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WHITE PAPER

V2X - The Opportunity is Now

A Wards Intelligence White Paper

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verizon business

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Executive Summary

The availability of newer technologies and the desire to reduce fatalities means that a collective understanding of opportunities and benefits, supported by new thinking and strategies, could create an accelerated roadmap to scale Vehicle-to-Everything (V2X) and intelligent transport systems (ITS) by 2030. This white paper outlines the current state of the V2X and ITS industry, and why it has never been in a better position for success. It then explores 5G technologies and suggests new thinking that could accelerate road safety success as well as support ambitions for better mobility and traffic efficiency in the U.S.

The State of V2X and Intelligent Transport Systems (ITS) in 2024

Each year, six million car accidents occur on U.S. roads and, unfortunately, 43,000 people lose their lives as a result. According to the National Safety Council, costs related to motor vehicle accidents in the U.S. reached $500 billion in 2021.

The seamless combination of V2X technology with ADAS and the enablement of ITS has been a vision for over a quarter of a century. The challenge is this requires the coming together of complex technical, political, legal, and organizational systems. Unfortunately, the collective vision for the future and knowledge of the cross-industry technical and operational possibilities and challenges are not always synchronized.

In a smart transportation system, vehicles need to reliably communicate not only with each other but also with diverse and differing road infrastructure. To deploy V2X, the ITS community must evolve from just being highway infrastructure owners and operators toward a service delivery business model. However, this requires a new mindset as well as the adoption of new tools and skill sets to assist operators adapt to these new business model expectations.

This 20-plus-year challenge is not just a U.S. or North American issue it is a global one. All have struggled with the "chicken or egg" conundrum of the infrastructure or the vehicle first. This perpetual dilemma was further compounded by the technology competition emerging around ten years ago between the original V2X standards DSRC, and the 3GPP cellular standard 4G LTE V2X.

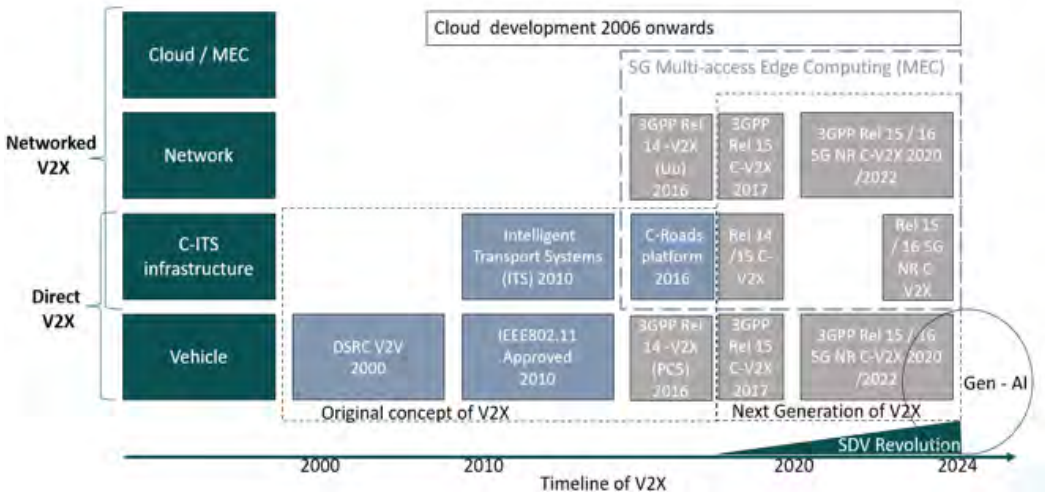
In the first quarter of 2017, 3GPP Release 14 finalized specifications for C-V2X communications supporting basic active safety applications. LTE-V2X refers to direct communications via the PC5 interface, and this was further refined in Release 15 in June 2018. 3GPP Release 14 also specified enhancements in network communications for reliable vehicle-to-network (V2N) connectivity. Subsequently, in June 2020, the 5G NR-V2X was defined in Release 16, specifying V2X capability to support new day two use cases.

While technologists and experts immersed in this space are well-versed in the V2X technologies involved, the majority of the public and even professionals in the transportation sector are not. For clarity in this paper, we will use the following ITS America's designators:

- **Direct V2X** refers to LTE-V2X, also known as C-V2X, utilizing the direct PC5 communications interface in the 5.9 GHz ITS spectrum.
- **Networked V2X** refers to the ability of vehicles, infrastructure, and other road users and assets to exchange data with one another using network-based systems. This is also known as V2N and uses the Uu interface, outside the 5.9 GHz band, over an operator network using licensed spectrum.

