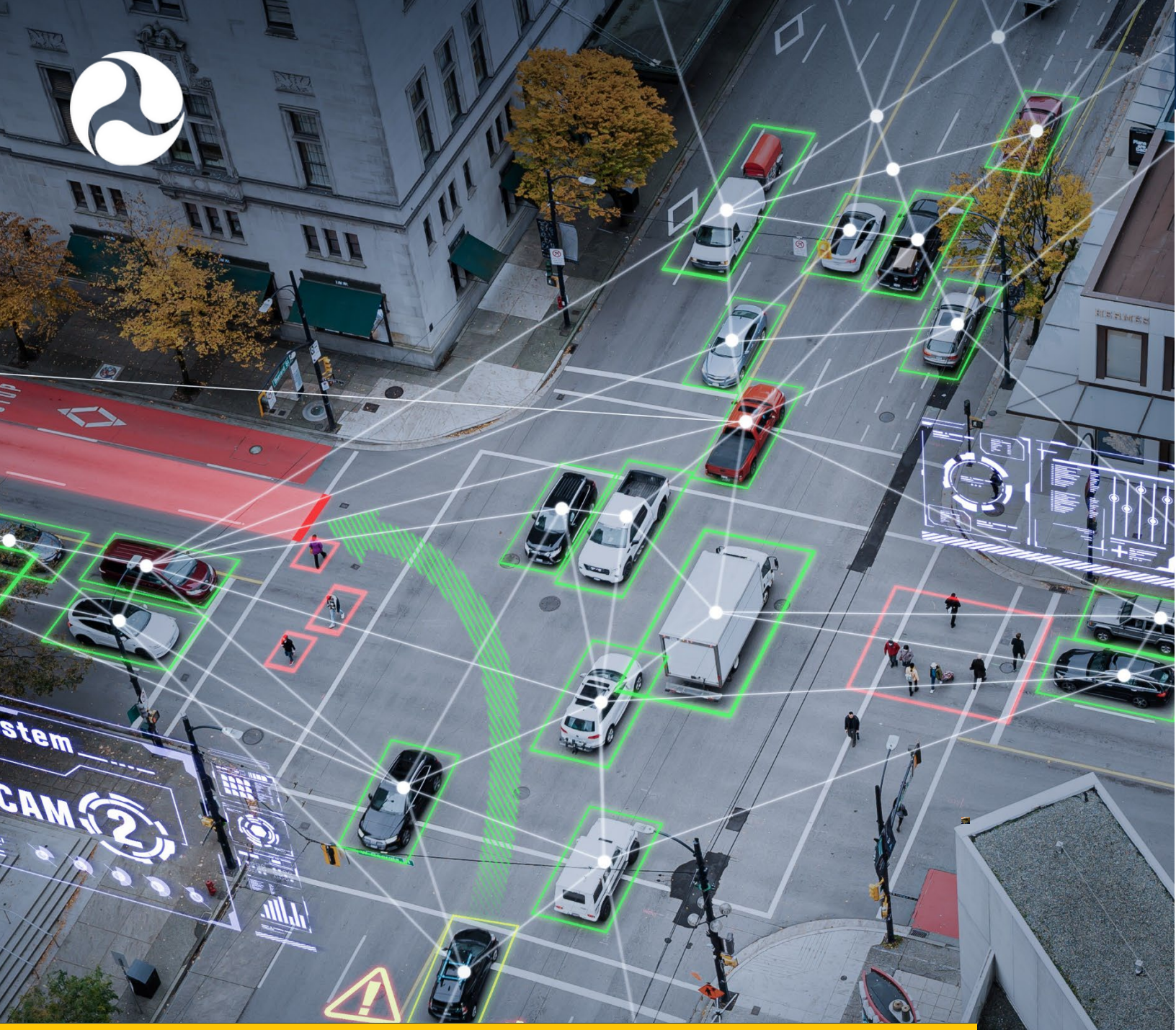

INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

RETROSPECTIVE ANALYSIS AND LOOKING INTO THE FUTURE

MAY 2026

Source: Getty Images/ Choi Dongsu


Source: Adobe Stock/gorodenkoff

Executive Summary

The *Intelligent Transportation Systems (ITS) Retrospective Analysis and Looking Into the Future Report* provides a comprehensive overview of the history, current state, and future outlook for ITS in improving safety, mobility, and efficiency across all modes of transportation. The Report aims to capture key milestones achieved in the ITS industry, investments, priorities, transformative technologies, and opportunities to accelerate ITS. The Report highlights the importance of collaboration between public and private sectors, new procurement models, and opportunities to accelerate the advancement of ITS in the transportation industry.

This Report reviews the history of ITS and outlines the benefits it offers for the future. It is organized into three sections. Section One: What is ITS? traces the history of ITS and highlights key benefits and success stories. Section Two: Looking To the Future examines future trends and presents data on ITS growth potential. Section Three: Stakeholder Perspectives on the Future of ITS provides an in-depth look at the perspectives from 24 stakeholder agencies on the future direction of ITS.

The Report includes a review of the history of ITS and its proven success stories through applications such as adaptive traffic signals, queue warning systems, electronic toll collection, and more. Results from recent ITS Deployment Tracking Survey data demonstrate growth in ITS adoption, and the Survey remains a critical tool for identifying deployment gaps, assessing trends, and guiding technical assistance. Across the country, agencies increasingly view ITS as a strong investment, and the U.S. Department of Transportation (U.S. DOT) continues to support progress through research and innovation in vehicle-to-everything (V2X) communications, automated vehicles (AV), digital infrastructure (DI), and artificial intelligence (AI).

Stakeholder perspectives on the future of ITS add further insight by capturing current conditions, major milestones, and emerging opportunities. Drawing on 24 interviews with public agencies, private-sector partners, research institutions, and associations, the Report identifies technology, data, and workforce development as the top future priorities, along with safety, deployment, partnerships, cybersecurity, multimodal needs, and DI.

Key trends shaping the future of ITS include cloud adoption, enhanced connectivity, AI-enabled decision-making, DI, new approaches for tolling, and new financing and procurement models. These innovations, alongside advances in real-time analytics, and 5G connectivity, are expected to accelerate deployment and support safer, more efficient, and more connected transportation systems.

Together, these efforts position the nation to accelerate ITS deployment, strengthen safety measures, and advance a more connected, resilient, and data-driven transportation system.

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What is ITS?

Source:iStock/gorodenkoff

Transportation Innovation to Improve Safety and Economic Competitiveness

ITS technologies are essential for modern transportation management. They provide a proven set of strategies for advancing transportation safety, mobility, and efficiency by integrating communication and information technology applications into the management and operation of the transportation system across all modes. ITS technologies are at work in dynamic message signs warning of highway conditions, in traffic signal controllers that are timed to improve safety and relieve congestion, and in roadway monitoring applications that help agencies rapidly respond to incidents as they happen.

*ITS is a **cost-effective** technology-based approach that augments traditional construction-based solutions, leading to a faster return on investment.*

ITS technologies are transforming surface transportation by offering a connected environment among vehicles, the infrastructure, and passengers' wireless devices, allowing drivers to send and receive real-time information about potential hazards and road conditions.

***23 U.S. Code § 501(5)** defines Intelligent transportation system as: electronics, photonics, communications, or information processing used singly or in combination to improve the efficiency or safety of a surface transportation system.*

Example ITS Applications

ITS is essential for modern transportation system management. Here are examples of ITS and their benefits from the ITS Deployment Evaluation database.

Source: iStock/peeterv

- In Arizona, a pilot implementation of adaptive signal control technology (ASCT) in four locations in the Phoenix area found up to 51 percent weekday and 43 percent weekend travel time savings (2021-B01549).
- In South Carolina, a crash prediction model showed crash frequency decreased on 9 of 11 (82 percent) corridors equipped with ASCT (2022-B01620).

ADAPTIVE SIGNALS

Up to **51%** travel time savings

82% of ASCT-equipped corridors saw reduced crash frequency

Source: FHWA

- In Minneapolis, a queue warning system was found to reduce crashes by 56 percent and near-crashes by 69 percent after two years (2024-B01822).
- In Florida, queue warning implemented as part of an integrated active traffic management (ATM) system was estimated to reduce travel time up to nearly 6 percent and reduce crash risk up to 28 percent (2022-B01696).

QUEUE WARNING

Up to **6%** reduction in travel time

56% crash reduction with queue warning systems


Source: iStock/Alphotographic

ITS FOR TRANSIT

- In West Virginia, trips made with a multimodal real-time transit information application indicated a 63 percent average reduction in bus stop wait time (2022-B01646).
- In California, an integrated dynamic transit operation system was able to decrease connecting passengers' average wait time by 24 to 31 minutes for bus-to-bus connections (2021-B01613).

63% average reduction in bus stop wait time

24–31 min reduction in bus-to-bus wait time


Source: iStock/BeyondImages

FREEWAY MANAGEMENT

- In California, a study showed that coordination of freeway ramp metering with arterial traffic signal control as part of integrated corridor management reduced total travel time and delay by roughly 6 percent and 12 percent, respectively (2022-B01629).
- In Virginia, a variable speed limit (VSL) system used traffic detector data to determine a speed limit to optimize traffic flow, which reduced fatal and serious crashes by 13 percent (2024-B01838).

6% travel time and **12%** delay reduction

13% reduction in fatal and serious crashes with VSL system


Source: iStock/RyanJLane

SIGNAL PRIORITY

- In Georgia, transit signal priority (TSP) tested on connected school buses resulted in a more than 40 percent decrease in the number of stops and a more than 13 percent reduction in travel time (2023-B01804).
- In Salt Lake City, TSP using V2X communications between buses and signal controllers improved planning for signal retiming efforts at 30 signalized intersections, improving bus run-time reliability by up to nearly 3 percent (2023-B01721).

40% fewer stops and **13%** travel time reduction

Up to **3%** improvement in bus run-time reliability

Focus on Safety

The crisis of the widespread fatal crashes in the United States continues.

Fatal roadway crashes occur throughout the country, affecting thousands of Americans directly and indirectly each year. The map below demonstrates how widespread fatal motor vehicle crashes were in 2023, with each dot symbolizing a fatal crash.

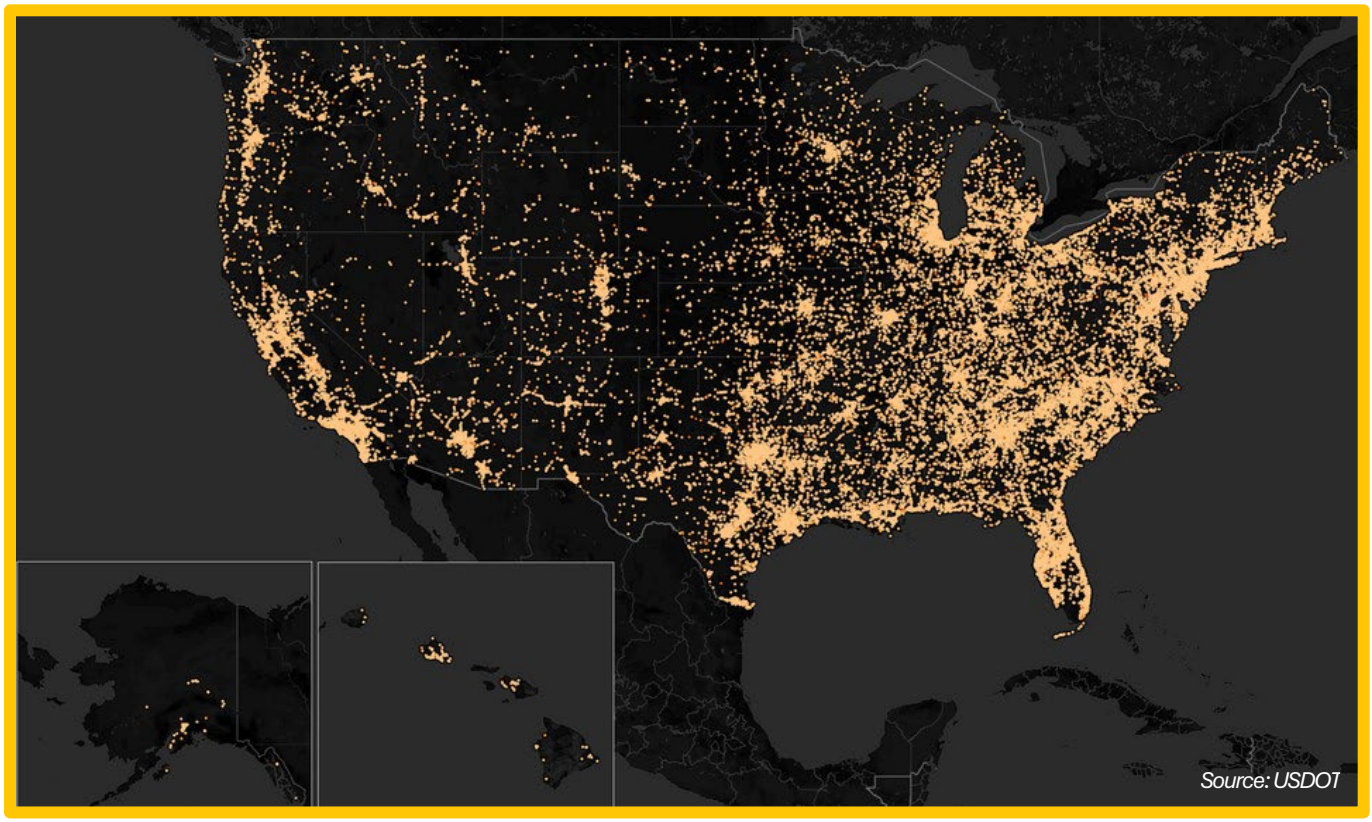


Figure 1. Fatal Motor Vehicle Crash Locations in 2023 from the Fatality Analysis and Reporting System (FARS)

37,654
Fatal motor vehicle crashes in 2023

8,820
of these crashes involved non-motorists

11%
increase in crashes 2017-2023, despite fewer vehicle miles traveled

Source: FARS, 2023

Focus on Safety

ITS SOLUTIONS IMPROVE SAFETY

ITS technologies provide cost-effective solutions to address safety and can be used in conjunction with infrastructure-based approaches. New technologies, such as AI and predictive analytics, are spurring innovation in safety technologies.

