections ahead of responding emergency vehicles. Networked V2X preemption can operate over much longer distances and across entire corridors compared to traditional EVP solutions, triggering preemption sequences at multiple intersections simultaneously as emergency vehicles approach. The networked approach also enables preemption to work seamlessly across jurisdictional boundaries, a critical capability for regional emergency response. Agencies implementing emergency vehicle preemption through networked V2X often see this as a high-value extension of their initial alerting deployments: the same vehicle devices that broadcast alerts can trigger preemption, and the network infrastructure serves both purposes. The operational benefits—reduced response times, improved safety for emergency personnel, and reduced risk to other motorists—justify the investment in signal system integration.

WORK ZONE SAFETY: 3

Construction zones are some of the highest-risk environments in the transportation network for both workers and motorists, with more than 40,000 injuries occurring annually from work zone crashes and hundreds of fatalities among both workers and drivers.[1] Networked V2X transforms work zone safety by enabling dynamic alerts that warn drivers as vehicles approach active construction areas. As network V2X can equip both worksites and mobile operations like paving, striping, or pothole repair, agencies have multiple deployment paths available to create safer work zones.

[1] National Safety Council. (n.d.). Motor vehicle safety issues: Work zones. NSC Injury Facts. https://injuryfacts.nsc.org/motor-vehicle/motor-vehicle-safety-issues/work-zones/

The combination of emergency vehicle capabilities, specialty vehicle capabilities, and work zone safety often serves as a powerful foundation for broader networked V2X deployment. Agencies gain experience with the technology, build internal expertise, establish relationships with vendors and partners, and demonstrate value to stakeholders. Once these core capabilities are operational, agencies are well-positioned to explore the expanded use cases described in subsequent sections of this document.

DEPLOYMENT STATUS AND SCALE

Networked V2X deployment has accelerated significantly in recent years, driven by convergence of several factors: declining costs of cellular connectivity, maturation of cloud platforms, growing OEM support for connected services, and increased availability of federal funding and support.

AGENCY AND IOO ADOPTION:

State DOTs, county governments, municipal transportation agencies, turnpike authorities, and local fleets across the United States are actively deploying networked V2X systems. Deployments range from single-jurisdiction pilot programs to multi-state regional initiatives. Many agencies are currently adopting approaches with lower infrastructure costs. Public transit agencies and emergency services departments are equipping fleet vehicles with networked V2X capabilities to broadcast their presence and coordinate operations.

ORIGINAL EQUIPMENT MANUFACTURER (OEM) INTEGRATION:

Major automotive manufacturers have already integrated networked V2X capabilities into their connected vehicle platforms. Many new vehicles ship with embedded cellular connectivity as standard equipment, providing the necessary communication pathway for receiving networked V2X alerts. OEMs recognize that delivering safety-relevant information from infrastructure enhances the value proposition of their connected services and complements onboard sensor systems. Tier 1 suppliers have also started offering network-supported alerting platforms and solutions as part of their broader offerings. This growing OEM industry support represents a critical milestone—connected vehicle services are transitioning from aftermarket add-ons to factory-integrated, highly desired capabilities.

NAVIGATION PLATFORM PARTICIPATION:

Major navigation platforms—including Waze, Google Maps, Apple Maps, and dedicated trucking/fleet navigation solutions—are increasingly incorporating safety alerts from networked V2X sources. These platforms reach hundreds of millions of users, providing immediate scale that hardware-dependent approaches cannot match. Navigation platforms serve as aggregation points, collecting and distributing V2X information from multiple agency sources and presenting it to users in intuitive formats. This role as intermediary also enables translation of technical V2X data into user-friendly notifications appropriate for different audiences.

FEDERAL SUPPORT AND GUIDANCE:

The U.S. Department of Transportation supports connected vehicle deployment through programs like the Advanced Transportation Technologies and Innovative Mobility Deployment (ATTAIN) grant program, Congestion Relief Program, the Safe Streets for All (SS4A), Better Utilizing Investments to Leverage Development (BUILD), and the Strengthening Mobility and Revolutionizing Transportation (SMART) grant programs. The Intelligent Transportation Systems Joint Program Office (ITS JPO) has expanded its focus to include networked approaches alongside direct V2X, recognizing that different communication methods serve complementary roles in the connected vehicle ecosystem. FHWA and NHTSA guidance increasingly acknowledge networked V2X solutions like digital alerting as viable near-term deployment strategies while continuing to support the evolution of the broader connected vehicle ecosystem in parallel. Additionally, the National Transportation Safety Board (NTSB) has recently highlighted how in vehicle digital alerting technologies have become an important tool to inform drivers about upcoming queues and hazards, particularly in the freight sector.[2] The combination of agency deployment activity, OEM integration, navigation platform participation, and federal support has created momentum behind networked V2X as a practical path toward realizing connected vehicle safety benefits. However, as adoption grows, agencies are discovering that the infrastructure and connectivity deployed for core safety alerts can enable a much broader range of applications.

[2] "Fatal I-70 Collision in Ohio Prompts Safety Recommendations on Trucks, Motorcoaches and Traffic Incident Management." Ntsb.gov, 2025, www.ntsb.gov/news/press-releases/Pages/NR20250924.aspx.

EXPANDED USE CASES AND OPERATIONAL BENEFITS

While safety alert dissemination serves as the primary driver for networked V2X adoption, the underlying connectivity infrastructure enables numerous additional applications that can enhance operational efficiency, improve service delivery, and generate additional value for deploying agencies. The following subsections explore expanded use cases that leverage the same network connections, devices, and platforms already deployed for core safety functions.

FLEET TRACKING AND AUTOMATED VEHICLE LOCATION (AVL)

USE CASE DESCRIPTION

Networked V2X devices deployed in public fleet vehicles for safety alert broadcasting inherently provide vehicle location and status information. This same connectivity can power comprehensive Automated Vehicle Location (AVL) systems that give agency personnel real-time visibility into fleet operations. Rather than deploying separate AVL hardware, agencies can leverage networked V2X devices to serve dual purposes: broadcasting safety information to other road users and reporting vehicle position, speed, heading, and status back to fleet management systems.