These complementary technologies can facilitate vehicle-to-vehicle (V2V), vehicle to Infrastructure (V2I), and vehicle-to-pedestrian (V2P) communications and are included in the 5GAA umbrella concept of C-V2X

Figure 1 How V2X Evolved



Source 1Wards Intelligence

These direct and network V2X solutions provide an opportunity for the industry toincrease the dependability, robustness, and scale of V2X applications by leveraging connectivity across a broad array of technologies. Additionally, the growth of cloud capability, the emergence of software-defined vehicles (SDVs), sensor fusion, and Gen AI all increase vehicle capability and generate a richer data view of the environment around the vehicle that can enhance Direct V2X capability far beyond the original intent.

There is a view within the U.S. ITS industry that, by 2016, there was momentum around DSRC with signal phase and timing (SPaT) challenges and OEM commitments. However, in 2020, the Federal Communication Commission (FCC), frustrated by the lack of progress in V2X deployment and under pressure from the Wi-Fi community, reduced the allocated safety spectrum from 75 MHz to 30 MHz and changed the specified technology from DSRC to C-V2X. The FCC said it would issue waivers to allow operating C-V2X until the second "report and order". Since then, there has been regulatory uncertainty, with the FCC only starting to license waivers in April 2023. This has reinforced OEM

hesitation on deployment and resulted in many infrastructure owner-operators (IOOs) pausing their 5.9GHz deployments.

In July 2024, the FCC Chairwoman, Jessica Rosenworcel, announced that the Commission will vote on final rules at an upcoming FCC meeting. The rules would codify C-V2X technical parameters in the Commission's rules, including power and emission limits and message prioritization. The rules would not require licensees, already operating under C-V2X waivers, to amend their currently deployed systems, and would provide a two-year timeline for sunsetting the use of existing DSRC-based technology.

However, despite this period of uncertainty, there have been several changes for the good. In 2023, ITS-A published a National V2X Deployment Plan, which assumed the use of C-V2X low-latency wireless communications systems that operate in the 5.9 GHz band, primarily for safety applications and to focus on the deployment of V2X at signalized intersections. It is estimated that there are 330,000 signalized intersections in the U.S. that should be covered with Direct V2X roadside units (RSUs), with responsibility for the oversight given to the various State DOTs.

In October 2023, the 5G Automotive Association (5GAA), automakers, IOOs, and others released the Day One Deployment Guide to identify the V2X messages and to encourage OEMs and IOOs to prepare for Day One deployment. Additional messages not in the Day One deployment, such as Personal Safety Messages (PSM), are being identified as needed by OEMs as they focus on Vulnerable Road Users (VRUs). Working with IOOs to deploy standardized infrastructure could allow for quicker deployment and would not depend on ubiquitous deployment in all vehicles.

The U.S. Department of Transportation (DoT) held V2X summits that resulted in a national interoperability and deployment plan, published in August 2024. The plan draws on the above industry publications and discussions and describes deploying new, interconnected safety technology in cars and on roadways across the country between now and 2036. The plan is broken down into three phases:

- The first phase, from 2024 to 2028, targets V2X technology on 20% of the National Highway System, adding V2X technology at a quarter of all intersections in the country's seventy-five largest metro areas, and recruiting at least two major automakers to begin installing Direct V2X devices in their vehicles.

- In phase two, from 2029 to 2031, the plan seeks to boost deployment to 40% of highways and half of intersections in major metro areas. The agency also wants at least five consumer vehicle models to include V2X devices.
- The final phase, from 2032 to 2036, includes the deployment of V2X on all highways and 85% of intersections in major metros, plus in-vehicle commitments from six automakers.