ROAD WEATHER SAFETY

The Ohio Department of Transportation installed a VSL system, which dynamically change the speed limit based on weather conditions, to improve safety along a 12-mile stretch of I-90. In the two years following VSL implementation, the total number of crashes declined by 22 percent and the number of crashes while snowing declined by 42 percent. Furthermore, no fatalities or major pileups occurred in the corridor during the two winters seasons after VSL implementation (2021-B01568).

Source: Ohio DOT


Source: FHWA

PEDESTRIAN SAFETY

Miami-Dade County installed a Pedestrian Collision Warning System on their buses to improve the rate at which buses yield to pedestrians. The Miami- Dade County Transportation Authority found a significant improvement in bus drivers yielding to pedestrians when the Pedestrian Collision Warning System was activated (88 percent) compared to when not activated (58 percent). This represents a 30-percentage point increase in yield rates (2020-B01477).

Focus on Safety

TRAFFIC INCIDENT RESPONSE

In 2020, the Georgia Department of Transportation (GDOT) conducted a 3-month pilot program to use cloud-based emergency call-taking app. The app allowed traffic operations and emergency centers to quickly locate and continuously communicate with motorists with the use of its cell phone geo locate, chat, and video features. The study found that by exclusively using the new app, stranded motorists were found within 3 minutes, compared to 23 minutes with using the current protocol on its own or with the new app as a backup method. This represents an 87 percent decrease in response time (2022-B01616).


Source: FHWA

SPEED MANAGEMENT

To combat the impact of speeding on crashes and fatalities on Roosevelt Boulevard, Philadelphia installed a series of speeding enforcement cameras. From the year before installation to the year after installation, Roosevelt Boulevard saw a 36 percent decrease in crashes and an 11 percent decrease in fatal crashes while the rest of the city saw no change or net increases in crashes across all categories (2023-B01760).

WORK ZONE SAFETY

An end-of-queue warning system was installed on a 96-mile section of Interstate 35 in central Texas to reduce uncertainty of queues at lane closures in work zones, especially at night. After deploying, TxDOT noted fewer rear-end crashes at lane closures equipped with the end-of-queue warning system (36 percent) versus lane closures without (58 percent). Likewise, there were fewer severe crashes on equipped lane closures (41 percent) versus unequipped lane closures (58 percent) (2020-B01510).

Source: INDOT

ITS Success Stories

These success stories show how multi-jurisdictional coordination and a systems approach promote the use of standards and interoperability, leading to widespread adoption. The EZ-Pass example demonstrates the rapid adoption of a connected, interoperable ITS system that provides real benefits to travelers and enhances U.S. competitiveness.

Source: iStock/GemStocks

E-ZPASS: MAKING INTERSTATE TRAVEL SEAMLESS AND EFFICIENT

The E-ZPass program is the largest, most successful, interoperable electronic toll collection (ETC) program in the world, consisting of 36 agencies in 20 states, servicing more than 37 million accounts and 63 million tags in 2024, and the collection of over $14.7 billion in electronic toll revenues.[1] The U.S. leads the ETC market, with growth anticipated to expand across North America and worldwide.

A study conducted in 2000 to evaluate the New Jersey Turnpike Authority's E- ZPass ETC system found that delay was reduced by about 85 percent overall for a total

savings of more than two million vehicle-hours per year.

(2007-B00421)

The I-95 Corridor Coalition sponsored by the U.S. DOT in 1992 played a large role in facilitating interoperable, multi-state adoption of E-ZPass. Over time, the focus of the Coalition has evolved from studying ITS technologies to a broader systems perspective that enables integrated deployments and coordinated operations.[2]


Source: iStock/Halfpoint

E-ZPass also has positive outcomes for maternal and infant health. In a 2009 study, researchers found that the introduction of E-ZPass reduced prematurity and low birth weight among mothers within 2 kilometers of a toll plaza by 10.8 percent and 11.8 percent, respectively.[3]

[1] https://www.e-zpassgroup.org/overview
[2] https://rosap.ntl.bts.gov/view/dot/39364
[3] https://www.nber.org/system/files/working_papers/w15413/w15413.pdf

ITS Success Stories

511: NATIONAL TRAVELER INFORMATION

On July 21, 2000, the Federal Communications Commission (FCC) designated 511 as the single traffic information telephone number for states and local jurisdictions in the U.S. In its first 5 years, more than 50 million 511 calls were made.[5] The 511 Deployment Coalition sponsored by U.S. DOT developed quality and service guidelines and for this safety-critical, nationwide interoperable technology deployment.[4]

The invention and rapid growth of smartphones apps required 511 systems to adapt to new methods of providing traveler information. Many states continue to enhance 511 services with new technologies, such as Georgia's cloud-based emergency call-taking platform (2022-B01616).

The adoption of 511 systems has contributed to an

annual savings of $4.7 billion

The adoption of 511 systems has contributed to an

175 million hours in reduced travel time

(2020-B01503)

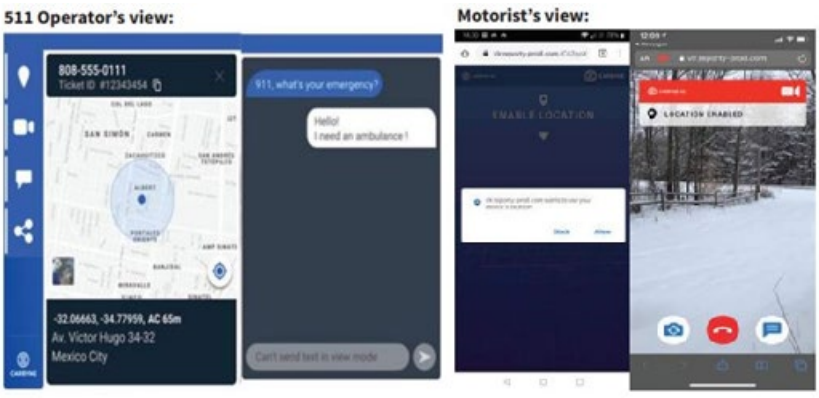


Figure 2. Operator and motorist views of 511 mobile application in Georgia

Source: TIME Task Force of Georgia

[4] https://rosap.ntl.bts.gov/view/dot/30826

Tracking ITS Deployment

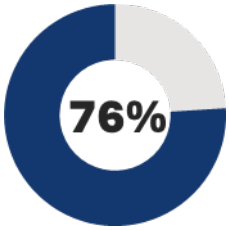
- The ITS Deployment Tracking Survey has tracked the evolution of ITS deployment since 1999. The ITS Deployment Tracking Survey is administered approximately every three years, most recently in 2023, to freeway management agencies (311 respondents), arterial management agencies (state DOT districts that manage arterials [276 respondents] and local agencies [423 respondents]), and transit agencies (464 respondents).
- The ITS Deployment Tracking Survey was initiated to track progress toward a 1996 U.S. DOT goal to achieve an integrated ITS infrastructure within the 75 largest metropolitan areas within 10 years. Since then, the survey continues as a critical tool for measuring the extent of ITS deployment.
- ITS Deployment Tracking Survey results help identify deployment gaps, assess trends, and support technical transfer activities to aid state and local agencies in planning and executing ITS deployments.

Source: iStock/Jacob Wackerhausen

Agencies have been continuously increasing deployment of ITS technologies since 1999, proving that state and local agencies across the country see real benefits, positive return on investment, and value in investing in ITS.

Tracking ITS Deployment

Findings from the most recent ITS Deployment Tracking Survey, conducted in 2023, revealed the extent of ITS deployment nationally as well as opportunities to accelerate the deployment of ITS and related technologies.



Finding 1: Most Freeway Agencies Deploy ITS for Safety

Most freeway agencies deploy at least one ITS safety systems technology (76%), with agencies deploying an average of 2.8 technologies.

Queue warning systems (40%) and wrong way driving detection systems (33%)

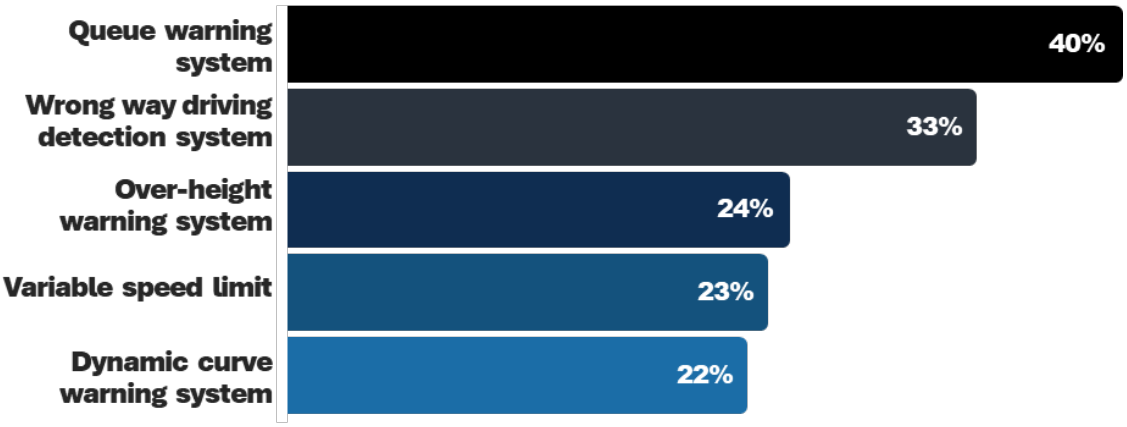
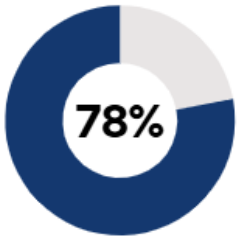


Figure 3: Safety systems technologies deployed by freeway management agencies

Finding 2: A Large Majority of State DOTs Managing Arterials Deploy ITS for Safety

Most State DOT districts managing arterials deploy at least one ITS safety systems technology (78%), with agencies deploying an average of 2.5 technologies.

Pedestrian warning systems (40%) and speed feedback signs (40%) are the most deployed ITS safety systems by State DOT districts managing arterials.



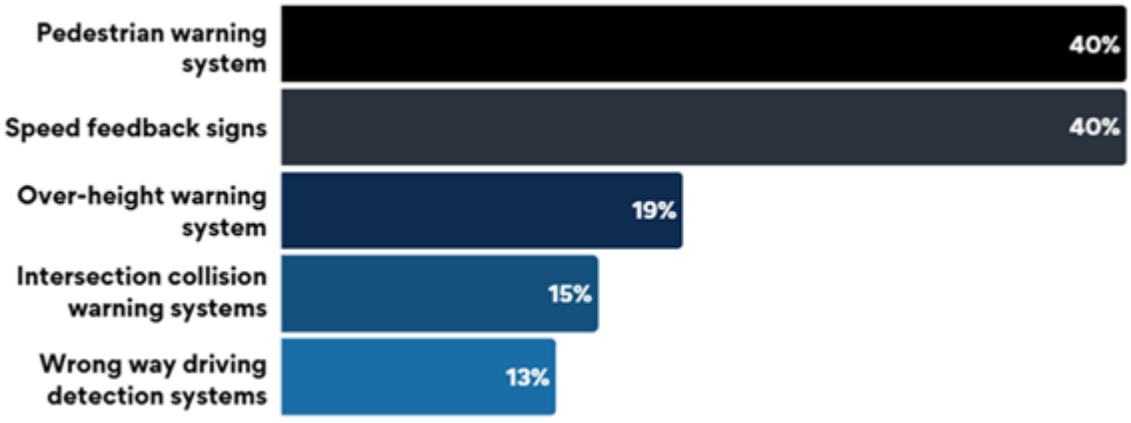


Figure 4. Safety systems technologies deployed by State DOTs managing arterials

Tracking ITS Deployment

Findings from the most recent ITS Deployment Tracking Survey, conducted in 2023, revealed the extent of ITS deployment nationally as well as opportunities to accelerate the deployment of ITS and related technologies.

Finding 3: ITS Adoption in Rural Areas Lags Behind Urban Areas

State DOT districts with a large urban area tend to deploy ITS at higher rates on freeways compared to districts without a large urban area.