VALUE TO DEPLOYERS AND AGENCIES

Real-time fleet visibility transforms operational management across multiple agency functions. Dispatchers can see precise vehicle locations when assigning tasks or responding to service requests. Supervisors can monitor field operations, verify service delivery, and optimize routing to reduce fuel consumption and vehicle wear-and-tear. Traffic management centers can track assets like snowplows, street sweepers, and maintenance vehicles to coordinate operations and verify that services have been delivered as scheduled. Emergency management coordinators gain visibility into the location and status of response resources during incidents or large-scale events.

The integration of AVL data with Computer-Aided Dispatch (CAD) systems enables even more efficient resource allocation. When a service request comes in, dispatchers can identify the nearest available vehicle, estimate arrival time, and automatically route assignments. This process reduces response times and ensures more efficient use of limited resources. For emergency vehicles, AVL integration allows dispatch centers to track responding units, coordinate multi-agency responses, and provide responding personnel with better situational awareness.

Integration with Traffic Management Center (TMC) and Advanced Traffic Management System (ATMS) platforms allows agencies to overlay fleet position data on traffic monitoring displays. This provides context for incident response, enables verification that maintenance vehicles are where they should be, and supports coordination between field operations and TMC staff. Some agencies use this capability to automatically close traffic incidents once maintenance or emergency vehicles clear the scene.

REAL-WORLD APPLICATIONS

Emergency responders track and share real-time location data for mutual aid response and coordination, and medical services track ambulance locations and status, enabling more effective deployment of resources across service areas. Many state DOTs have integrated networked V2X devices into snowplow fleets, providing real-time tracking during winter weather events. Road users and media can access live, web-based dashboards showing which roads have been treated, while supervisors track plow routes to ensure complete coverage. This visibility improves both operational efficiency and public communication during weather emergencies.

Municipal public works departments leverage AVL capabilities from networked V2X devices to track refuse collection vehicles, street sweepers, and utility repair trucks. This enables them to verify service delivery, respond to constituent inquiries about missed pickups, and optimize routes to reduce operational costs.

HAZARD AND INCIDENT DATA AGGREGATION

USE CASE DESCRIPTION

Every safety alert broadcast through networked V2X represents a data point: a specific hazard at a specific location and time. Aggregating this data over weeks, months, and years creates rich datasets that reveal patterns and trends that are not visible from individual incidents. Networked V2X platforms can automatically collect, categorize, and analyze all safety messages generated by an agency, creating comprehensive records of where and when hazards occur. These include emergency response hot spots, work zones, crashes, debris incidents, disabled vehicles, weather-related hazards, and any other condition that triggers an alert.

When combined with probe vehicle data[3] from equipped vehicles, agencies gain even deeper insights into how traffic behaves around incidents, how drivers respond to alerts, and how roadway conditions affect safety outcomes.

VALUE TO DEPLOYERS AND AGENCIES

Incident data aggregation transforms reactive safety alert systems into proactive safety planning tools. By analyzing where incidents cluster, agencies can identify high-risk locations that warrant engineering interventions, increased enforcement, or targeted safety campaigns. This data-driven approach supports Vision Zero initiatives by pinpointing where limited safety improvement budgets can have the greatest impact.

Creating heatmaps of incident locations helps agencies identify repeat problem areas. Work zones that trigger numerous hard braking events from approaching traffic might need improved advance signing or tapered speed reductions. An interchange that consistently sees debris incidents might benefit from additional trash collection or modified drainage design.

This data supports federal and state reporting requirements for safety performance measures. Agencies can demonstrate the effectiveness of safety programs by showing reductions in incident frequency at specific locations following interventions. The data can also support grant applications by providing detailed documentation of safety needs and evidence-based justification for proposed improvements.

For agencies pursuing Safe Streets for All (SS4A) grants and similar federal funding opportunities, comprehensive incident data provides the analytical foundation needed for competitive applications. USDOT increasingly requires data-driven safety planning, and networked V2X incident records provide precisely the kind of detailed, location-specific information that strengthens applications.

[3] Probe vehicle data refers to anonymized information about the position, speed, and movement patterns of vehicles as they travel on the road network, typically collected via GPS or V2X technology. This data helps agencies understand real-world traffic flow and driver behavior.

REAL-WORLD APPLICATIONS

Several state DOTs have begun using aggregated emergency alert data to analyze areas that generate the most frequent safety concerns. This helps them refine traffic control plans, provide upstream and downstream support and mitigation, and better coordinate with local responders for improved road safety.

Regional transportation planning organizations use networked V2X incident data to inform their Highway Safety Improvement Program (HSIP) project prioritization. By overlaying V2X incident reports with crash data, traffic volumes, and demographic information, they can identify where systemic safety improvements will have the greatest benefit.

City traffic engineering departments analyze patterns in emergency vehicle alert data to understand where response delays occur most frequently. This capability informs decisions about signal timing modifications, ideal EVP placement, turn restriction changes, and intersection geometry improvements that facilitate emergency vehicle movement. By identifying the areas where emergency response is most frequently delayed, city engineers do not have to guess or use anecdotal data to maximize EVP placement.

INTEROPERABLE VEHICLE AND SYSTEM COMMUNICATION

USE CASE DESCRIPTION

Networked V2X platforms serve as communication hubs that connect disparate systems, agencies, and vehicle fleets. Because these platforms use IP-based protocols and cloud architectures, they can facilitate data exchange between entities that historically operated in isolation. This includes fleet-to-fleet communication across different agencies, integration with traffic signal systems, connection to work zone management platforms, and links to regional transportation management systems.

This interoperability happens at multiple levels. At the data level, consistent message formats ensure that information generated by one agency can be understood and used by other agencies. At the system level, cloud-based architectures enable authorized users from different agencies to access shared operational data while maintaining appropriate security boundaries and access controls.