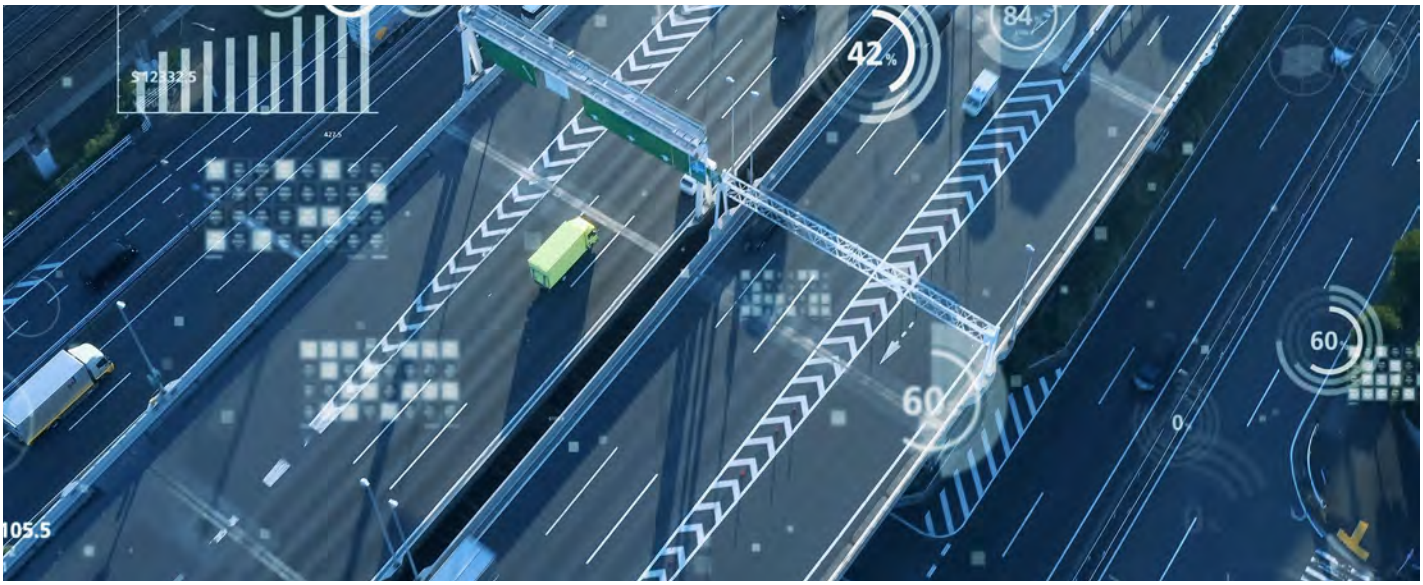
At the 2024 CAR-MBS conference in Traverse City, Michigan, a roundtable tackled the challenges of accelerating and optimizing V2X in automotive. The roundtable brought together Audi, Volkswagen, Harman, Tata, and Continental representatives, with Haas Alert and startup Cavenu. Also joining the conversation was Shailen Bhatt, head of the Federal Highways Administration.

The session started with a discussion about what many see as the "elephant in the room," that the industry has squandered an opportunity to utilize the 75MHz of spectrum in the 5.9GHz band, allocated by the FCC back in 2002, that has now been reduced to 30MHz.

The roundtable determined that there was a real need to show rapid developments in V2X and deliver benefits to society, otherwise this spectrum allocation could also be at risk in the future.

The point was made that it is necessary to think about the subject differently. For too long there has been a "chicken-and-egg" scenario of who should start first: the automakers or the IOOs? Now Utah's Department of Transport has concluded that it must be BOTH the chicken and the egg, and it has initiated infrastructure investments as well as enabled its fleets of vehicles with V2X capability.

Others in the room identified the biggest challenge as the 10,000+ IOOs of diverse sizes, many of which do not have the budget nor the capability to implement V2X, meaning that getting nationwide interoperable V2X infrastructure at scale is a serious challenge. As the ITS-A deployment plan noted: "It is important to keep in mind that the roadmaps for IOOs and OEMs are distinct, yet equally vital, for the successful deployment of V2X."



Only 20% of V2X use cases require ultra-low latency connectivity; the other 80% could be delivered via Network V2X. It's not so much about mission-critical information delivered via PC5, it's more about preventing people and vehicles from getting into dangerous situations by sharing available information early via Network V2X. But this also requires ubiquitous coverage from Communication Service Providers, or the possibility of eSIM-enabled vehicles seeking and swapping to alternative available networks for coverage, including in the future non-terrestrial networks.

20% of V2X use cases require ultralow-latency connectivity

80% of other V2X cases could be delivered via Networked V2X

In summary, there is an increasing sense of urgency to start and scale V2X but also to adopt a more open mind to collaboration and different technologies being leveraged to incrementally move the deployment forward. It's not about policy or technology, it's about focusing on the service and delivering value by leveraging existing technology and using available data.