- ITS safety systems technologies (84% vs. 73%)
- Methods for incident detection/verification (94% vs. 79%)
- Roadside ITS infrastructure (82% vs. 65%)
- Managed lane strategies (34% vs. 19%)

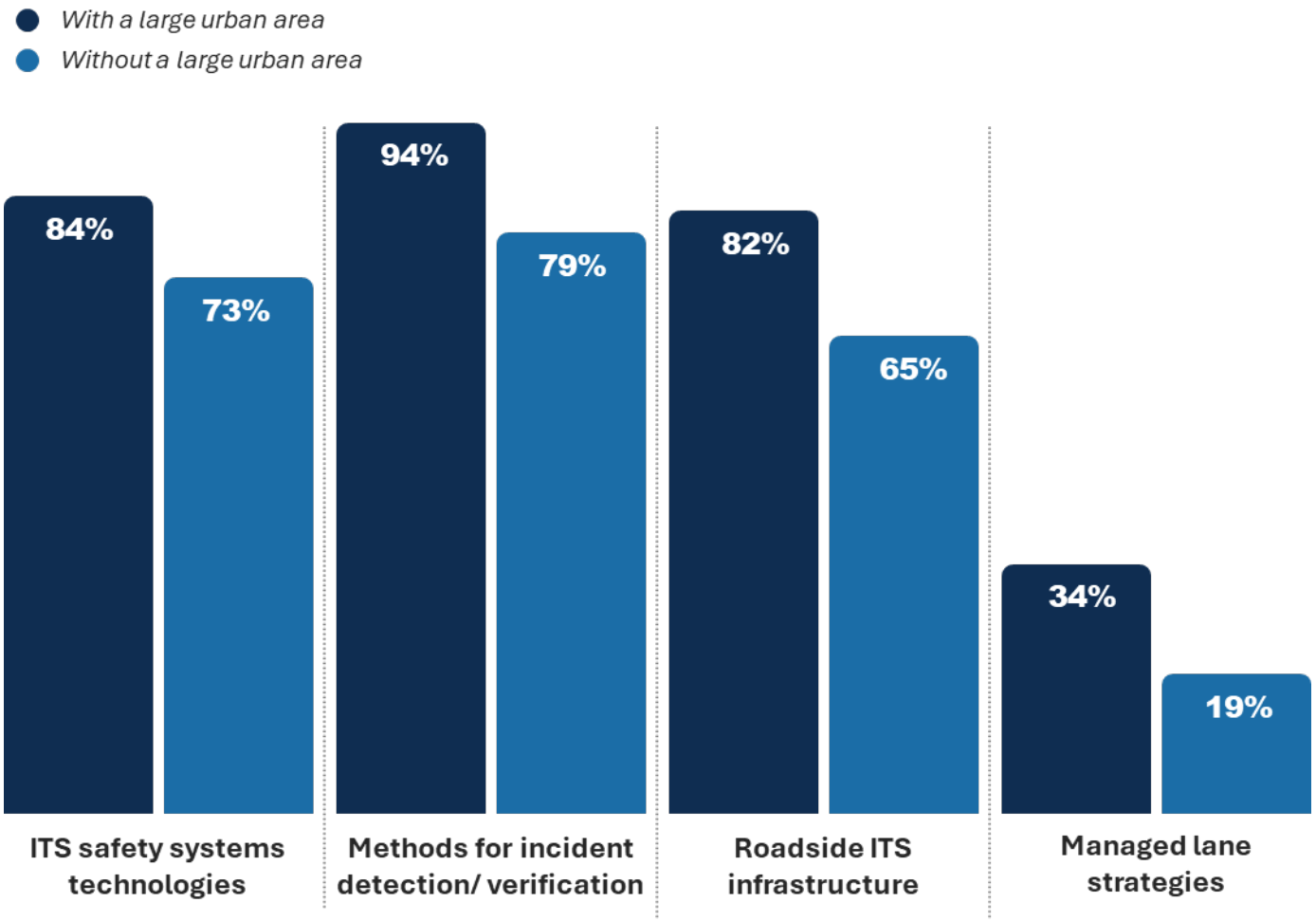


Figure 5. Deployment of ITS applications on freeways in State DOT districts with and without large urban areas

Tracking ITS Deployment

Findings from the most recent ITS Deployment Tracking Survey, conducted in 2023, revealed opportunities for the further development of connected vehicle (CV)/vehicle-to-everything (V2X) technologies.

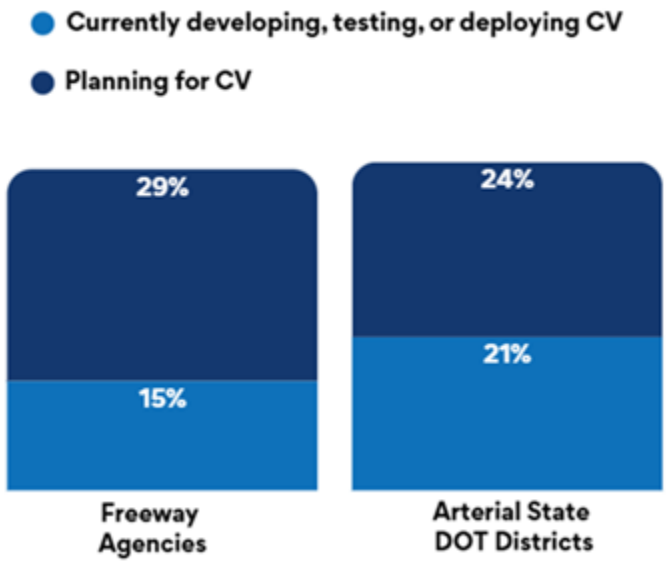


Figure 6. Current CV plans by freeway agencies and State DOT districts managing arterials.

Finding 4: Readiness for Emerging CV and V2X Technologies

Agencies are preparing for a future connected ITS environment. The 2023 ITS Deployment Tracking Survey asked all agencies about their deployment of CV technologies.

Finding 5: Future Plans for ITS

Reflecting the significant value that ITS provides, a large majority of freeway agencies (79 percent) and State DOT districts managing arterials (73 percent) surveyed in 2023 plan to expand and/or upgrade ITS.

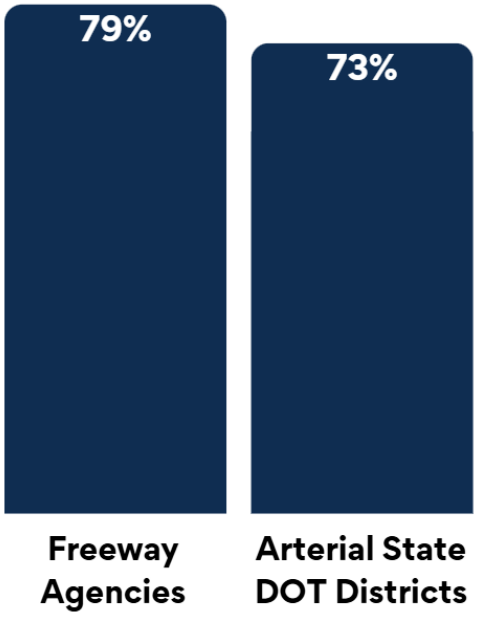


Figure 7. Percent of agencies planning to expand and/or upgrade ITS in the next three years

Looking to the Future

Through examining past ITS success stories, trends in technology, and U.S. DOT priorities and goals, the ITS JPO is now focused on the widespread deployment of vehicle-to-everything (V2X) technologies to contribute toward reducing roadway fatalities and improving the efficiency of how people move across the country. The Department has been working towards a shared vision of a nationwide, secure interoperable V2X ecosystem by setting a vision, goals, and milestones at U.S. DOT, and issuing a formal call to action for stakeholders, including the U.S. DOT, public agencies, and the private sector. The future of ITS is ripe with opportunities for innovation, driven by emerging trends, evolving technologies, and a shifting policy landscape.

The future of ITS is expected to be shaped by several key trends, such as cloud adoption, enhanced connectivity, and AI informed decision-making, as well as more widespread developments where we can learn and share best practices, proven technologies, and improved user outcomes, according to industry trend reports. Various industry trend reports also indicate that advancements in digital twin technology, satellite-based digital tolling solutions, and the adoption of new financing models will contribute to safer, smarter, and more connected transportation systems.[5] Furthermore, advancements in digital twin technology, satellite-based digital tolling solutions, and the adoption of new financing models that improve the efficiency of procurement models that contribute to the creation of safer and smarter transportation systems in a faster and more collaborative way.[6]

[5] https://www.yunextraffic.com/newsroom/trend-report-2025-its-industry
[6] https://aashtojournal.transportation.org/the-future-of-intelligent-transportation-systems

Increasing the Velocity of Innovation

ITS technologies are advancing at a rapid pace. The U.S. DOT is investing in research and deployments in new areas to make the transportation system safer, more efficient and increase U.S. global competitiveness.

V2X

The U.S. DOT is focused on improving road safety, mobility, and efficiency through broader use of V2X technology, which enables vehicles and wireless devices to communicate with each other and with roadside infrastructure. The goal is to enable a safe, efficient, and scalable transportation system through the nationwide deployment of interoperable V2X technologies.

The U.S. DOT is sponsoring V2X Accelerator sites in Arizona, Texas, and Utah that will serve as national models to accelerate and spur new deployments of V2X technologies. The sites will promote the deployment of lifesaving V2X technologies, while ensuring connected technologies communicate securely and without harmful interference across a variety of devices and platforms.

42%

reduction in average annual crashes with roadside units transmitting digital alerts to CVs equipped with onboard units in Wyoming (2024-B01868)

25%

speed reduction, within the first second, when drivers received a digital alert from a nearby emergency response vehicle (2024-B01868)

Increasing the Velocity of Innovation

AUTOMATED VEHICLES

The U.S. DOT is committed to facilitating a new era of transportation innovation and safety, ensuring that the United States remains a leader in automation. The U.S. DOT will conduct, in partnership with stakeholders, foundational research and demonstration activities to safely evaluate and integrate automated driving systems, while working to improve the safety and efficiency of the transportation system.

Source: ITS JPO

ARTIFICIAL INTELLIGENCE

The U.S. DOT seeks to harness the power of data fusion and AI innovation to improve safety at intersections, especially for pedestrians. The U.S. DOT sponsored the Intersection Safety Challenge (ISC) in 2023, and it aimed to transform intersection safety leveraging emerging technologies including AI and Machine Learning (ML) to identify unsafe conditions involving vehicles and other road users at roadway intersections.

The U.S. DOT is also exploring responsible AI for ITS with promising use cases in incident detection, crash prediction, predictive maintenance, and decision support. A multi-pronged approach ensures collaboration with infrastructure owners and operators, removes barriers to implementation, works towards common standards, and maximizes industry innovation.

DIGITAL INFRASTRUCTURE

The modern transportation system is rapidly integrating CVs and AVs, trucks, pedestrians, bicycles, public transit, and shared use mobility services into a cohesive, interactive network. The transportation system is increasingly reliant on the exchange of digital information, with system operators using these data to track and manage operational conditions and respond to system disruptions in real time, including safety-critical issues.

A new multimodal digital infrastructure will enable digital information exchange across modes, integrate with existing systems, and enable efficient, interoperable interaction among CVs and devices. The U.S. DOT envisions a national, interoperable digital infrastructure that integrates localized systems and creates a safer, more efficient transportation system

The ITS Multimodal Digital Infrastructure Program is conducting research, development and testing of ITS technologies and applications related to digital infrastructure, and facilitating coordination with other U.S. DOT, government and industry activities.


Source: iStock/metamorworks

Stakeholder Perspectives on the Future of ITS

Overview

The *Stakeholder Perspectives on the Future of ITS* section builds on the shared vision and desire for an interoperable V2X ecosystem. It aims to capture the key milestones achieved in the ITS industry from ITS experts working in diverse positions, from local agencies to national telecommunications companies. This section captures trends, investments, priorities, needs, as well as promising transformative technologies and opportunities to accelerate ITS in ways that aims to improve the lives of the traveling public. This section details key themes that emerged across the 24 stakeholder interviews including (in order of mentions in the stakeholder interviews) technology, data, workforce development, general public, deployment, planning, safety, partnership, cybersecurity, system, multimodal, funding, and digital infrastructure. An illustration of a potential futuristic city with people using multiple modes of travel enabled by technology, connectivity, and automation on the road and in the air is shown in Figure 8 below.

"We must maintain our focus on safety. Mobility is important, however mobility without safety does not get us anywhere. Safety must be a top priority."

~State agency stakeholder

Figure 8: Illustration of what intelligent transportation could look like in the future

Source: U.S. DOT ITS JPO, March 2025

Background

The *Stakeholder Perspectives on the Future of Intelligent Transportation Systems* (ITS*) Report* examines the progress made in advancing ITS and a wide variety of transportation industry perspectives, from public to private, on the future of improving transportation with technology. There were 24 different stakeholders that were interviewed. Those interviews were intended to capture industry suggestions on creating a more informed, coordinated, efficient, and safer transportation system. This section was developed through stakeholder interviews to gather perspectives on the future of ITS in two areas:

- **Emerging Trends to Watch** gathers technologies that are shaping the ITS landscape, ranging from advancements in automation to AI supporting more widespread V2X deployments. Changing technologies and industry trends from a variety of stakeholders play a critical role in how the industry moves forward and how transportation systems can be used to address new challenges, such as drone assessment using AI after natural disasters in rural areas or near- miss video analytics to understand intersection crashes in cities.