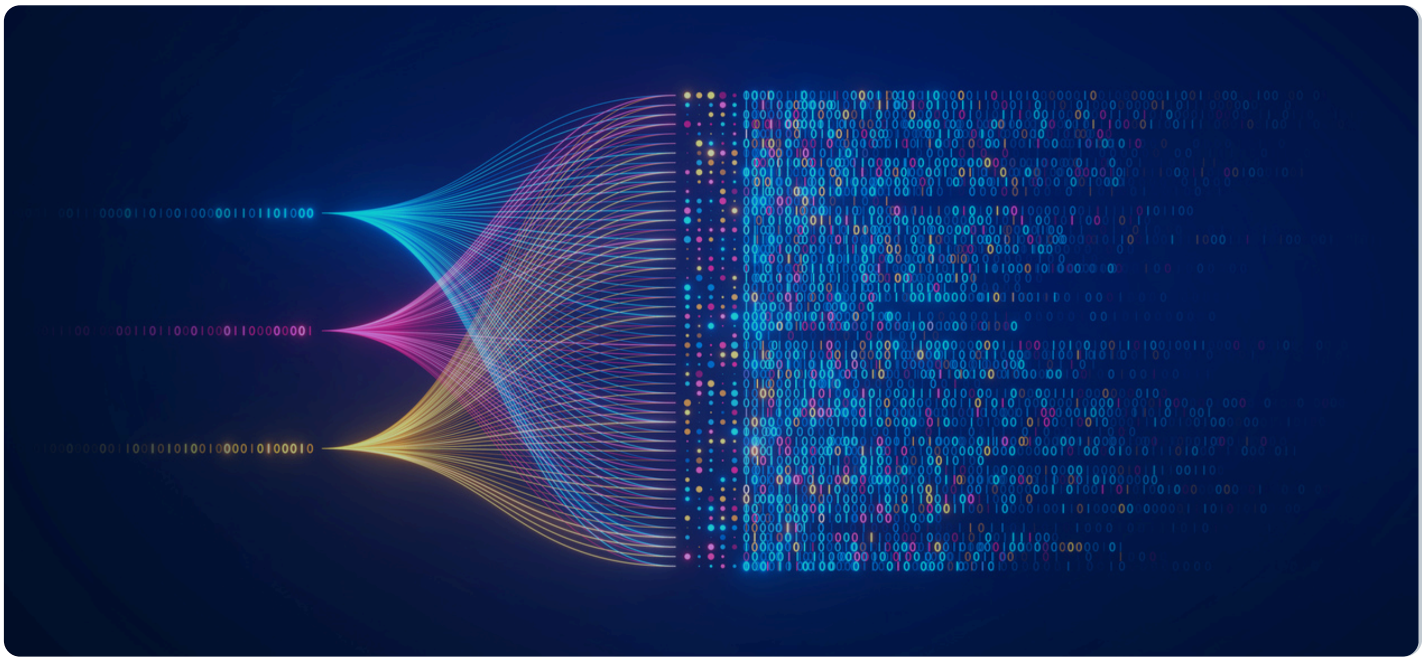
VALUE TO DEPLOYERS AND AGENCIES

Interoperability eliminates data silos that historically limited coordination between agencies and jurisdictions. When multiple agencies deploy networked V2X, they can choose to share information that benefits all parties. A state DOT's work zone alerts can automatically appear in county emergency management dashboards. Municipal police emergency vehicle alerts can trigger awareness notifications in state highway patrol systems. Transit agency bus location data can inform traffic signal priority systems managed by city transportation departments.

This coordination is particularly valuable at jurisdictional boundaries, where incidents and conditions in one agency's territory directly affect operations in adjacent areas. Networked V2X enables seamless information flow across county lines, state borders, and municipal boundaries. A crash on a state highway approaching a city can trigger coordinated response from multiple agencies, with each having access to shared situational awareness information.

System interoperability reduces the need for agencies to maintain multiple separate platforms. A regional approach where multiple agencies connect to a shared networked V2X infrastructure can spread costs across participants while ensuring everyone benefits from network effects. The more agencies and vehicles participate, the more valuable the system can become to all users.

Bridging to traffic signal systems opens additional capabilities. Traffic signal information broadcast through networked V2X can reach equipped vehicles across wide areas. Emergency vehicle preemption requests can be transmitted through the network to signal controllers, enabling earlier preemption activation. Transit signal priority can operate across jurisdictional boundaries as buses travel regional routes.



REAL-WORLD APPLICATIONS

Some metropolitan planning organizations have established regional networked V2X consortia where multiple counties, cities, and state DOT districts share a common platform. This enables coordinated incident management, reduces vendor fragmentation, and provides consistent service delivery to travelers crossing jurisdictional boundaries.

Separately, some states have integrated networked V2X platforms with traffic signal systems, allowing emergency vehicle alerts and similar notifications to automatically adjust signal timing plans in affected corridors. This helps manage congestion and reroute traffic around incidents more effectively.

ENHANCED TRAVELER INFORMATION

USE CASE DESCRIPTION

The same networked V2X communication channels that carry safety-critical alerts can deliver a broader range of traveler information to enhance mobility, improve user experience, and support higher-level Advanced Driver Assistance Systems (ADAS) functionality. These include higher-fidelity road condition information, route guidance around incidents, real-time parking availability, special event notifications, severe weather advisories, air quality alerts, and information about alternative transportation options. The geofencing capabilities inherent in networked V2X enable highly targeted message delivery—information reaches only those travelers who need it, when and where they need it.

Enhanced traveler information goes beyond simple notifications to provide actionable guidance. Rather than just alerting drivers to a road closure, the system can suggest alternative routes. Instead of only warning about heavy traffic, it can recommend departure time adjustments or modal shifts to transit. This contextual, actionable information helps travelers make better decisions and improves overall network efficiency when supported by end-point systems and applications.

VALUE TO DEPLOYERS AND AGENCIES

Enhanced traveler information supports agency goals of improving mobility, reducing congestion, and supporting multimodal options. When travelers receive timely, accurate information about conditions and alternatives, they can adjust their travel behavior in ways that benefit the entire network. This is particularly valuable during planned events, construction projects, and recurring peak congestion periods.

Agencies can use enhanced traveler information to support specific policy objectives. Cities implementing congestion pricing can deliver targeted messages about pricing zones, alternative routes, and transit options. Agencies managing special events can provide parking guidance, pedestrian safety reminders, and real-time capacity information. Regions promoting multimodal transportation options can deliver transit schedule information and bikeshare availability precisely when and where users are most likely to need it.