Connectivity Benefits & Opportunities

The critical ingredient in ITS, V2X, and autonomous vehicles, is connectivity. However, providing consistency of connectivity is problematic as the cellular industry tends to move in 10-year generations of technology. Initially, the first two generations were about mobile voice, then from the year 2000 with 3G, the industry started to develop mobile broadband which it further developed with 4G. Since 2020, the industry has been focused on creating a ubiquitous connectivity fabric that will enable cyber-physical systems to support immersive consumer experiences, digital twins based on an energy-efficient, accurately positioned, sensing network of networks. 5G is the start and this will mature through more advanced features and evolve into 6G from 2030 onwards.

One major challenge for the automotive and ITS industry is that the "clock speed" of telecoms and the cloud industry, in terms of technology innovation and deployment, is at a minimum around four times the pace.

Automakers are only just beginning to install 5G modems in vehicles. Part of the reason for this delay was that the cost differential between 5G and 4G chipsets and modems was approximately double. The other issue is that, on a cost-performance basis, there was no major difference between 5G and 4G until the standalone 5G core (5G SA) became operational. Then 5G advanced services started to deliver enhanced capabilities, including services such as network slicing, lower latency, and many other advantages.

All this frames the challenges in the automotive industry in terms of the technology timing, cost, and longevity of services. The proposed first 6G commercial deployments are scheduled for 2030, and this is causing anxiety in terms of when CSPs will sunset 4G LTE networks and transition to 5G / 6G networks to gain

network efficiency. Another major concern is about their UN Regulation 155 cybersecurity obligations, if a network goes dark and the vehicle can't be updated.

Even with assurance from the FCC, it will take three to four years before a substantial number of Direct V2X vehicles will arrive on the market.

Security

From its earliest days, V2X was created with security and privacy in mind and was consciously designed to make it easy to implement securely. However, the more a system can communicate and is seen as more beneficial to the user, the greater the risk of a malicious external attack. Two key technologies that help protect against this kind of attack are sandboxing and authentication.

Sandboxing in this situation means deliberately limiting the types of data that will be accepted. In Direct V2X a series of applications (specific set of messages) are defined and specified in standards published by SAE, ETSI, CCSA, and other organizations that can be sent over the air, as well as a specific set of uses that can be made of those messages.

5G SA & 5G Advanced

As its name suggests, 5G SA is an end-to-end 5G network that does not rely on any 4G core or RAN components to function. 5G SA features ultra-low latency, supported by lower handover time, resulting in nearly real-time communication. 5G SA also provides enhanced end-to-end security, including advanced encryption and identity protection. Both features should be appealing for in-vehicle commerce. Another benefit of 5G SA is greater flexibility around billing and charging.

5G SA also introduces 5G advanced services, including support for non-terrestrial networks, addressing challenges such as long propagation delays and large Doppler effects, which are prevalent in networks like Low Earth Orbit (LEO) and Geosynchronous Earth Orbit (GEO). Another new capability is the concept of Integrated Communication and Sensing (ICAS) which extends the capability of cellular networks from mere communication to include sensing functionalities, effectively enabling the network to 'see' and 'feel' its surroundings offering innovative services by fusing the physical with the digital world.

Networked V2X: What can it Add to V2X and ITS

At Mobile World Congress 2024 in Barcelona, the V2X community began to emphasize the UU-based Network V2X enhanced by 5G low latency to communicate urgent information to drivers.

At the ITS America conference in Phoenix, the USDOT ran a pilot training course on V2X that was intended to help all the states and local DOT employees understand V2X. One of the standout insights was that USDOT does not recognize V2N as an element of V2X. The logic behind this is that the network is not an "actor" in the way that a vehicle, infrastructure, and people are. The network merely transmits the data and provides support.

An alternative perspective from 5GAA, 5G Americas, and ITS-A is that the Network V2X mode uses the 5G mobile network as a complementary tool to assist with V2X use cases delivering end-to-end services, including those related to safety, emergency vehicle operations, work zone alerting, and various information-sharing benefits.

Furthermore, Network V2X can also leverage mobile phones to provide alerts and information to drivers, which drivers already hook up to in-vehicle systems. Again, this helps accelerate integration and adoption of V2X technology, at minimal cost.