- **Opportunities for Accelerating ITS Deployment** focuses on how technologies and processes can provide immediate opportunities to implement widespread ITS efforts. This includes gaining industry perspectives on workforce development needs to provide high-impact results to how policy, procurement, processes, partnerships, and planning can allow for new technologies and innovation to improve our transportation system. The interviews conducted focus on opportunities to accelerate ITS that are focused on improving road safety and how people move.

The interviews focused on stakeholder perspectives covering trend observations, insights on investment and priorities, opportunities to accelerate ITS now that can help improve transportation, and considerations for ITS across the transportation system over the next ten years. Stakeholders shared perspectives on where the industry is headed. The wide variety of insights from the stakeholder interviews are captured in this Report, providing a possible path forward in an actionable way to help shape the future of transportation through intelligent transportation.

Types of Transportation Industry Voices

There is a wide range of stakeholder perspectives from across the surface transportation ecosystem. Stakeholder interviews were conducted in the Fall of 2024 to capture transportation industry perspectives on the future of ITS with subject matter experts who lead the way in intelligent transportation. Stakeholders interviewed emphasized the importance of workforce development, data management, and the integration of advanced ITS technologies in shaping the future of transportation. For example, a business consultant highlighted the increasing implementation of autonomous systems, the transition of decision-making from humans to machines, and the continuous growth in data generation and analytics. Another example from a county public agency that manages transit, road, and bridges underscored the role of autonomous technologies in improving overall travel quality for the public. The stakeholders included diverse perspectives from a cross-section of industry voices detailed below and shown in Figure 9 on the next page:

- **Associations:** Four leaders of associations that represent a group of members in the ITS industry were interviewed. These associations advocate for the advancement of ITS, set transportation standards, and share best practices that shape the future.

- **Businesses:** Five subject matter experts from private sector businesses that provide proven ITS technologies and services, including in the following business sectors:

- **Auto Manufacturers:** One auto manufacturer stakeholder that provides vehicles with connected, automated, and ITS integration technologies.
- **Consultants:** One consulting company that works with and/or on behalf of public agencies on ITS strategies, planning, funding, implementation, operations, and maintenance.
- **Technology:** Two technology focused businesses that provide cutting-edge solutions, from hardware to software, that enable smarter transportation systems.
- **Telecommunications:** One company that provides network, telecommunications, and digital infrastructure that allows for connectivity between people, vehicles, and transportation infrastructure.

- **Public Agencies:** Twelve public agencies or governments that serve as infrastructure owners and operators (IOOs) responsible for regulating, planning, funding, building, operating, and maintaining transportation systems for the traveling public.
  - **Cities and Counties:** Five public agencies managing surface transportation on a city or county scale for mobility for residents and commuters.
  - **Port Authorities:** One agency responsible for managing air, land, rail, and sea transportation facilities and systems that supports the movement of people and goods.
  - **States:** Four state departments of transportation that serve as IOOs at a statewide level for all modes of transportation.
  - **Transit:** Two transit agencies providing public transportation services at a local, regional, or statewide level.
- **University Research:** Three university transportation research institutions providing cutting-edge research on ITS focused on new technologies, data analytics, and innovative solutions.

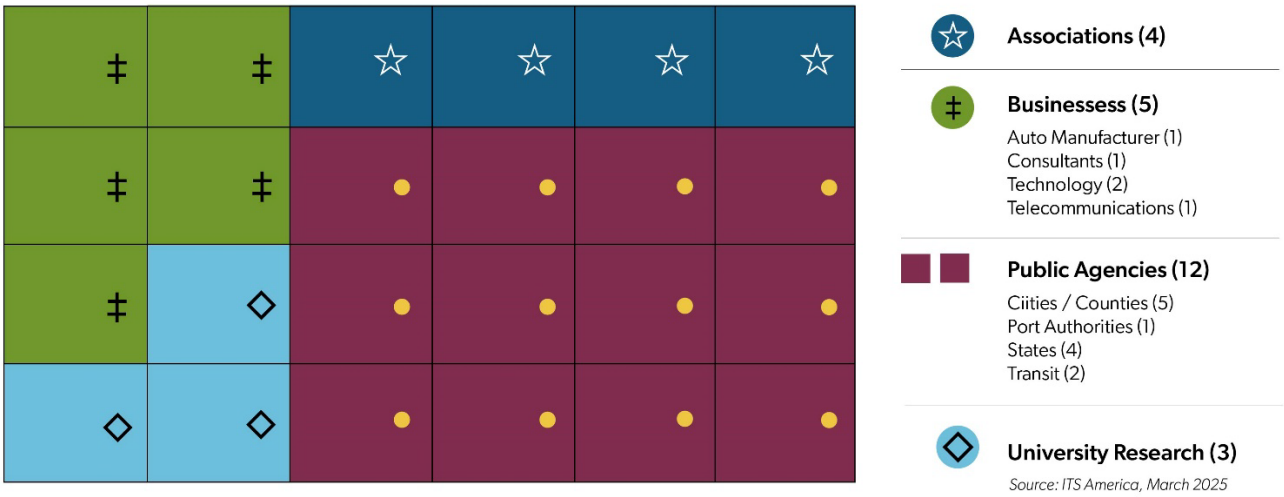


Figure 9: Future of ITS stakeholders interviewed by organization type

Source: ITS America, March 2025

Trends

Trends identified by stakeholders pointed to a data-driven, connected transportation future. Responses indicated forward momentum in connectivity, including the FCC adoption of the *Use of the 5.9 GHz Band Report and Order* for cellular vehicle-to-everything (C-V2X) technology issued on November 21, 2024.[7] Association stakeholders mentioned that improving data interoperability ensures data from various sources could be utilized by different systems. The graphic below shows how C-V2X (Figure 10).

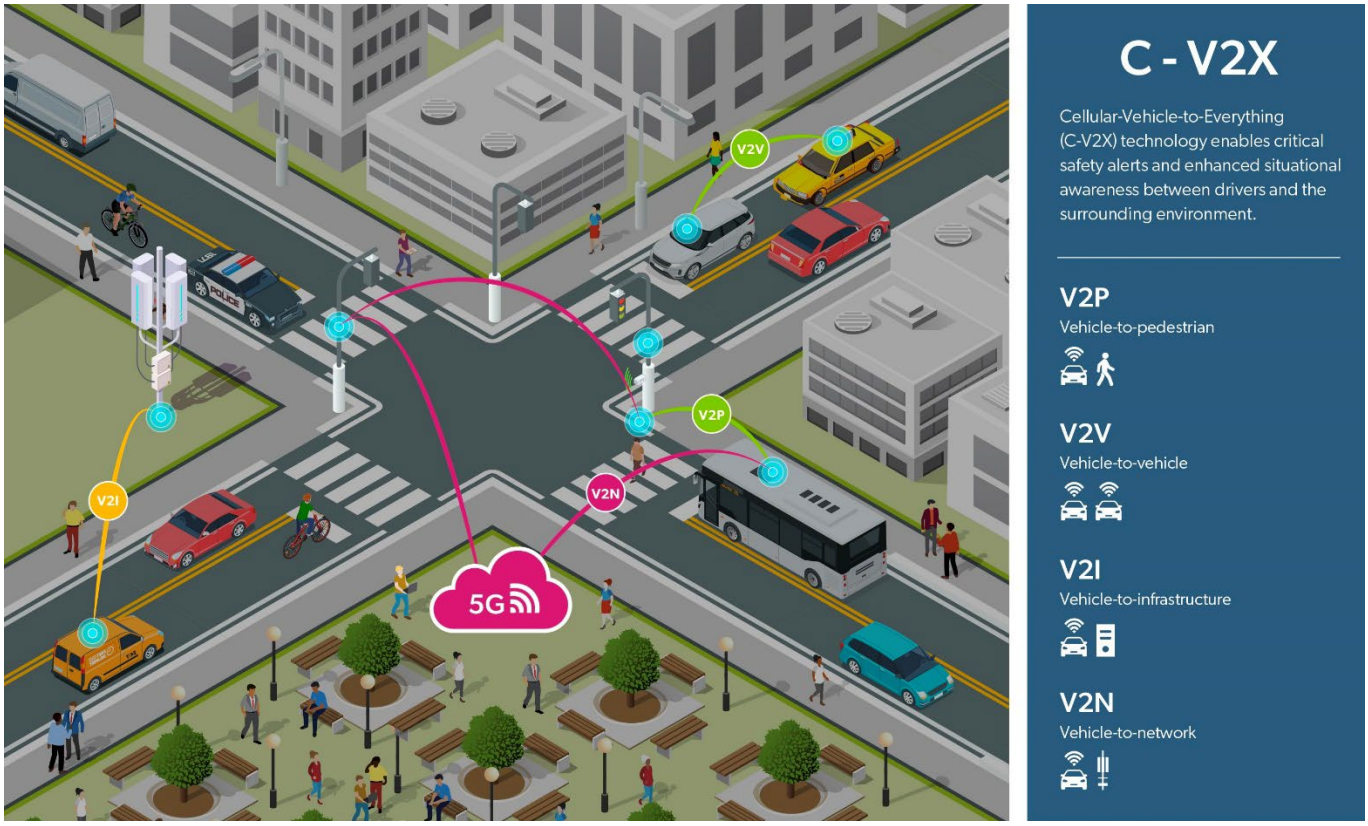


Figure 10: Graphic of how C-V2X works at an intersection in Bellevue, Washington

Source: City of Bellevue, September 2023

A common trend identified by several stakeholders across all the stakeholder groups is the increased opportunities for AI and ML in daily transportation processes. Utilizing the increased amount of data generated from the various sources, AI will be a useful tool in decision-making, assisting several areas from transportation infrastructure management; to travel-related decisions; to emergency response and disaster relief. Association stakeholders discussed the potential for AI tools to utilize predictive capabilities, identifying dangerous conditions early and allowing decisionmakers to preemptively mitigate them.

Stakeholders stated that in this data-focused future, data would be collected from the further deployment of advanced sensor technologies. Light detection and ranging (LiDAR) and thermal sensors would enhance data accuracy and reliability, improving safety outcomes for all road users. In addition to new sensor technologies, stakeholders indicated that new analysis tools will be applied to existing sensors. For

[7] https://www.fcc.gov/document/use-5850-5925-ghz-band

example, the City of Bellevue is adding an AI analysis tool to existing traffic camera feeds to identify near-miss events.

Another common trend stated by stakeholders representing private businesses is the continuing development and deployment of AVs. Stakeholders pointed out that AVs are being designed to operate on existing roadway infrastructure, with a focus on improving roadway safety for all road users as well as reducing congestion. However, AVs were not a common trend mentioned by stakeholders in other stakeholder categories.

Public agency stakeholders highlighted the importance of partnerships and collaboration. Stakeholders from public agencies stated that forming partnerships and sharing knowledge across public agencies, businesses, and university research institutions would help accelerate ITS advancements. An example of a public agency partnering with a university research partner on two ITS projects funded by the U.S. DOT Strengthening Mobility and Revolutionizing Transportation (SMART) grant program discussed during a stakeholder interview is described in the case study below.

Road Commission for Oakland County (RCOC)
Two SMART Grant Funded Intelligent Transportation Projects

The Road Commission for Oakland County (RCOC) was awarded both fiscal year (FY) 2022 and 2023 United States Department of Transportation (U.S. DOT) Strengthening Mobility and Revolutionizing Transportation (SMART) grants for two projects in Oakland County, Michigan in partnership with the University of Michigan Center for Connected and Automated Transportation.