The targeted nature of networked V2X information delivery ensures that messages reach relevant audiences without overwhelming users. Geofencing ensures travelers only see information about conditions they will actually encounter. User preferences and subscription models allow customization so that commuters see different information than occasional travelers.

Integration with navigation platforms magnifies the value of enhanced traveler information. When navigation apps receive structured data about conditions, closures, and alternatives, they can automatically recalculate routes and provide seamless guidance. This level of integration transforms passive information dissemination into active travel management.

REAL-WORLD APPLICATIONS

Connected corridors and enhanced ITS systems are beginning to generate high-fidelity roadway data that will ultimately support enhanced traveler information delivery and guidance to autonomous vehicles and ADAS systems. By providing pre-identified hazard locations in advance, it is possible to proactively avoid dangerous areas by adjusting routes accordingly.

Cities hosting major events can deploy networked V2X to manage the influx of travelers, providing real-time parking availability, recommended approach routes based on current traffic conditions, and pedestrian safety reminders near venues.

Some regions use networked V2X to support multimodal trip planning by delivering real-time transit arrival information to drivers as they approach park-and-ride facilities, encouraging mode shift during peak congestion periods.

SYSTEM DIAGNOSTICS AND REMOTE MONITORING

USE CASE DESCRIPTION

Networked V2X devices installed in vehicles and infrastructure inherently maintain network connections that enable two-way communication. This connectivity allows remote monitoring of device health, performance metrics, and operational status of vehicles and assets. Advanced systems can provide additional telemetric data, detect and flag anomalies, and automatically generate maintenance work orders.

Remote configuration management allows agencies to update device settings, adjust alert parameters, modify geofence boundaries, and deploy software updates without physical access to equipment. This is particularly valuable for devices installed on mobile fleet vehicles or in hard-to-access locations like highway signage or remote traffic signal cabinets.

VALUE TO DEPLOYERS AND AGENCIES

Remote diagnostics and monitoring reduce operational costs by minimizing the need for truck rolls and field inspections. Technicians only visit sites when diagnostics indicate actual problems, rather than performing scheduled preventive maintenance on devices that are operating normally. This is especially valuable for agencies with large geographic service areas or limited maintenance staffing.

Predictive maintenance capabilities enabled by continuous monitoring prevent service disruptions. When a device shows degrading performance, agencies can schedule replacement before failure occurs rather than responding to outages. When connectivity issues emerge, they can be addressed proactively rather than discovered only when an operator attempts to broadcast an alert.

System health monitoring provides performance data that informs procurement decisions and vendor accountability. Agencies can track mean time between failures, identify problematic device models or configurations, and use performance data in vendor negotiations or warranty claims. This data-driven approach to system management ensures that agencies get maximum value from their V2X investments.

Remote configuration updates enable rapid system evolution. As new use cases emerge or requirements change, agencies can deploy updated software. When operational needs evolve, compliant devices can be updated remotely to maintain optimal performance.

REAL-WORLD APPLICATIONS

State DOTs managing hundreds of connected devices across vast geographic areas use remote monitoring dashboards to track asset and system health. Maintenance personnel receive automated alerts when devices go offline, when batteries need replacement, or when environmental conditions such as extreme temperatures may affect performance.

Fleet managers monitor the health of networked V2X devices installed in construction trucks, snowplows, and emergency vehicles. When a device fails or requires attention, maintenance can be scheduled during routine vehicle servicing rather than requiring special appointments.

Traffic management centers monitor the operational status of networked V2X components integrated with signal systems and other infrastructure. This provides a unified view of ITS infrastructure health and enables coordinated maintenance planning.

Some agencies use diagnostic data to optimize device placement and configuration. By analyzing signal strength patterns and message transmission success rates, they can identify locations where additional infrastructure might be needed or where settings require adjustment.

DATA FOR RESEARCH AND POLICY DEVELOPMENT

USE CASE DESCRIPTION

Networked V2X deployments generate rich datasets that extend well beyond immediate operational needs. Vehicle position and movement data from equipped vehicles provides insights into driver behavior, traffic flow patterns, speed distributions, hard braking events, and vehicle trajectories. Infrastructure-generated messages create records of hazard locations and durations. The combination offers researchers and policymakers unprecedented visibility into how transportation networks function at a granular level.

This data supports academic research, safety studies, infrastructure planning, and policy evaluation. Researchers can analyze how drivers respond to different types of alerts, how effective various safety countermeasures are, and how traffic patterns evolve over time. Policymakers can use the data to justify investments, evaluate the impact of interventions, and support evidence-based decision making.

Importantly, networked V2X data can be anonymized and aggregated to protect privacy while still providing analytical value. Modern privacy preserving techniques enable agencies to share data with researchers and planning partners without compromising individual user privacy.

VALUE TO DEPLOYERS AND AGENCIES

Networked V2X data provides precisely the kind of before-and-after analysis that makes compelling cases for safety improvements, congestion mitigation projects, and innovative technology deployments.

Performance measurements and reporting requirements are easier to satisfy when agencies have access to objective, continuous data streams. Rather than relying on periodic manual counts or surveys, networked V2X provides ongoing performance indicators such as travel times, speed patterns, incident frequencies, and system utilization rates. This supports federal requirements for performance-based planning and programming.

Collaboration with university research partners can be mutually beneficial. Academic researchers gain access to real-world data for studies, while agencies benefit from analytical expertise and independent evaluation of their programs. These partnerships often lead to publications that raise the profile of agency innovations and contribute to the broader ITS knowledge base.

Regional planning organizations use networked V2X data to inform long-range transportation plans, identify areas needing improvement, and prioritize projects in their Transportation Improvement Programs (TIPs). The data helps ensure that limited funding goes to projects with the greatest potential benefit.

REAL-WORLD APPLICATIONS

State DOTs have partnered with universities to analyze work zone safety data from networked V2X deployments. These studies evaluate the effectiveness of different alert strategies, measure driver behavior changes in response to warnings, and inform the development of improved work zone traffic control practices.

Metropolitan planning organizations use networked V2X data to support corridor studies and major investment analyses. Detailed traffic data helps justify significant infrastructure projects and demonstrates need in competitive grant applications.

Some agencies publish anonymized, aggregated data through open data portals, enabling third-party developers, civic hackers, and community organizations to create applications and analyses that benefit the public. This approach aligns with principles of open government and can lead to innovative uses of public data.