These juxtaposition mindsets typify the challenges the industry has faced in coming together on a collective message concerning the complementary use of cellular networks with Direct V2X to deploy advanced use cases that could save lives.

Precise Location

In 2023, 5GAA studied precise positioning technology and concluded that safety-critical applications, such as VRU protection at an intersection requires extremely high accuracy to prevent accidents, and enhance ADAS and eventually autonomous driving systems, but is less critical for applications such as infotainment systems.

5G Advanced can offer centimeter-level horizontal and vertical location accuracy in indoor and outdoor scenarios. This compares to an accuracy of 3–10 meters for GPS, which is limited to outdoor coverage.

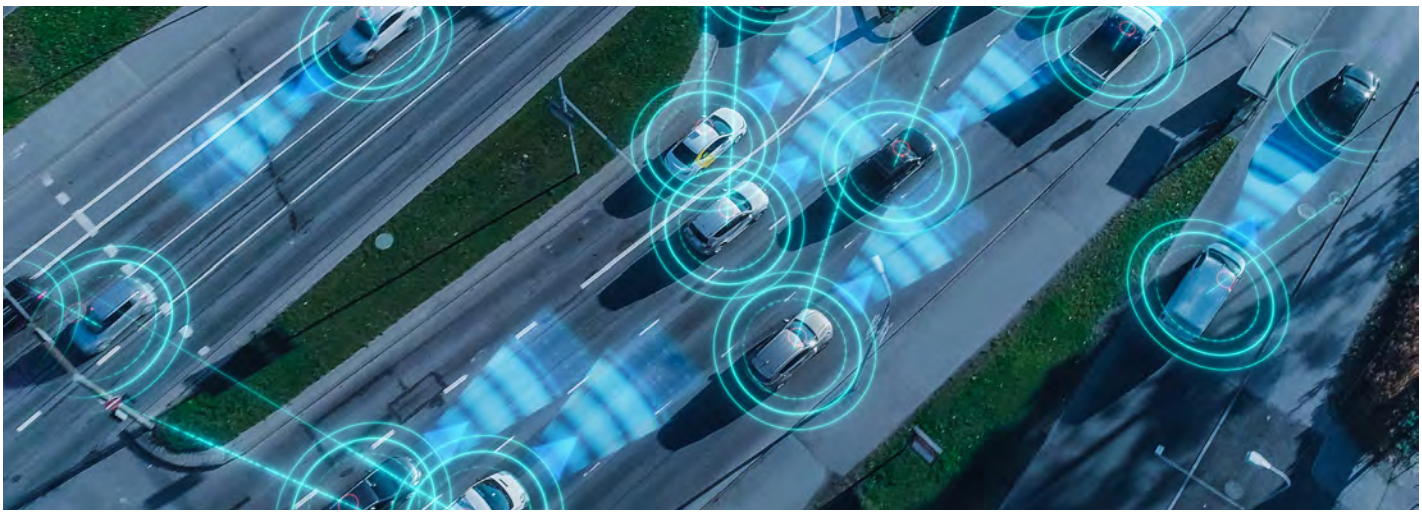
An alternative or supplement to this approach uses real-time kinematic (RTK) reference stations that CSPs can construct across the U.S. The RTK stations collect satellite data, and then the CSP backend analyzes and distributes the GNSS correction data to RTK-capable devices that use the correction data to help determine their location within approximately 1cm in near-real time.

Multi-access Edge Computing (MEC)

Direct V2X apps depend on ultra-low latencies to operate effectively. A centralized cloud isn't adequate to deliver the required latency, but a derivative of cloud computing called multi-access edge computing (MEC) located near the edge of a 5G SA network has the potential to deliver network V2X with comparable latencies. MEC brings computing resources and infrastructure closer to devices that generate or consume data, which significantly reduces latency. The MEC processes and stores data within the radio access network (RAN) and only delivers certain key information to centralized data clouds.

MECs can facilitate various end-to-end services based on the bandwidth and/or latency requirements of differing applications. The MEC can incorporate roadside edge network infrastructure that can provide vehicular services (over PC5) by aggregating various roadside sensors and data processing. The MEC can adapt the CPU and storage resources to manage the large fluctuating volumes of data to and from the vehicles or RSUs, based on the service requirements. The use of a hierarchical architecture using gateways and roadside units can further reduce the latency and processing load of the overall network.