The FY22 project uses C-V2X technologies to improve safety, operations, maintenance, and financial longevity. The primary focus of the project is to reduce vulnerable road user (VRU) crashes and near-misses from C-V2X VRU alerts. The project explores opportunities for the traffic management center (TMC) networks to be modified to allow connectivity for the enhanced deployed technologies, such as edge computers, C-V2X roadside units (RSUs), and cloud services. The County also intends to evaluate the cybersecurity and performance use of unlicensed Wi-Fi to transmit low- latency messages and alerts. The County also aims to attract additional funding and private investment through the C-V2X project. [8]

[8] www.transportation.gov/sites/dot.gov/files/202411/RCOC_508.pdf

The FY23 SMART grant further develops optimizing signals as a service (OSaaS) into a data-driven automatic signal retiming system from CV trajectory data at 30 to 40 intersections. This project updates signal timing parameters for fixed-time and coordinated-actuated signalized intersections on a bi-weekly or monthly basis based on the CV trajectory data. The project is expected to decrease travel times and congestion, eliminate the need for manual traffic signal retiming, and reduce the need to install or maintain infrastructure-based sensors for traffic management.[9] An example of vehicle trajectory based on average speed is shown in Figure 11 below.[10]

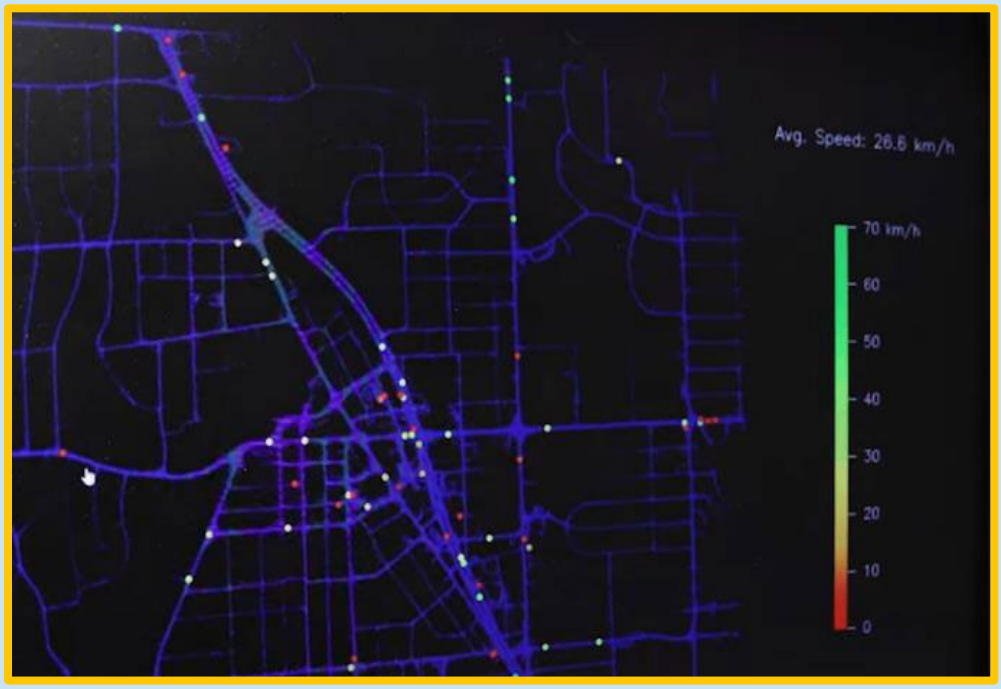


Figure 11: Example of vehicle trajectory data that displays CV speeds from the University of Michigan

Source: University of Michigan, November 2023

Some trends across stakeholders interviewed indicate a shift towards digitization and interconnectivity, with the adoption of technologies such as sensors and cameras transforming infrastructure and enabling better data collection. Stakeholders discussed how AI and ML can enhance predictive maintenance and decision-making, leading to improved safety and efficiency. The integration of V2X communication and AV technology is expected to progress, reducing human error, preventing crashes, and improving traffic flow according to stakeholders interviewed. Emphasis is on standardizing data collection methods to create actionable insights while ensuring cybersecurity and standard certifications to protect systems.

Stakeholders stressed the need for collaboration across public agencies, businesses, and technology providers to ensure successful and widespread ITS deployments. Overall, stakeholders indicated that leveraging advanced technologies and fostering collaboration is vital for a more efficient, safe, and connected transportation system.

[9] https://ccat.umtri.umich.edu/research/u-m/automatic-signal-retiming-for-large-scale-networks-with- vehicle-trajectory-data/

[10] https://cee.engin.umich.edu/2024/02/21/improving-traffic-signal-timing-with-a-handful-of-connected- vehicles/

Industry Insights

- Transportation personnel perform data analysis augmented by ML and AI.
- Public agencies leverage the growing number of advanced sensors that are both infrastructure-based and in-vehicles to provide more complete and reliable data to public agencies and vehicle manufacturers.
- Public agencies develop partnerships and collaborate across public, private, and research organizations.

Investments

Many of the proposed investments from the stakeholders focused on data and connectivity. A common investment mentioned by public and business stakeholders is the deployment of smart infrastructure and sensor technologies. These advanced sensors will provide up-to-date messaging and information to IOOs and CVs. Public agency stakeholders pointed to the growing need for investments in cybersecurity due to additional data being collected, analyzed, and disseminated. Those same stakeholders indicated that investments in broad data interoperability and robust data protection are also needed. Further, university research stakeholders identified the need to invest in durability and redundancy to ensure ITS systems hold up over time. Broadly, stakeholders from multiple organization types noted that intelligent transportation and data systems play an important role in improving transportation safety and ensuring ITS data systems will work when most needed.

Related to this, the most common investment identified by stakeholders is providing infrastructure for connectivity. Building out broadband and wireless infrastructure would provide fast, efficient pathways to transmit data from the new sensor technologies, both infrastructure-based and vehicle-based. A futuristic graphic of vehicular connectivity is shown in Figure 13. Further, business stakeholders stated that AI paired with edge computing provides opportunities to expedite decision-making processes and improve operational efficiency.

Both public agencies and business stakeholders identified investment in connected vehicle technologies. Investments in fostering public-private partnerships (P3s) are deemed essential for driving innovation and ensuring the successful implementation of ITS technologies. Stakeholders shared that P3s are an opportunity to collaborate across organizations in ways to maximize funding, explore new methods, increase innovation, develop comprehensive regulations and deployment guidelines, and build trust with the public. Business, association, and public agency stakeholders all state the need for investment into P3s. As a funding and deployment tool for ITS, P3s can be vital in the research and development (R&D) phase for industry and the pilot phase of projects for public agencies. Stakeholders shared that researchers could measure outcomes and associations can share best practices and successful use cases. An example of how the transportation industry can work together to advance ITS deployments and develop proven technologies mentioned during one of the future of ITS interviews is described in the case study on the next page.

Vehicle-to-Everything (V2X) Day One Deployment District in Atlanta, Georgia, USA

The August 2025 ITS World Congress featured a demonstration in a one square-mile area in downtown Atlanta, Georgia surrounding the football stadium. The existing conditions of one demonstration corridor are shown in Figure 12 below. The deployment district featured V2X technologies that improve mobility and safety, from automated signal prioritization to vulnerable road user safety to after-market devices on emergency vehicles, transit buses, and school buses. The demonstration aims to validate successful V2X solutions so GDOT and other public agencies could purchase and continue implementing solutions that are scalable permanent solutions. Demonstrations will include networked traffic signals and automated signal pre-emption applications through C-V2X and RSU technologies. The technologies will showcase important V2X communication, such as basic safety messages (BSM), mapping information (MAP), pedestrian presence alerts, and signal phase and timing (SPaT). The project will also feature a V2X data sandbox to understand how various data sources can be used in a real-time V2X demonstration to improve transportation, from high-resolution closed-circuit television (CCTV) transportation video to connected vehicle data. The technologies demonstrated were industry certified to support more widespread deployment following World Congress both in Atlanta, Georgia and beyond.[11]

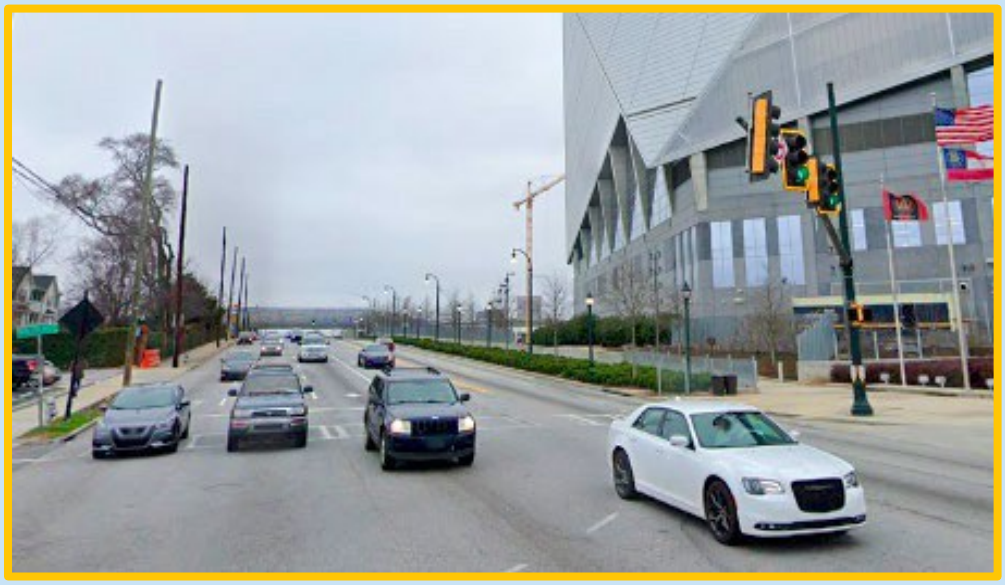


Figure 12: Northbound streetview image along the demonstration district corridor on Northside Drive west of the football stadium

Source: Google streetview, August 2024

[11] https://itsa.org/day-one-deployment-district/

Figure 13: Futuristic rendering of C-V2X technology

Source: iStock/BluePlanetStudio, March 2025

Industry Insights

- Connectivity through broadband and wireless infrastructure is needed to support the further deployment of additional ITS technologies.
- Advanced sensors installed on infrastructure and vehicles provide a broader data set for decision-makers across the transportation sector.
- Additional cybersecurity investments are needed for data collection and analysis.
- AI provides an analysis tool that improves efficiency.
- Increased collaboration and funding opportunities between public and private sectors are needed.

Priorities

Every category of stakeholders stated that the number one priority for the future of ITS is focusing on safety. Stakeholders stressed utilizing ITS technologies to enhance the safety of all road users, including pedestrians, cyclists, and vehicle occupants. This includes the deployment of connected technologies, advanced driver assistance systems (ADAS), live feed camera systems, advanced sensors, and real-time traffic management solutions to reduce crashes and improve how people move around. Figure 14 illustrates a school bus that alerts the driver of approaching vehicle speeds to help increase student safety and a vehicle that provides an in-dash school bus stop sign alert (shown in the upper right of the figure) both through C-V2X technologies.[12]

Figure 14: School bus and vehicle displaying safety information through C-V2X technologies

Source: Audi of America, September 2023

Additional priorities laid out by stakeholders include data standardization, connectivity, and interoperability. Public agency stakeholders emphasized the need for standardized data formats and robust data governance frameworks to enable seamless data exchanges between different systems and stakeholders. This includes the collection and analysis of data from various sources, such as vehicles, infrastructure, and sensors. Similarly, all categories of stakeholders highlighted the need for robust connectivity solutions that ensure seamless communication between vehicles, infrastructure, and mobile devices. In addition, university research stakeholders point to the necessity of digital infrastructure to enhance the deployment and effectiveness of intelligent transportation. Further, public agency stakeholders emphasized the need for electrical and telecommunications connectivity in rural areas to support ITS deployments. This includes developing telecom networks essential for real-time data transmission and efficient operation of ITS technologies.

[12] https://media.audiusa.com/releases/583

Association, public agency, and business stakeholders identified a skilled workforce capable of managing and maintaining ITS technologies as a need. Stakeholders said investment in training and education of transportation system management and operations (TSMO) and ITS deployment is necessary to ensure that the workforce can support advanced transportation systems. There is a need to upskill the workforce to handle advanced transportation technologies, making sure that individuals across various roles feel comfortable and competent in utilizing ITS solutions.

One priority identified by association stakeholders is regulatory and guideline support. Technology interoperability, and the widespread adoption of ITS, can be ensured by providing clear regulatory support and guidelines. Stakeholders for all organization types indicated a need for national coordination and Federal guidance in setting standards. Stakeholders noted that both efforts could help create a more cohesive and efficient transportation system and prevent fatal and serious injuries on roads.

Industry Insights

- Safety is identified as the top priority for all ITS stakeholders.
- Stakeholder stressed the ability to use and share data through standardization, connectivity, and interoperability as a critical need.
- Robust workforce development on possible ITS uses and ensuring maintenance of technologies is needed.
- Regulatory guidelines and support will provide clarity and direction for IOOs to develop and deploy ITS equipment.

Needs

Of the 24 interviews conducted, 11 of the stakeholders across all four categories said one of their greatest needs is having a skilled and trained workforce. Stakeholders indicated their requirement for training and developing the workforce to understand and use ITS technologies. Public agency stakeholders highlighted the importance of developing workforce training programs, apprenticeships, and continuous learning opportunities to manage and maintain ITS technologies. Several public agency stakeholders also stressed the necessity of training staff to keep up with rapid technological advancements, such as AI and advanced sensors. University research and public agency stakeholders identified that the need is especially acute in rural and under-resourced areas. Association stakeholders voiced the importance of educating the workforce broadly across various departments to encourage application of ITS solutions throughout transportation processes, from planning to maintenance.

University research and public agency stakeholders both stated the need for public education and outreach. University research stakeholders underscored the necessity of continuous community engagement to ensure inclusive participation. Engaging with the community to ensure that transit services meet specific cultural and operational needs was highlighted as a need. Stakeholders from public agencies noted the importance of community engagement in aligning transit services with regional planning efforts to achieve economic and social goals. An example of how a public agency is improving transit through AVs and other ITS technologies discussed during a stakeholder interview is described in the case study below.

Ultimate Urban Circulator (U2C) in Jacksonville, Florida, USA

The Jacksonville Transportation Authority (JTA) is currently executing a three-phase U2C project focused on improving transit options through ITS improvements in Jacksonville, Florida.
The first phase of the U2C project, called the Bay Street Innovation Center (BSIC), introduced automated vehicles (AVs) through an on-demand transit circulator which operates with mixed traffic on a three-mile loop in downtown Jacksonville, Florida. Autonomous vehicles with drivers were tested along the BSIC. This phase included numerous intelligent transportation technologies, including vehicle-to-infrastructure (V2I) communications, dynamic signals, pedestrian detection sensors, and flood warning sensors. Figure 15 shows the BSIC AV circulator, equipped with multi-functioning steering wheel, two radars, and three three-dimensional (3D) 360-degree multi-layer LiDAR safety functions. The AV circulator was launched in June 2025.