STRATEGIC CONSIDERATIONS FOR AGENCIES

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As agencies consider expanding their use of networked V2X beyond core safety alerts, several strategic factors warrant careful consideration. Understanding these factors helps ensure that deployments deliver maximum value, integrate effectively with existing systems, and position agencies to take advantage of emerging capabilities.

COST-EFFECTIVENESS AND SCALABILITY OF NETWORKED V2X

A key advantage of networked V2X is its ability to deliver wide-area coverage and expanded functionality with a cost structure that aligns well with many agency budgets and deployment timelines. By leveraging existing commercial cellular networks, networked V2X enables agencies to deliver safety and mobility benefits without the need to build, operate, and maintain a dedicated communications network.

Networked V2X leverages existing cellular infrastructure that has already been deployed and is continually upgraded by commercial carriers. Commercial cellular carriers have already invested billions of dollars in network coverage, capacity, and reliability. Agencies benefit from this infrastructure without bearing its full cost. In areas where cellular coverage already exists, which increasingly includes most populated areas and major transportation corridors, networked V2X can begin operating without significant new communication infrastructure deployment.

Expanding networked V2X services as use cases and technology evolves can be cost effective for agencies. Once the core platform is deployed, adding new use cases often requires only software configuration and integration work rather than additional hardware installation. This makes it economically feasible to pursue expanded applications that might not justify dedicated infrastructure investment.

Scalability operates on multiple dimensions. Geographic scalability allows agencies to expand coverage areas simply by equipping vehicles or deploying devices where needed. Functional scalability enables agencies to add new message types, integrate new data sources, and serve new user groups through platform configuration. Volume scalability supports growing numbers of vehicles, messages, and users as adoption increases. Cellular network operators will need to address network scalability as the aggregate capacity and quality of service (QoS) demands of networked V2X grow.

Shared regional platforms can further improve cost-effectiveness by spreading infrastructure and operational expenses across multiple participating agencies. When neighboring jurisdictions collaborate on networked V2X deployment, each contributes a portion of the costs while all benefit from expanded coverage and enhanced interoperability.

Agencies should consider total cost of ownership when evaluating networked V2X options. This includes not only initial hardware and software costs, but also, depending on the solution, may include expenses for cellular data connectivity, cloud platform hosting, software maintenance and upgrades, and operational support. Comparing these costs against alternatives requires accounting for differences in coverage, capability, and flexibility.

LEVERAGING EXISTING CELLULAR NETWORKS AND CLOUD PLATFORMS

The maturity and widespread deployment of commercial cellular networks offers an immediate opportunity for stakeholders to achieve networked V2X outcomes quickly. Fourth generation (4G/LTE) cellular networks provide adequate bandwidth and latency for most V2X applications, while fifth generation (5G) networks offer enhanced capabilities that enable more demanding use cases. Cellular carriers continue to expand coverage and capacity, providing improving service without requiring agency investment. Moreover, satellite access technology, working seamlessly with land mobile networks, is becoming increasingly prevalent and capable. In the coming years, the launch of thousands of low earth orbit satellites is expected to unlock the potential for Non-Terrestrial Network (NTN) communication as a companion to current 5G networks.

Modern cloud platforms offer capabilities that would be expensive or impractical for agencies to develop and maintain independently. Cloud providers operate data centers with redundancy, security, and uptime guarantees that exceed what most agencies could achieve with on-premises infrastructure. They provide scalable computing and storage resources that automatically adjust to demand. They offer development tools, Application Programming Interfaces (APIs), and services that accelerate application development and integration.

For agencies, this means that networked V2X platforms can be deployed as cloud-native services that require minimal local infrastructure. Most agencies need only end-user devices for vehicles and field personnel, and integration points to their existing systems. The cloud platform handles message routing, data storage, user authentication, device management, and other backend functions.

Importantly,

safety-of-life scenarios are among the most demanding in terms of communication performance and latency. While networked V2X solutions and technology are advancing with increased connectivity, many safety-of-life V2X applications, such as collision avoidance and emergency braking alerts, demand ultra-low latency and near-100 percent message delivery. Even slight communication delays or packet losses can undermine these applications. Decision makers should be aware of these limitations when assessing appropriateness of networked V2X deployments.

NETWORKED V2X SECURITY ARCHITECTURE

Networked V2X operates over cellular networks using the Uu interface, which leverages existing cellular network architectures where devices establish authenticated, encrypted connections to known network endpoints. Cloud-to-cloud communications in these architectures inherently provide authentication, authorization, message integrity, and non-repudiation through established enterprise security frameworks such as mutual Transport Layer Security (mTLS), OAuth 2.0, and cloud platform security services. When a vehicle or infrastructure element connects to a Network V2X platform, it authenticates through the cellular network and establishes encrypted tunnels for data exchange. These persistent, authenticated sessions eliminate the need to sign individual messages, as trust is established at the connection level rather than the message level.

However, reliance on commercial networks and platforms also introduces potential challenges that agencies must address. Cellular connectivity depends on commercial carrier coverage, which may be incomplete in rural or remote areas. Agencies deploying networked V2X in areas with limited cellular service may need to evaluate coverage carefully or consider hybrid approaches that combine network and direct communications.

Data security and privacy require attention when using cloud platforms. Agencies must ensure that platforms implement appropriate security controls, encrypt data in transit and at rest, and comply with relevant regulations and policies. Most cloud providers offer compliance certifications and security tools that support agency requirements, but agencies retain ultimate responsibility for protecting the data they collect and manage.

Vendor selection deserves careful consideration. While cloud platforms provide flexibility and reduce infrastructure burden, they also could create dependencies on specific vendors. Agencies should evaluate lock-in risks, assess data portability options, and consider long-term sustainability when selecting platforms and service providers. Accessing open interfaces and leveraging standard APIs for platform integration can also help mitigate vendor lock-in by ensuring even broader interoperability.

INTEGRATION PATHWAYS WITH AGENCY IT AND TRANSPORTATION SYSTEMS

The value of networked V2X expands significantly when integrated with existing agency systems rather than operating as a standalone platform.