A significant demonstration was organized by 5GAA members in Q4 2023 at the Mcity test facility at the University of Michigan. They showed a VRU use case using network communication in an interoperable scenario with two service provider VRU apps using two CSP MEC infrastructures. During the live demonstration, the focus was on the service interoperability of near real-time safety-enhancing alerts as well as information highlighting the impressive capabilities of mobile network communications.



Slicing

Network slicing allows CSPs to operate multiple logical networks, or "slices," using their common infrastructure to serve multiple customers, while simultaneously isolating the network slices to ensure specific service level agreements (SLAs). Network slicing provides distinct advantages over dedicated network solutions by providing increased flexibility and lower costs. Offering different "slices" of the mobile network based on the specific service requirements of the end customer also gives CSPs the ability to tailor their solutions to leverage the full extent of their network capabilities.

Virtual Roadside Unit: A Potential Game Changer

A cellular radio access network (RAN) architecture allows a base station to be split into three parts: the central unit, the distributed unit, and the radio unit. This approach increases deployment flexibility, allows centralization of common functions, and reduces the cost and complexity of deployment and management of the network.

According to a 5G Americas whitepaper "Vehicular Connectivity: C-V2X & 5G" published in September 2021, RSUs could also be disaggregated and deployed in a distributed manner. Radio panels could be spread across a large coverage area on traffic lights and the MAC layer of the RSU can be placed close to the 4G/5G central unit. A centralized logical upper layer could allow the same distributed RSU radio panels to serve larger coverage areas and reduce potential service transitions. This distributed RSU deployment could deliver both technical and operational benefits including scalable, secure, and near real-time processing on the MEC as well as significantly reducing the rollout times and cost of ownership for the ITS infrastructure operators.

As Direct V2X technology evolves, ITS infrastructure operators can choose how they upgrade the system. They could do a simple software upgrade of the RSU central unit for new functions based on the latest standards, or they can upgrade certain parts of the RSU distributed units without affecting the ongoing operation of the rest of the RSUs.

Public-Private Opportunities

The Stress and Challenge of Financing and Maintaining an ITS Infrastructure

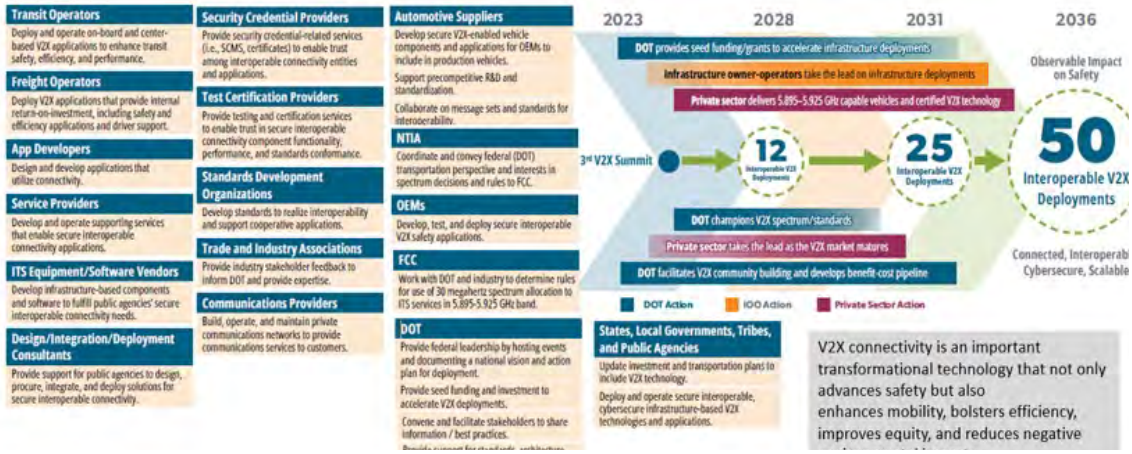
IOOs are challenged with maintaining their aging roadways and are increasingly becoming fatigued from the stress of planning, financing, and maintaining existing and new ITS infrastructure. In many cases, they do not have the technical resources or knowledge to keep up with, let alone understand and evaluate, the fast-moving technologies associated with networks, V2X, ITS, cloud, and edge computing.

The fact that there are so many IOOs means that automakers who are also resource-challenged cannot work with all the individual municipalities. Everyone is interested in opportunities to drive the deployment of V2X on a larger scale, but the size of the diverse ecosystem that must be involved can be overwhelming.