Phase two, the Skyway conversion, will also convert the existing skyway superstructure and eight stations into an elevated road for autonomous vehicles. The third phase will expand the AV service area beyond the BSIC by extending into several neighborhoods in the surrounding downtown area.[13]

Figure 15: Autonomous vehicle equipped with various technologies being tested on the Bay Street Innovation Corridor

Source: JTA, February 2025

University research and public agency stakeholders both stated the need for collaboration. Public agency stakeholders stated that enhanced collaboration across businesses, university research, and public agencies is crucial for accelerating ITS deployment. Sharing knowledge, successes, and challenges is essential for fostering innovation and advancing transportation technologies. A university stakeholder added the importance of encouraging transit providers to adopt the General Transit Feed Specification – Flex (GTFS-Flex) data standard to create more adaptive transit models.[14] An example of how GTFS-Flex can help with traveler information for people using transit is shown in Figure 16 on the next page.

[13] https://u2c.jtafla.com/
[14] https://gtfs.org/community/extensions/flex/

Figure 16: Transit station with real-time information displays showing GTFS-Flex data

Source: AASHTO, December 2021

Association, business, and public agency stakeholders all stated that with the increased use of data, there is an increased need for more robust data and cybersecurity measures and networking policies. Protecting these technologies from potential cyber threats is deemed paramount. It is crucial to inform the public about data usage to build trust and mitigate any potential concerns. Investments in cybersecurity measures are necessary to safeguard the integrity and functionality of the transportation system.

Industry Insights

- Robust workforce development focused on installing and maintaining ITS equipment is needed.
- Collaboration between public agencies, university research, and businesses can lead to innovative approaches to solving problems.
- Public education and outreach can help build support for potential ITS projects.
- Data protection and cybersecurity will be paramount as additional data is collected, analyzed, and disseminated to the public.

Transformative Technologies

The following types of emerging technologies were commonly mentioned during stakeholder interviews across all organization types: sensors, AI, ML, C-V2X, electric vertical takeoff and landing (eVTOL) aircraft, AVs, sensor-embedded road stripes (i.e., smart lane markings), and drones. Several university researchers pointed to advanced sensor technologies as transformative technology. One university research stakeholder emphasized the importance of deploying multiple types of sensors at intersections to ensure data accuracy and system redundancy. Another university research stakeholder discussed the necessity of integrating sensors into infrastructure for real-time data collection and alerts, particularly in extreme weather conditions. One business stakeholder pointed out the importance of sensors for predictive maintenance and optimizing road safety. Another business stakeholder emphasized the use of sensors in data management systems, such as smart streetlights and bridge condition monitors, to collect valuable data for transportation planning and operations. These advanced sensors would also feed data referenced in other transformative technologies.

All stakeholders stated that AI and ML are two of the most transformative technologies approaching the transportation sector. Public agency stakeholders said these tools are expected to revolutionize many areas of transportation, including TSMO, data processing, and operational efficiency by providing real-time data analysis and predictive capabilities. University research stakeholders noted the wide variety of uses for AI in enhancing connectivity, as well as the potential of AI-augmented data analytics to bridge gaps in transportation data. Association stakeholders emphasized the role of AI in analyzing and processing large datasets, predictive analytics, and real-time traffic adjustments. An example of how a public agency is leveraging AI to improve transportation outlined during a stakeholder interview is detailed in the case study below.

Texas Department of Transportation (TxDOT) AI Strategic Plan

The Texas Department of Transportation (TxDOT) published the first AI Strategic Plan for transportation across Texas in December 2024. The 2025-2027 AI Plan establishes a vision, principles, and roadmap so AI can be a transformative technology while addressing public privacy concerns. This Plan guides how to integrate advanced analytics and intelligent systems into the TxDOT operations and transportation system. The plan has five key focus areas for using AI as an advanced analytics and intelligent transportation tool: optimizing infrastructure, data-driven decision making, enhancing stakeholder experience, unlocking workforce potential, and ensuring security.

The TxDOT AI Plan includes a range of use cases, from using AI for data-driven crash hotspot mitigation to leveraging AI for speed limit evaluation. The Plan provides an AI implementation roadmap shown in Figure 17 below.[15]

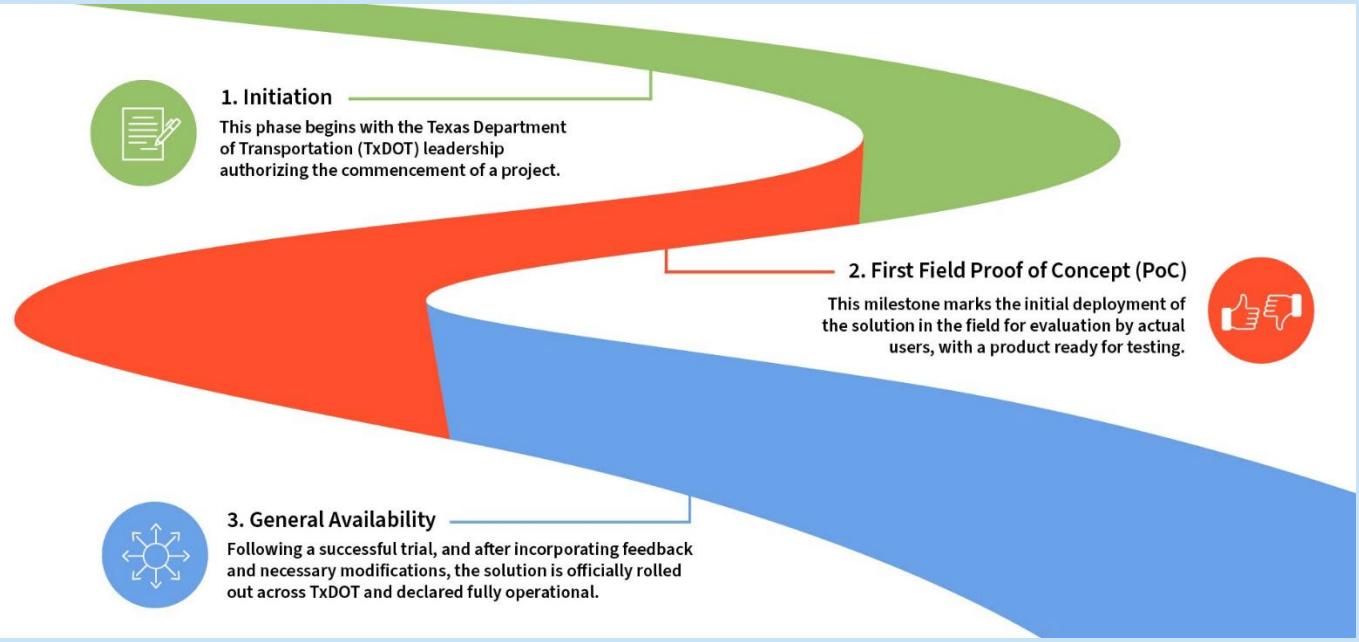


Figure 17: Three key milestones for AI implementation at TxDOT are initiation, proof of concept, and availability as shown in the roadmap

Source: TxDOT, December 2024

All categories of stakeholders discussed at some level the relationship between transformative technologies and data management, analytics, and connectivity. The data and technology overlaps mentioned during the interviews are noted below:

- **Digitized Traffic Signal Controllers:** A business stakeholder discussed the advantages of transitioning traffic signals from the current analog designs to digital activation and control. Digitizing the intersection, from controllers to signal heads, would simplify conflict monitoring, communication, and TMC control of the intersection. Further, a digitized intersection would better process data from multiple data streams, such as vehicle and pedestrian detection.
- **Open Data Platforms:** A university research stakeholder highlighted the importance of open, shared, and interoperable data platforms to improve operational efficiency and support innovative projects. Public agency stakeholders also stressed the need for standardized data formats and improved data governance to enable better planning and operation decisions.
- **Real-Time Data Processing:** Public agency stakeholders highlighted the importance of real-time data collection and processing to improve decision-making and transportation operations. The integration of video analytics and digital twins showcases the potential of data-driven insights in enhancing TSMO and infrastructure management. An example would be utilizing video analytics and digital signal controls to adapt signal timing based on queue length in real-time.

[15] https://www.txdot.gov/content/dam/docs/str/ai-strategic-plan-09-20-2024.pdf

Another transformative technology identified by all stakeholder categories is C-V2X communications. University research stakeholders stressed the need for dedicated wireless spectrum for interoperable CV operations. According to association stakeholders, the integration of C-V2X communications into roadway vehicles and infrastructure is seen as vital for enhancing safety and efficiency within the transportation ecosystem. Business stakeholders highlighted the need for a robust policy framework to support V2X deployment and noted the positive impacts on traffic flow and fuel efficiency. Public agency stakeholders noted the importance of deploying C-V2X infrastructure in rural areas, where ITS infrastructure investment has often been delayed compared to more densely populated areas. Deploying C-V2X across rural areas would require building out broadband or wireless connectivity across large, sparsely populated areas. A state agency stakeholder discussed that long distances, insufficient knowledge transfer, and lack of standardized protocols make it difficult to deploy CV RSUs across rural areas. Public agency stakeholders also stressed the need to share safety benefits of current CV technologies, such as preventing crashes through in-vehicle messages from RSUs, while also acknowledging the challenges of transitioning to full automation. An example of current RSU equipment is shown in Figure 18 below.

Figure 18: Photo of an installed RSU at an intersection in Denver, Colorado

Source: City and County of Denver, August 2024

A state Department of Transportation (DOT) discussed how installing a broad fiber network can provide numerous safety and efficiency benefits, especially related to ongoing weather challenges. Two stakeholders mentioned that an eVTOL aircraft can significantly improve transportation mobility, particularly for deliveries, by reducing ground congestion. Stakeholders said that AVs help reduce human

error, improve safety, and enhance efficiency. Several stakeholders went on to mention that updated design standards are needed to ensure AVs can operate effectively with existing infrastructure.

Stakeholders from two university research institutions talked about the benefits of innovative road markings and drones. Innovative road markings equipped with embedded sensors and retro-reflective materials can improve vehicle detection and communication. Additionally, the utilization of drones can address resource and capacity limitations in areas with limited infrastructure by performing inspections, issuing warnings about signal outcomes, and executing other functions, thereby enhancing overall system performance.

Industry Insights

- AI with machine learning could assist decision-makers with data processing and making decisions faster.
- Advanced sensors will help build a broader data set for decision-makers across the transportation sector.
- C-V2X communications will provide early warnings to roadway users and allow IOOs to identify dangerous conditions and distribute warning messages.

Opportunities to Accelerate

All categories of stakeholders identified data standardization and interoperability as an important opportunity to accelerate ITS. University research stakeholders stressed that harmonizing these transportation data standards, such as Service Interface for Real Time Information and GTFS-Flex, ensures that technologies can work together seamlessly. Association and public agency stakeholders stressed the need for open data standards to facilitate sharing and collaboration across businesses and public agencies. Business stakeholders emphasized the need for clear policy frameworks and industry certifications to foster innovation and ensure safety. A business stakeholder emphasized the importance of coordinated procurement methods and uniform standards to reduce costs and improve efficiency.

Through the ITS Architecture and Standards Program the ITS Joint Program Office seeks to advance standards-based, interoperable ITS deployments.

Stakeholders from all four sectors asserted that collaboration and partnerships are another opportunity to accelerate ITS deployments. Association, business, and public agency stakeholders maintain that P3s and similar collaborations would foster innovation across the transportation sector. Public agency stakeholders pointed to technical expertise from the private sector as beneficial for advancing innovative solutions. Association stakeholders highlighted that those collaborative efforts could lead to more effective solutions and faster deployment. Business stakeholders discussed the importance of intergovernmental agreements and collaboration among jurisdictions. Business stakeholders also mentioned the significance of regional coordination and partnerships with IOOs, highlighting the importance of including telecommunications stakeholders in national ITS discussions and fostering collaboration across various industries.

Several stakeholders identified funding as an opportunity to accelerate ITS deployments. Public agencies, associations, and business stakeholders noted that alternative funding sources, beyond grant programs, will need to be explored for future infrastructure and ITS investment. Business stakeholders pointed to the challenge of securing long-term funding for the deployment and maintenance of ITS technologies. Two stakeholders mentioned that refining the vendor selection process can expedite the ITS procurement process, including a streamlined list of vendors that provides proof of concept and baseline standards.

Lastly, all categories of stakeholders recognized policy and regulatory support as a key opportunity to accelerate ITS deployments. University research stakeholders said that simplifying bureaucratic processes for funding and grants can accelerate ITS implementation, particularly in resource-constrained local governments. Association stakeholders stated that ensuring long-term funding stability is essential to boost vendor confidence and encourage private sector investment. Business stakeholders highlighted the significance of maintaining the essential safety spectrum and supporting C-V2X technologies and noted the critical role of the U.S. DOT in providing leadership and defining digital infrastructure. An example of how a future street integrated with ITS technology could look is shown on the following page in Figure 19 on the next page.