Most agencies already operate numerous systems relevant to connected vehicles: CAD, traffic management centers, maintenance management systems, fleet management platforms, 511 traveler information services, and geographic information systems. Integrating networked V2X with these systems enables data sharing, coordinated operations, and unified user interfaces.

Modern networked V2X platforms typically offer APIs that facilitate integration. RESTful APIs, streaming interfaces, and message queue systems enable other agency applications to send data to networked V2X platforms, receive data from them, and trigger actions based on V2X events. This bidirectional integration means that data flows where it provides value without requiring manual transfers or duplicate data entry.

Integration with **CAD systems** enables automatic generation of V2X alerts when incidents are entered into CAD, ensuring that appropriate warnings reach drivers without requiring separate operator actions. It allows CAD operators to see when V2X alerts are active, providing situational awareness. Emergency vehicle alerts generated by networked V2X devices can automatically update CAD with vehicle locations and status.

Traffic management center integration provides TMC operators with a unified view that combines traditional ATMS data (detector speeds, camera feeds, incident reports) with networked V2X information. Operators can manage V2X alerts from the same interface they use for other traffic management functions. Automated incident detection systems can trigger coordinated responses that include both traditional traffic management actions, such as posting messages on dynamic message signs, and networked V2X alert distribution.

Fleet management system integration enables automated workflows where vehicle location data from networked V2X feeds directly into AVL platforms, dispatch systems, and routing optimization tools. Work zone management systems can trigger V2X work zone alerts when maintenance activities begin and automatically deactivate them when work completes. Maintenance management systems receive diagnostic alerts from V2X devices, creating work orders for technician attention.

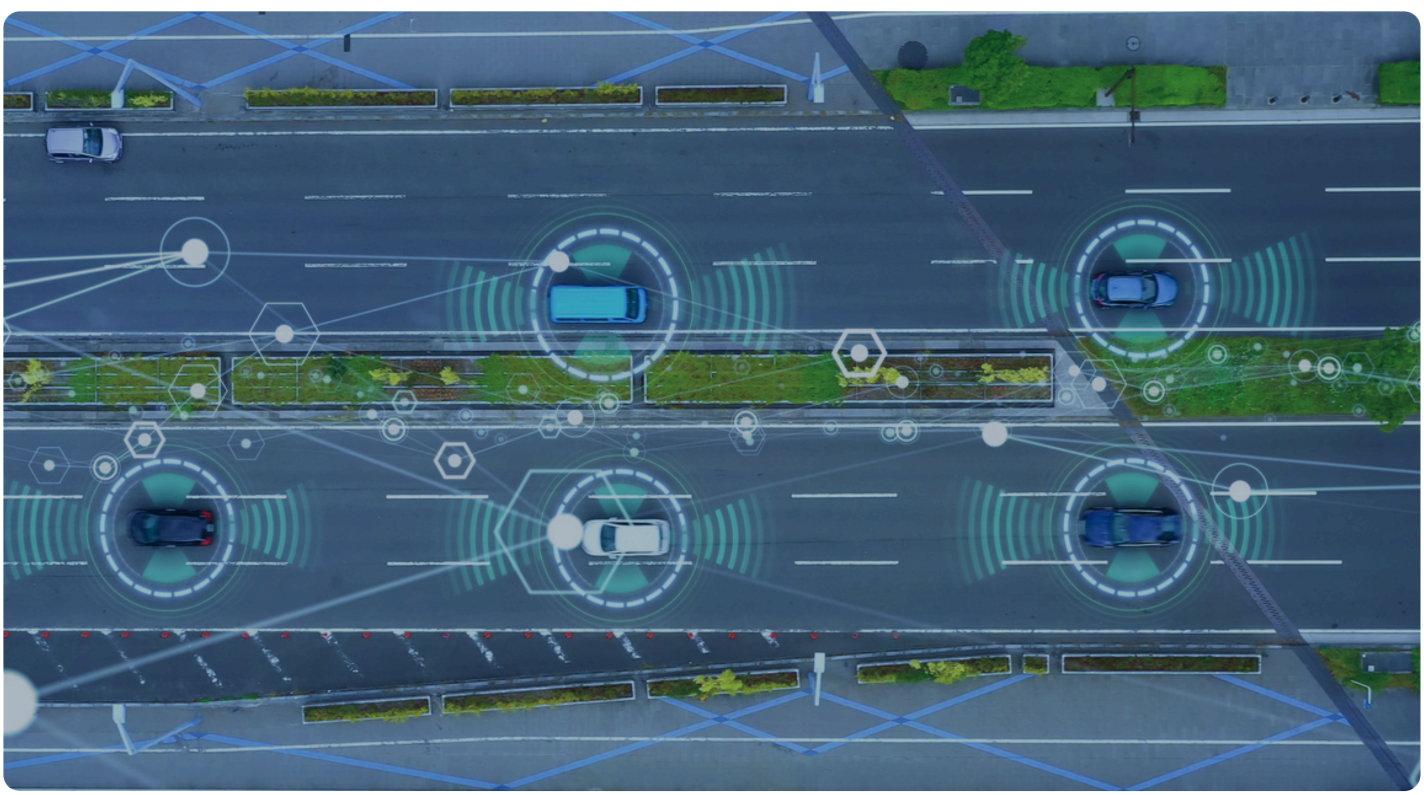
Integration with **511 traveler information systems** allows agencies to broadcast consistent information across multiple channels. An incident reported through one system appears in all others, ensuring travelers receive the same information whether they access it through phone calls to 511, a website, a mobile app, or networked V2X alerts delivered to their vehicle.

GIS integration enables spatial analysis, map-based interfaces for managing geofenced alerts, and visualization of incident patterns. Planners can use GIS tools to analyze V2X data alongside other spatial datasets such as crash records, traffic volumes, and demographic information.

Agencies should develop integration strategies early in deployment planning.

Understanding which systems need to connect, what data should flow between them, and how integration will be implemented ensures that networked V2X becomes part of the agency's broader technology ecosystem rather than another isolated system requiring separate management.

Many agencies lack internal IT staff with expertise in API integration, cloud services, and modern software development practices. Partnerships with vendors, consultants, or regional technology providers can help bridge these gaps. Some regions have established shared services models where a lead agency or third-party organization provides technical expertise and integration services to multiple participating agencies.