The diversity is captured in the chart below which also shows the recently published USDOT V2X deployment plan. The plan is inclusive and aims to have 50 state-wide interoperable V2X deployments by 2036. The plan foresees V2X as a transformational technology helping to advance not only safety but also enhance mobility, bolster efficiency, improve equity, and reduce negative environmental impacts.

The challenge is the complexity and sheer size of the funding necessary to deliver the USDOT V2X deployment plan. Even if federal funding is available via various sources, the process to secure them can be time-consuming and daunting for smaller players.

Figure 2 Extracts for USDOT V2X Deployment Plan



Overcoming Barriers to Scale

From the outset of 5G V2X, there was considerable enthusiasm about the potential collaboration between IOOs and CSPs to recognize synergies during the rollout of high-density 5G network deployments. Operators could potentially integrate the necessary functionalities for V2I applications into 5G infrastructure, while IOOs, deploying RSUs to enhance road safety, could incorporate the required features to support the expansion of 5G network infrastructure. This collaborative approach offered opportunities for mutually beneficial public-

private partnerships, even potentially resolving the longstanding "chicken or egg" challenge that has impeded V2X deployment for over two decades.

However, for numerous reasons including timing, sequencing, regulatory uncertainty, and lack of understanding on both sides, the opportunities slipped by.

Nevertheless, there could now be an opportunity for CSPs, together with cloud providers, to function as facilitators and provide common platforms to help IOOs reduce costs and accelerate deployment by helping to create a virtualized V2X/ITS infrastructure game plan.

An Opportunity for Carriers to Work Together

Today's cellular network coverage across roads and highways is not consistent enough to enable reliable connected services on a single CSP. Coverage gaps, particularly in more remote areas, mean connections aren't always available. This poses a systemic risk in the fast-approaching, more connected transportation system of the future. CSPs' strategy for network coverage should shift from the traditional approach of basing coverage on population density to considering traffic density as well. If intersections are the focus for V2X, then busy junctions in rural areas will need connectivity to communicate with vehicles or traffic assistance systems. This could become easier as 5G non-terrestrial networks (NTNs) become an essential piece of the connectivity puzzle, to complement mobile and fixed wireless access (FWA) based infrastructure.

It's not yet known how practical network slices will be, but one consideration could be to use common dedicated slices for automotive safety applications. This would require common standards for seamless V2X interoperability between systems, and across implementations, to deliver ubiquitous service availability. If this becomes a critical feature, then it needs to be supported by synchronized mechanisms across multiple layers of the communication stack to allow efficient and flexible utilization of available resources, both within a single CSP and across multiple CSPs utilizing a harmonized Quality of Service (QoS) framework.

The Role of Standardization

Standardization in V2X is also crucial for ensuring interoperability, safety, and efficiency across different ecosystem stakeholders like OEMs, IOOs, CSPs, and cloud providers. A common V2X deployment reference architecture, interoperable communication protocols, and frameworks, as well as application data format compatibility, enable seamless interaction between vehicles, road infrastructure, pedestrians, and other actors in a functional interoperable ITS system.

It also fosters the development of scalable systems, reduces complexity for automakers, developers, and operators, and avoids potentially fragmented V2X implementations that impede leveraging the ITS system's full potential. There are various standardization bodies including, 3GPP, ITU, SAE, and ETSI working in this area and are guided by input from 5GAA and the regional ITS organizations on different perspectives of ITS and regional requirements.

V2X & ITS - The Road to 2030

In 2024, the time is right as an alignment of factors creates a window of opportunity to address the grave issue of 40,000 road deaths annually. However, this will require new thinking from all parties involved.

Coast-to-Coast and Border-to-Border National Interoperable ITS / V2X Network

In the U.S., the vision is for a driver to be able to drive coast to coast and have a continuous seamless V2X experience that ensures safe driving in all the States. Equally, vehicles that travel from one border to another should experience interoperable V2X systems in the same way that the driver's phone seamlessly changes network coverage for continuous data and voice applications.

Networked V2X Delivering Safety Information to all 4G/5G Enabled Connected Vehicles and Aftermarket Devices

At the ITS America conference in Phoenix, a panel discussion around digital infrastructure and the volume deployment of RSUs focused on the beginning of a 12-year journey with the State and local Departments of Transport following the national U.S. DOT plan and utilizing the $6.5 billion in the Infrastructure Act to cover all the intersections throughout the U.S. with Direct V2X.