Figure 19: Graphic displaying the future of intelligent transportation

Source: iStock, March 2025

Industry Insights

- Data standardization and interoperability would allow data repositories to be consistent across sources, facilitating data distribution across public, private, and research entities.
- P3s will facilitate collaboration and funding opportunities between public and private sectors.
- Regulatory support and guidelines will provide clarity surrounding the C-V2X safety spectrum to support more digital infrastructure and widespread ITS deployments.

Key Themes

Each interview summary included a list of themes from discussions with industry stakeholders. There were 149 themes that emerged across 24 interviews. These themes were analyzed to understand which words and phrases were common across stakeholder perspectives. Each interview theme was categorized into a key theme category based on a critical point made by a stakeholder. The quantitative results for any key theme that emerged five times or more based on terms searched and the number of mentions are listed in Table 1 below. A word cloud was also produced that included all the themes mentioned during the interviews, as shown in in Figure 20 on the next page, to compare to the tabular assessment in the table. The key themes mentioned five or more times in the stakeholder interviews are described in detail in this section. Several other words and phrases came up as sporadic themes in a few interviews but did not emerge as a key theme or industry-wide perspective and are not detailed below.

Table 1: Quantitative results of key themes mentioned during future of ITS interviews

Key Theme	Terms Searched	Mentions Count
Technology	technology, retrofit, automation	19
Data	data	11
Workforce Development	workforce	11
Deployment	deploy	10
General Public	outreach, awareness, stakeholder, engage, society, public	9
Planning	plan, future, integrate	9
Safety	safe	8
Partnership	partner, collaborate	7
Cybersecurity	cybersecurity, privacy, security	6
System	system	5
Multimodal	mode, modal, user	5
Funding	fund	5
Digital Infrastructure	digital, digital infrastructure	5
Other Themes		39
Total		**149**

Figure 20: Word cloud of interview themes

Source: ITS America, March 2025

Technology

Technology was mentioned as a theme 19 times across the stakeholder interviews. A variety of stakeholder types, including public agencies and research institutes, mentioned technology. An association stakeholder noted that technology plays a significant role in enhancing human capabilities and reducing errors. Stakeholders said prioritizing technological advancements and allocating resources effectively can improve transportation system efficiency. Stakeholders across multiple organization styles also noted that automated and predictive technologies can enhance mobility and efficiency in transportation. For example, a university stakeholder said automated sensors and calibration would decrease barriers to ITS deployment. Multiple stakeholders discussed how predictive modeling technology can help optimize decision-making that requires careful consideration. A county public agency discussed how the implementation of ITS technology is becoming more cost-effective, scalable, and user- friendly due to rapidly changing technology, allowing for more agencies to adopt technology. Several stakeholders noted that tracking outcomes and performance measures of technology investments are essential for agencies to justify funding and staff resources for deployments. A vehicle original equipment manufacturer (OEM) noted that exploring aftermarket solutions to retrofit older vehicles with connectivity capabilities can modernize existing infrastructure without complete reconstruction. A public agency stakeholder stressed the integration of new technologies requires updated design standards to ensure safety, efficiency, and interoperability. Overall, stakeholders highlighted that large-scale implementation of connected technologies can provide significant systemwide benefits.

The following types of emerging technologies were mentioned throughout the interviews and are described in detail in the: "Transformative Technologies" subheading: sensors, AI, ML, C-V2X, eVTOL aircraft, AVs, sensor-embedded road stripes, and drones. Sensors and cameras gather real-time data, such as traffic conditions. Several stakeholders said sensors and cameras provide valuable information for decision-making that is crucial for improving system efficiency. Public agency stakeholders said AI and ML are expected to revolutionize many areas of transportation, including TSMO, data processing, and operational efficiency by providing high-speed data analysis and predictive capabilities. Other stakeholders discussed how installing a broad fiber network and sensor-embedded road stripes can provide numerous safety and efficiency benefits.

Stakeholders believe the integration of C-V2X communications into roadway vehicles and infrastructure is vital for enhancing safety and efficiency within the transportation ecosystem. Stakeholders also mentioned how the implementation of eVTOLs, AVs, and drones can improve transportation mobility and reduce congestion. Stakeholders say AVs help reduce human error, improve safety, and enhance efficiency. Several stakeholders went on to mention that updated design standards are needed to ensure AVs can operate effectively with existing infrastructure.

Data

Data was identified as a key theme 11 times. All types of stakeholders emphasized the importance of data for the future of intelligent transportation and that data is the heart of modern transportation systems. Although data encompasses a wide range of topics, stakeholders specifically mentioned aspects such as data interoperability, synthetic data generation, data analysis, data visualization, data quality, data management, and data contribution. Stakeholders indicated that data interoperability is key to improving traffic management, safety, and predictive maintenance, while also enhancing mobility services. One public agency pointed out the need for more data interoperability frameworks that allow for multiple types of data to be collected and analyzed seamlessly. The collection of data, whether through real-world methods or synthetic generation, is intrinsically linked to ITS. Stakeholders discussed how technologies, like AI, can facilitate the generation of synthetic data, enable real-time cross-checking of data sets, and provide advanced analysis and predictive insights. A private technology business noted that data-driven decision-making currently focuses on physical infrastructure over digital services, which limits the potential for innovative ITS deployment. Both public agencies and associations discussed how leveraging historic and real-time data is key for improved decision-making. Several public agencies said quality, real-time data from a variety of sources can enhance traffic management and safety. Those same public agencies also noted that CV data allows for understanding trip patterns in real-time and predicting future trips.

> **"If we're looking at transportation as becoming much more data-driven, then having the infrastructure to share data is important."**
>
> *~University research stakeholder*

A private business stakeholder noted that while there is an abundance of data available, efficient systems need to be developed to process this data into actionable information effectively. Additionally, a state DOT said improved data governance and management are essential to enable and protect intelligent transportation. Several stakeholders mentioned there is a need for empirical evidence from initial deployments to support broader ITS implementation; this could be accomplished by developing better metrics and success stories to demonstrate the benefits of ITS deployment. Multiple types of stakeholders

discussed how standardizing data formats is also needed for easier sharing, interoperability and integration, from complete trip planning to intersection operations.

Stakeholders discussed the importance of incentivizing data contributions from riders and transit providers to improve service optimization. A state DOT suggested that creating data visualizations to share the results of ITS deployments with the public would be beneficial. Overall, stakeholders noted that ITS technology utilizes and generates data, indicating there is a strong need for high-quality information. Several stakeholders said technologies can assist in data processing to make more efficient, data-driven decisions and share the successes of ITS deployments to encourage more widespread adoption.

Workforce Development

Workforce development was a key theme in 11 interviews from a variety of transportation industry viewpoints. Most of the stakeholders that mentioned workforce development were public agencies followed by associations. One business and university research institution also mentioned the need for more workforce development focused on the future of intelligent transportation. Stakeholders consistently mentioned the importance of developing a skilled workforce to meet the future demands of the transportation system. A public transit agency said educating and training engineers and technicians on the capabilities of ITS technologies is essential to help design, build, and maintain transportation infrastructure. A stakeholder from a national association emphasized that transportation professionals in broader departments and sections also need to feel comfortable working with and identifying ITS solutions. Stakeholders believe equipping staff with the necessary skills and knowledge is crucial for effectively implementing and managing new transportation technologies and projects.

> **"Making sure that we understand how this technology works, along with getting hands-on training and experiences about how to install and troubleshoot equipment, is one of our goals. If we're looking at transportation as becoming much more data-driven, then having the infrastructure to share data is important."**
>
> *~County agency stakeholder*

Stakeholders noted two common challenges regarding improving ITS workforce development: 1) there are not enough trained staff in ITS technologies, and 2) there is limited technical expertise in rural areas. Several public agencies discussed the shortage of adequately trained staff to install ITS systems and process data. Public agencies noted the need to train and retain a skilled workforce. Stakeholders suggested that appropriate training programs, potentially through collaboration with local universities, may help address skill gaps. An association noted that industry-wide training could include a basic understanding and ways to use ITS, encourage network management, and build data analysis skills that would help support more ITS deployments and interoperability in the future. Additionally, a university stakeholder mentioned that limited technical expertise in rural areas hampers ITS deployment.

Stakeholders stated that mitigating these challenges could strengthen the workforce. Stakeholders emphasized that a transportation workforce skilled in ITS is needed to meet the demands of future transportation systems.

Deployment

ITS technology deployment emerged as a key theme ten times throughout the stakeholder interviews. National associations and public agencies noted the importance of sharing best practices, successes, and failures among agencies and IOOs to encourage broader adoption of ITS. Multiple stakeholders talked about how proven success stories can help reduce reluctance to deploy these technologies. Public agency stakeholders noted that there is a need for successful deployment case studies to demonstrate C-V2X, adaptative signal control, and video analytics that work to support more widespread deployment. A vehicle OEM mentioned business case and adoption triggers for V2X technologies, such as tolling and parking integrations, which provide immediate and tangible benefits. A vehicle manufacturer also noted that safety applications that reduce road fatalities should be prioritized in vehicle-to-infrastructure (V2I) and vehicle-to-vulnerable road users (V2VRU) deployment strategies. Another vehicle OEM stakeholder indicated that installing aftermarket safety devices on older public fleet allows vehicles to access RSU messages.

> **"It is deploying what we know… getting things on the road, getting them real, showing the benefits and using those to help resolve some of the problems that we're seeing with traffic fatalities."**
>
> ~Business stakeholder

Stakeholders described several challenges to deploying ITS, including data processing, timeliness, efficiency, and contracting. A vehicle OEM mentioned that one of the main challenges of deployment is ensuring that vehicles can process V2X data without overloading drivers or requiring excessive computing power. A stakeholder indicated that issues such as procurement, technology vetting, and regulatory hurdles can cause delays in technology deployment. Several stakeholders expressed concern that delays result in some agencies deploying outdated versions of the technology by the time a project is implemented.

Public agencies also noted there is a need for new contracting methods to speed up ITS deployment but stressed that these methods must also reflect the varying laws and processes in each state. Additionally, stakeholders said tracking the success of proof-of-concept deployments is important to justify scaling and further investments. The goal stakeholders emphasized is to achieve standard, national ITS deployment, encompassing both connectivity and human interface aspects.

General Public

General Public was identified as a key theme nine times. Public transit agencies often mentioned the impacts of ITS on the public. Stakeholders believe ITS can save lives and improve efficiencies, but there is a need for strong regulatory frameworks to ensure these technologies serve the collective interests of the public. Several stakeholders said the advancement of ITS requires public agency, private industry, and general public trust. Stakeholders discussed the importance of ongoing investment in public awareness campaigns for securing funding, creating tailored policies, and advancing innovation in ITS technology.

> **"I think the best salespeople are your colleagues. If I can point to my neighbor that has implemented a solution, and it worked, it makes it easier for me to be able to justify that same solution."**
>
> ~Association stakeholder

Transit agencies highlighted the importance of educating riders on transit apps and collecting feedback to enhance services. A transit agency emphasized the need for cultural sensitivity in education. A university researcher discussed how the public should be engaged throughout ITS planning processes to understand how ITS can improve how they move around. Several city, county, and state public agencies noted that technology can provide data to share insights and outcomes with the public. Stakeholders expressed a need to expand the variety of stakeholders in national discussions, particularly telecommunication stakeholders, to provide a unique perspective on technology development and deployment. Overall, stakeholders noted that public awareness, education, and trust are all needed to successfully deploy intelligent transportation.

Planning

Planning was identified as a key theme nine times across the stakeholder interviews. Most stakeholders that discussed planning were state DOTs. Planning encompasses various strategies and considerations for the deployment of ITS. Stakeholders noted that incorporating technology into transportation projects can increase the likelihood of ITS deployment. A public transit agency said having a synchronized approach across funding, regulation, and stakeholder engagement is important when deploying ITS technology. A state DOT highlighted the importance of identifying long-term goals so agencies can slowly add investments to reach their goals. Public agency stakeholders stressed that long-term planning is needed despite the frequent changes in technology and short-term funding. Several stakeholders across the industry said that identifying a strategy for the future with measurable impact metrics ensures beneficial ITS development and efficient use of funding.

Public agencies mentioned that national strategies are needed to provide guidance for coordinated and streamlined ITS deployment. Stakeholders stated that recognizing ITS as a continually developing field is critical for future transportation improvements. A state DOT said infrastructure should be designed to support future vehicle technologies. Several stakeholders highlighted that investing in smart technology, V2X, and digital infrastructure will help public agencies prepare for the eventual widespread use of fully connected and automated vehicles. Another state DOT emphasized that deployment should be planned in both urban and rural areas.

> **"Power and communications will need to be a key investment for intelligent transportation to work in rural areas."**
>
> ~University research stakeholder

Stakeholders said planning with ITS solutions can also help advance economic development and other goals. Many stakeholders believe incorporating technology into transportation planning will ensure the successful deployment of ITS at a national level.

Safety

Safety was mentioned by industry stakeholders as a key theme eight times. Stakeholders discussed how ITS play a crucial role in enhancing transportation safety. Across most stakeholder interviews, there was a consensus that technologies help improve both transportation safety and operations by creating safer environments for all modes of transportation, including pedestrians, cyclists, and freight. Several stakeholders said ITS technologies facilitate effective communication and coordination among vehicles, infrastructure, and various road users. Vehicle OEMs discussed how aftermarket safety devices can improve safety while extending the life of vehicles.