RECOMMENDATIONS AND NEXT STEPS

Agencies considering expanded use of networked V2X should approach deployment strategically, building on successful core safety implementations while planning for growth and evolution. The following recommendations provide guidance for agencies at different stages of networked V2X adoption.

HOW AGENCIES CAN BEGIN EXPLORING EXPANDED USE CASES

1 START WITH INVENTORY AND ASSESSMENT

Agencies should begin by understanding which elements of their infrastructure and assets are already equipped with connectivity. Document existing networked V2X devices, platforms, and integrations. Identify which expanded use cases could be enabled with existing infrastructure through configuration or minor enhancements versus which would require additional investment. This assessment prevents redundant spending and reveals opportunities to extract more value from current systems.

2 ENGAGE STAKEHOLDERS ACROSS DEPARTMENTS

Networked V2X benefits extend across agency functions. Traffic operations, fleet management, public safety, planning, IT, and maintenance departments all have potential interests. Convene a cross-functional working group to explore how expanded V2X capabilities might support departmental objectives. This engagement often reveals use cases that technology staff would not have identified independently and builds organizational support for expanded deployment.

3 PRIORITIZE BASED ON VALUE AND FEASIBILITY

Not all expanded use cases will have equal value for every agency. Prioritize based on alignment with agency strategic goals, potential for measurable impact, implementation complexity, and resource requirements. Quick wins that deliver visible value with modest effort help build momentum and justify further investment. Start with use cases that leverage existing devices and require primarily software configuration or integration.

PILOT BEFORE COMMITTING TO LARGE-SCALE DEPLOYMENT

4

Test expanded use cases through small-scale pilots that demonstrate value and identify implementation challenges before agency-wide rollout. Pilots should be planned with scalability as a goal, and have clear objectives, defined success metrics, and limited duration. Document lessons learned and use pilot results to refine approaches before scaling.

DEVELOP DATA GOVERNANCE POLICIES

5

As networked V2X generates more diverse data types and serves more use cases, clear governance becomes essential. Establish policies for data access, retention, sharing, and privacy.[4] Define roles and responsibilities for data management. Ensure compliance with relevant regulations and agency policies. Data governance prevents problems before they occur and enables agencies to leverage data confidently.

PLAN FOR EVOLUTION

6

Networked V2X technology and capabilities continue to evolve. Deploy systems with flexibility to adapt as requirements change. Favor platforms that support standard interfaces, offer regular software updates, and demonstrate commitment to interoperability. Plan for periodic reassessment of capabilities and vendor performance.

[4] ITS America Privacy Principles. March 2025

KEY QUESTIONS TO ASK SOLUTION PROVIDERS

When evaluating networked V2X platforms and vendors, agencies should **ask probing questions that reveal capabilities, limitations, and vendor approaches** to the expanded use cases outlined in this document:

REGARDING PLATFORM CAPABILITIES:

- What data analytics and reporting capabilities are included? Can agencies export raw data for their own analysis?
- How does your platform support multiple agencies or jurisdictions sharing infrastructure? What mechanisms exist for access control and data isolation between participating agencies?
- What message formats and data structures does your platform support? How flexible is the system for custom message types?
- What APIs or integration interfaces do you provide for connecting to external systems such as CAD, ATMS, fleet management, and traveler information platforms?
- How does your solution handle geofencing and targeted message delivery? What tools do agencies have to define and manage geographic zones?

REGARDING EXPANDED USE CASES:

- How does your platform support AVL functionality? Can vehicle location data integrate with CAD and fleet management systems?
- What diagnostic and monitoring capabilities do you provide for deployed devices? Can agencies track device health, battery status, and connectivity remotely?
- Does your platform aggregate incident and hazard data for analysis? What tools exist for identifying patterns and generating reports?
- How do you support enhanced traveler information beyond basic safety alerts? Can agencies deliver customized messages based on user preferences or vehicle type?
- What research and policy development support do you provide? Can agencies access anonymized datasets for analysis and grant support?

REGARDING INTEROPERABILITY AND STANDARDS:

- How can your platform interoperate with Direct V2X systems if needed? Can your solution facilitate message exchange between network and direct communications?
- What is your approach to security and authentication? What security frameworks do you implement for cloud-based communications?
- How do you handle interoperability with other networked V2X providers? Can your platform exchange messages with other platforms serving adjacent jurisdictions?
- How do you incorporate evolving industry practices and emerging standards into your platform?

REGARDING LONG-TERM SUSTAINABILITY:

- What is your business model and pricing structure? Are there per-message fees, per-device fees, or subscription models? How does cost scale as deployment grows?
- What is your software update and maintenance approach? How frequently do you release updates and how are they deployed?
- How do you handle data portability? If an agency decides to change vendors, what mechanisms exist to export data and configurations?
- What is your vendor roadmap for the next 3-5 years? What new capabilities are planned?
- Can you provide references from agencies currently using expanded V2X capabilities? What has their experience been?

REGARDING IMPLEMENTATION AND SUPPORT:

- What implementation services do you provide? How long does typical deployment take?
- What training and documentation do you offer for agency staff?
- What ongoing technical support is included? What are response times for critical issues?
- How do you handle software customization or integration work that may be needed for agency-specific requirements?

OPPORTUNITIES FOR COORDINATION ACROSS DEPARTMENTS OR JURISDICTIONS

Networked V2X is inherently a collaborative technology. Its value increases as more participants join and as systems interoperate across boundaries. Agencies should actively seek coordination opportunities:

INTERNAL COORDINATION:

Within agencies, coordination across departments ensures that investments benefit multiple stakeholders. IT departments need to be engaged early to ensure network security, data management, and system integration align with agency standards. Fleet management can leverage devices deployed for safety alerts to gain AVL capabilities. Planning departments can access data for analysis and grant support. Public safety can integrate V2X with dispatch and emergency response systems. Maintenance departments can use diagnostics and remote monitoring to optimize device servicing.

REGIONAL COLLABORATION:

Metropolitan regions often include multiple cities, counties, transit agencies, and state DOT districts. Regional coordination enables travelers to experience consistent service as they cross jurisdictional boundaries and allows agencies to share infrastructure costs. Metropolitan planning organizations can serve as conveners, bringing together agencies to discuss shared deployment, data sharing agreements, and collaborative approaches. Some regions have formed V2X working groups or consortia that meet regularly to coordinate activities.