This long deployment timeline compounds another industry challenge, which is the lifecycle of roadside units – from 15 to 30 years. There is concern about how to cover the cost of updating the software to ensure the RSUs remain available and accurate. The logical approach is to plan to use over-the-air updates, which could save vehicle and service engineers from having to be deployed for physical updates and improve economic efficiency for most DOTs.

Over the last ten years, cellular network evolution has moved faster than transport infrastructure systems. There is now a clear opportunity for network virtualization, cloud, and edge computing to radically improve the safety opportunities for V2X, as well as the speed of rollout. Some have suggested the utilization of virtual roadside units, with edge computing as a mechanism to address cost, coverage, and speed of deployment issues.

One approach could be to analyze traffic and accident data for the 330,000 intersections in the U.S. and prioritize high-risk intersections for physical RSUs utilizing available funds and create a public-private business model to address the long tail with lower cost, and faster deployment of virtual RSUs.

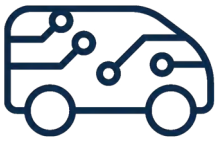
New Value-added Services and Revenue Streams

Having a common platform and infrastructure, with consistent interfaces and services, creates an opportunity for IOOs to work with the autotech industry to create and package V2X-enabled services into value-added connected vehicle offerings that consumers are willing to pay for, and where the revenue can be shared between public and private sector entities.

Some DOTs have piloted Road Usage Charging (RUC) or Mileage Based Usage Fees (MBUF) on a limited scale, as a model to offset the anticipated declining revenues from the gas tax, as the market eventually shifts from internal combustion engine vehicles to EVs. However, they have struggled to scale these initiatives.

There is an opportunity to leverage the V2X/ ITS platform, combined with coordinated and sustained public outreach and education, to scale V2X adoption and fund continued deployment by linking safety and user convenience-oriented features to achieve both goals.

Given the time challenge to get PC5-enabled vehicles into the market, an opportunity for CSPs to address is the aftermarket. Standardization efforts in SAE for standalone V2X units and testing protocols are being developed by OmniAir Consortium to enable aftermarket products. Creating an initial consumer proposition built on the OBD dongle/Usage-Based Insurance (UBI) models that CSPs already have in place could drive benefit-based consumer demand and encourage OEMs to accelerate their V2X installation plans. An incremental value could be generated by reconnecting vehicles that lost 2G/3G connections and enhancing the benefit package with Network V2X safety offerings.



Conclusion

V2X and ITS are a fascinating example of technology companies, industries, and governments all working at different clock speeds, having differing expectations and mindsets but all with a single purpose of safety and the prevention of road accidents leading to deaths.

Despite this level of complexity and the sheer number of state and local governments that need to commit and find funds, V2X in the U.S. is probably at its best state of readiness and should be in motion by 2025, assuming it is given the green light from the FCC.

With federal funding available and the positive shift in mindsets that recognize that the State DOTs need to be the chicken that lays the egg, the road is set. That said, it will be a long road over the next ten years until the USDOT infrastructure deployment plan is in place nationwide.

OEMs remain hesitant to commit to V2X until the FCC issues its final order. The view is that it will take two to three years to get cars to market following that. However, this may be mitigated by the move to software-defined vehicle architectures that are global and allow more flexible and agile development processes. We are already witnessing much faster development cycles in China. Because Direct V2X is taking root faster there, we can expect standardized architectures to accommodate this, which should translate to faster time-to-market in the U.S.

A catalyst that could accelerate the V2X/ITS deployment roadmap is the engagement of CSPs, cloud providers, and the autotech community. The continual evolution of virtualized low-latency cellular networks, multi-access edge computing, and the use of AI across the car-to-cloud continuum suggest that there are multiple possibilities to deliver and enhance network-based V2X services.

The opportunity to leverage 5G MEC networks and deploy virtual RSUs to cover more intersections quickly and cost-effectively is of interest. This could persuade the ITS community to accelerate its digital roadmap by embracing the benefits of cloud and virtualization.

Recognition of the importance of Network V2X safety services through mobile and vehicle apps could accelerate consumer awareness of the benefit of V2X and encourage the development and adoption of aftermarket pucks that are easy to install. This creates a symbiotic business case to drive V2X penetration in parallel to OEM installation which would reduce the current number of road accidents and fatalities as well as deliver traffic efficiencies and potential environmental benefits.