STATEWIDE INITIATIVES:

State DOTs can play leadership roles by establishing statewide networked V2X platforms that local agencies can join. This approach provides economies of scale, ensures interoperability, and enables comprehensive coverage. State DOTs can leverage their existing relationships with cellular carriers and cloud providers to negotiate favorable terms. They can develop procurement vehicles (such as state contracts) that local agencies can use to deploy compatible systems.

MULTI-STATE COORDINATION:

For agencies near state borders or serving interstate corridors, coordination with neighboring states ensures service continuity. The Eastern Transportation Coalition, I-80 Coalition, and other multi-state partnerships provide forums for discussing connected vehicle deployment and aligning approaches. Federal programs through the USDOT Joint Program Office can facilitate multi-state coordination by providing common platforms, shared approaches, and coordination support.

PUBLIC-PRIVATE PARTNERSHIPS:
Collaboration with OEMs, navigation platforms, Mobile Network Operators (MNOs), and technology providers can accelerate deployment and expand reach. Some agencies have established agreements with navigation platforms to ensure their alerts appear in those apps. Others work with automotive OEMs to pilot new connected services or provide feedback on vehicle implementations of V2X capabilities. These partnerships can also provide agencies with access to probe vehicle data that complements agency-generated information.

ACADEMIC PARTNERSHIPS:
Universities with transportation research programs offer opportunities for agencies to leverage research expertise, access graduate student support for analysis, and contribute to the broader knowledge base. Many universities have connected vehicle testbeds or research fleets that can serve as proving grounds for new capabilities before full deployment.

Effective coordination requires clear communication, defined governance structures, and documented agreements. Memoranda of understanding (MOUs) or interagency agreements should specify roles, responsibilities, cost sharing, data access, and decision-making processes. Regular meetings and communication channels keep participants aligned as deployments evolve.

APPENDIX

ITS AMERICA

GLOSSARY OF TERMS

TERM	DEFINITION
ADAS	Advanced Driver Assistance Systems—vehicle features that support driving tasks (e.g., lane keeping, adaptive cruise control) and may use received V2X data as a complement to onboard sensor data inputs.
API	Application Programming Interface—a defined method for software systems to exchange data and trigger actions.
ATTAIN	Advanced Transportation Technologies and Innovative Mobility Deployment—USDOT grant program supporting innovative transportation technology deployments.
ATMS	Advanced Traffic Management System—software used by agencies/TMCs to monitor and manage traffic operations.
AVL	Automated Vehicle Location—capability to track fleet vehicles' locations and related status information in real time.
CAD	Computer-Aided Dispatch—systems used by public safety/operations centers to manage incidents, resources, and dispatching.
Cloud (Cloud Platform)	Internet-hosted computing services (compute, storage, security, analytics) used to run applications and manage data without on-premises infrastructure.
Connected Vehicle	A vehicle that communicates wirelessly with cloud services, infrastructure, and other systems (including V2X applications).
DOT	Department of Transportation—state, county, or local transportation agency.
EVP	Emergency Vehicle Preemption—traffic signal control that provides right-of-way to approaching emergency vehicles.
FHWA	Federal Highway Administration—USDOT agency focused on highway programs and guidance.
Geofencing	Using a defined geographic boundary to target when/where messages or services apply (e.g., alerts shown only to travelers near a work zone).
HSIP	Highway Safety Improvement Program—federal-aid program funding infrastructure safety improvements.
IP	Internet Protocol—foundational networking protocol suite used for routing data over the internet and private networks.
IOO	Infrastructure Owner-Operator—entity responsible for operating transportation infrastructure (e.g., DOT, toll authority, municipality).
ITS	Intelligent Transportation Systems—applications of sensing, communications, and computing to improve transportation safety and efficiency.

TERM	DEFINITION
ITS JPO	ITS Joint Program Office—USDOT office that supports connected and automated vehicle research and deployment programs.
mTLS	Mutual Transport Layer Security—encrypted communication where both client and server authenticate each other using certificates.
MNO	Mobile Network Operator—a cellular carrier providing wireless connectivity services.
Networked V2X	V2X communication delivered via commercial cellular and/or IP networks and cloud platforms, rather than over short-range direct radio links.
NHTSA	National Highway Traffic Safety Administration—USDOT agency focused on vehicle safety standards and road safety programs.
NTN	Non Terrestrial Network—communications using satellites and related systems as a complement to terrestrial cellular networks.
OAuth 2.0	An authorization framework commonly used to allow applications to access resources securely via access tokens.
OEM	Original Equipment Manufacturer—vehicle manufacturer that integrates connected services and related hardware/software into vehicles.
Probe Vehicle Data	Anonymized information about vehicle position, speed, and movement patterns used to understand traffic flow and roadway conditions.
RESTful API	A common API style that uses standard web methods (e.g., GET/POST) to access resources over HTTP.
SMART Grant	Strengthening Mobility and Revolutionizing Transportation—USDOT grant program supporting advanced technologies and data-driven innovations.
SS4A	Safe Streets and Roads for All—federal program supporting local and regional roadway safety planning and implementation.
TMC	Traffic Management Center—operations center where agencies monitor and manage traffic and incident response.
TIP	Transportation Improvement Program—short-range, prioritized list of transportation projects, typically managed by an MPO.
Uu Interface	The cellular air interface between a user device (e.g., vehicle modem) and the cellular network, used for network-based connectivity. This interface is specified in 3GPP technical specifications.
V2X	Vehicle-to-Everything—communications between vehicles and other entities (vehicles, infrastructure, pedestrians, networks) to support safety, mobility, and operations.
511	A traveler information service (phone/web/app) providing road conditions, incidents, and travel times in many regions.

LINKS TO RELEVANT ITS AMERICA RESOURCES

ITS AMERICA

V2X APPLICATION MAPPING IN NETWORKED V2X

A BLUEPRINT FOR TRANSPORTATION TECHNOLOGY

ITS AMERICA BEYOND 5.9 V2X DEPLOYMENT PLAN


ITS AMERICA