Multiple public agencies noted the importance of validating ITS interventions to understand their safety impacts. Stakeholders across multiple organization types noted that data and technology can be used to

improve safety at a systemic level, such as gaining data from a pilot to determine the safest solution across a corridor or road. A stakeholder said coordination with research institutes could help with tracking safety performance measures. Stakeholders noted that specific technologies should be tested and proven in both urban and rural areas to advance widespread deployment. Overall, the industry thinks that ITS deployment offers great promise to enhance safety across all transportation systems.

Partnership

Partnerships emerged as an industry perspective seven times throughout the stakeholder interviews. Various types of stakeholders discussed fostering and expanding partnerships to advance ITS. Partnerships among the following groups were mentioned: public agencies, private businesses, academic groups, and the government. Additionally, stakeholders noted the importance of global collaboration.

Several stakeholders said collaboration through P3s and new procurement models could support advancements in ITS by streamlining processes, innovation, and funding to expedite ITS deployments and encourage collaborative upgrades. A public transit agency said that developing new partnerships with hospitals, employers, and businesses can help secure additional funding and enhance service offerings. Multiple stakeholders across all organization types interviewed think that enhanced collaboration is needed across states and industries, involving a wide array of stakeholders such as academia, government, and private companies. Stakeholders deemed this cross-industry collaboration vital for knowledge sharing and accelerating the deployment of ITS technologies.

An association highlighted that global collaboration efforts, such as coordination with ITS organizations in Europe, Asia, and other regions, can leverage global innovations to improve domestic ITS implementations. A public transit agency said that a partnership with the Federal government is key, as the government provides funding, regulation, and oversight to ensure that ITS deployment aligns with public safety, environmental, and accessibility goals. Another public transit agency believes risk management strategies support collaboration and allow other entities to learn from past experiences. Overall, the industry said cross-collaboration and partnerships are key to effectively and efficiently deploying ITS nationally.

Cybersecurity

Cybersecurity was identified in six key themes in the interviews, primarily by public agencies. Cybersecurity was addressed in the context of national transportation networks. Overall, discussions about cybersecurity were related to the need for additional public awareness and data sharing privacy. With the continuous advancement of technology, stakeholders noted a growing need for enhanced security to protect data transferred between users and networks. An association stakeholder added that greater security is needed to increase the resilience of intelligent transportation. For example, a university research institution said technology, such as global positioning systems (GPS), needs to be equipped with secure systems to reduce the likelihood of cyberattacks.

Public agencies noted the necessity for vendors to adopt robust cybersecurity measures in new technologies. A stakeholder said cybersecurity standards vary across different jurisdictions, which can make it challenging for technology vendors to meet all requirements. Overall, stakeholders emphasized the importance of balancing innovation with privacy, ensuring that cybersecurity investments are communicated to the public to gain their support. Stakeholders also highlighted the need to address privacy and cybersecurity concerns as ITS becomes more widely deployed.

System

Systems came up five times as a key theme across all stakeholder groups interviewed. Discussions focused on systems approaches and the need for more industry integration, holistic systems, redundancy, and standardization to help support the widespread advancement of intelligent transportation. A public agency said a transition from disparate technology to systemic approaches could allow for more comprehensive and interoperable systems, along with reduced costs. A technology business stakeholder stressed that analog systems do not allow for data to move between systems, but digital systems reduce data transfer friction. For example, that same stakeholder works on converting intersections from analog to digital to allow signals to adapt to real-time traffic conditions, such as reducing congestion during a major event or allowing a pedestrian more time to cross the street. A consultant suggested that a system-wide unified and collaborative effort for data analytics, procurement, and overall planning or operational processes would allow for more efficient progress. A research university stakeholder suggested system redundancy, such as having two or more sensors at an intersection, can help confirm that the data collection, analysis, and associated decision-making are correct. Stakeholders noted that proven technologies should help define guidelines for nationwide replication for other public agencies. A telecommunications stakeholder stated that all ITS technology and standards need to move and progress together to help facilitate greater interoperability across the entire transportation system. Overall, several stakeholders noted the importance of ITS working together as a holistic, multimodal system.

> **"Envision a time where those sensors provide information and connectivity in a way that becomes like a fifth sense."**
> ~Association stakeholder

Multimodal

Multimodal was captured as a key theme five times, mostly mentioned by public agencies, transit providers, and associations. Stakeholders mentioned pedestrians, cyclists, micromobility users, and transit users as some multimodal user types. Pedestrians, cyclists, and scooters were among the modes mentioned by stakeholders where detection technology is lacking or does not integrate well with existing systems. Public agencies mentioned that multimodal users should be integrated into technology detection. In addition to multimodal users, an association stakeholder added that ITS deployments should consider all ages and abilities, as well as urban, suburban, and rural contexts. Additionally, a transit agency noted that AI influences how information is presented to users, potentially embedding biases. When data is provided in an easy-to-use, interoperable way, a public agency said technology can be used to make route planning easier and offer incentives to alter travel behavior, such as taking transit and adjusting travel time. Stakeholders discussed how ITS can improve the safety of multimodal users and encourage mode shift.

Funding

Funding appeared as a key theme five times. Funding is required for the deployment, operation, and maintenance of intelligent transportation. Several stakeholders said that identifying additional funding sources and procurement models are currently a hinderance to widespread ITS deployment, maintenance, and integration across the transportation system. Many agencies use Federal grant funding to pay for projects but cannot continue funding the technology

> **"We must come up with a business model that's going to fund the ITS system. Once this gets going, the system can reinfuse money to keep building it up – the impact will be limitless."**
> ~County agency stakeholder

once the grant period ends. One public agency stakeholder received two SMART grants to improve traffic management, safety, mobility, and overall transportation efficiency of their jurisdiction.[16] Although Federal funding is helpful, multiple stakeholders noted competitive grant funding is not a long- term way to deploy and maintain these systems.

Stakeholders noted more direct funding, outside of competitive grant applications, is needed for agencies to invest in technology. Stakeholders said the establishment of dedicated, long-term Federal formula funding would be helpful to ensure the financial stability, operations, and upgrades of ITS technologies.

A vehicle manufacturer noted the need to balance investments in V2X deployment with the financial pressures from the transition to electric vehicles. An association also discussed the need for effective funding alternatives for transportation technologies that could replace the traditional gas tax system and cumbersome grant management. Overall, multiple stakeholders advocated for long-term funding sources, P3s, and a national model for ITS funding to help technology go beyond just the testing phase.

Stakeholders believe diversified and directly obligated funding would ensure continual investment in technological advancements.

Digital Infrastructure

Digital infrastructure emerged as a key theme five times throughout the stakeholder interviews. Businesses commonly mentioned digital infrastructure, especially those working in data aggregation. Stakeholders discussed the importance and benefits of digital infrastructure for the transportation sector. Public agencies stressed the need for a national digital infrastructure effort. A stakeholder from a state DOT said national digital infrastructure efforts should involve a cross-section of stakeholders from public agencies, banks, and telecommunication companies. A business stakeholder emphasized that protecting and maintaining national digital infrastructure is necessary to ensure a fully interoperable transportation system. Overall, stakeholders advocated for significant investments in digital infrastructure to enhance the efficiency and safety of transportation systems.

> **"The infusion of digital infrastructure, as a core functionality of how we work and operate, is part of the future."**
>
> ~City agency stakeholder

Digital infrastructure has a broad definition but generally means technology that provides information and insights to advance transportation stems. Digital twins and digital intersections were two types of digital infrastructure specifically mentioned. A technology business suggested that the digitization of intersections could include replacing analog conflict monitors with digital safety measures to reduce complexity and costs. A state DOT said creating four-dimensional digital twin models can improve planning and operational decisions in transportation, such as simulating a new traffic pattern to see if crashes may occur before a crash occurs in real life. Stakeholders said investing in digital infrastructure can make maintaining transportation systems more affordable and manageable.

[16] https://www.transportation.gov/grants/SMART

Other Themes

In addition to the key themes, stakeholders mentioned several other themes including investment, transit, interoperability, standards, and procurement. Connectivity, CVs, and AVs also were mentioned. Stakeholders talked about how connected systems can improve the safety and mobility of transportation. A business suggested that opportunities for road user experiences with AVs through shared mobility and public transportation can increase public trust.

Numerous stakeholders talked about how investing in ITS will provide extensive benefits. However, one public agency noted that resource constraints can limit and delay ITS advancements. Public transit agencies and a research university discussed that ITS is also applicable to public transit. Stakeholders emphasized the importance of creating interoperable systems, which can be completed by establishing data sharing frameworks. Stakeholders discussed how a streamlined, collaborative procurement process would help advance ITS deployment; for example, two stakeholders talked about the potential of a subscription-based procurement model.

"The procurement process can get in the way of the alignment with the rate that technology develops."

~City agency stakeholder

Conclusions

ITS has proven to be a successful instrument to save lives while providing a positive return on investment for public agencies. Throughout this Report, the stakeholders provided insight into their visions on where ITS should go in the future. Several themes were repeated, with a large focus on technology, data, workforce development, deployments, and most importantly, safety.

The recurring focus on data collection and analysis indicates its crucial role in advancing transportation systems. Enhanced data capabilities will aid decision-makers in making day-to-day improvements and guiding policymakers in strategic investments. Data collection and analysis would greatly help grow several disparate sections of transportation, from V2X to infrastructure maintenance. Continued growth of data analysis will help decisionmakers make day-to-day improvements throughout the transportation system and assist policymakers in choosing where to invest limited funds for maintenance, improvements, and expansion. Other important themes, such as data interoperability and standards, were also discussed.

> **"I think what we are doing with ITS will transform safety and mobility for human drivers, human operators, and other human users of the system in the next ten years."**
>
> ~State agency stakeholder

Digital infrastructure came up throughout the stakeholder interviews as a key to the future of intelligent transportation. The integration of digital twins and intersections, facilitated by advanced sensors throughout infrastructure and vehicles, were noted as transformative measures for improving planning, operational decisions, and overall mobility.

Stakeholders from all organization types highlighted V2X communication as a key technology in the future of advancing intelligent transportation. The ability to communicate messages between vehicles and the surrounding infrastructure can provide roadway users with advanced warnings and notifications, potentially reducing collisions and saving lives. The potential of CVs to improve safety and mobility was highlighted, as was the need for interoperable systems and streamlined procurement processes.

Workforce development was identified as a key to the future of successful ITS deployments. Stakeholders said that an educated workforce with the skills and knowledge needed to build, operate, and maintain ITS deployments is crucial for improving safety outcomes for all roadway users.

Funding and procurement emerged as a critical theme, highlighting the necessity for long-term, diversified funding and partnerships to support the deployment and maintenance of ITS technologies. Stakeholders emphasized the importance of moving beyond competitive grants to establish dedicated federal funding, ensuring financial stability and encouraging continual investment in technological advancement.

Stakeholders shared that more collaboration across the transportation and telecommunications industries through new types of procurement and P3s could help maximize funding and innovation moving forward.

Overall, stakeholders provided a comprehensive vision for the future of ITS, advocating for collaborative efforts, long-term funding, and using technology to ensure the long-term success of transportation systems.

Suggested Next Steps by Stakeholders

During the interviews, stakeholders provided perspectives on possible next steps the industry may need to take to set up ITS for success, advance widespread deployment, and improve user outcomes in the future. The stakeholder perspectives on next steps are categorized and detailed below:

- **Workforce Training and Development:** This would provide the ITS community with knowledgeable personnel to ensure successful deployments. Stakeholders identified the need to introduce and educate transportation professionals about the benefits of ITS, and to train technicians in how to build, operate, and maintain the hardware needed.
- **Smart Infrastructure Deployment:** Transportation data collection and analysis will show how ITS advances into the future. Advanced sensors, on infrastructure and in vehicles, will provide data that will help identify safety concerns, like dangerous conflict zones and hazardous roadway conditions, as well as traffic improvements, such as queue warnings and congestion mitigation.
- **Data Connectivity:** Transmitting collected data for analysis and distribution is paramount for leveraging smart infrastructure improvements. Building out broadband or wireless communication infrastructure will aid public agencies, businesses, and university researchers with conducting studies, finding market-based solutions, and communicating travel information to the public.
- **Public Education and Outreach:** Having the support of public opinion would help acquire the needed backing for ITS projects to be built and succeed. Public support could be expanded by demonstrating the life-saving potential and congestion improvements offered by these ITS technologies. Developing outreach materials would help build trust between deployers and the general public.

List of Abbreviations

4D ..... Four Dimensional
5G ..... Fifth Generation
ADAS ..... Advanced Driver Assistance Systems
AI ..... Artificial Intelligence
AV ..... Automated Vehicle
C-V2X ..... Cellular Vehicle-to-Everything
CAV ..... Connected and Automated Vehicle
CV ..... Connected Vehicle
DI ..... Digital Infrastructure
DOT ..... Department of Transportation
eVTOL ..... Electric Vertical Takeoff and Landing
FCC ..... Federal Communications Commission
GPS ..... Global Positioning System
GTFS-Flex ..... General Transit Feed Specification – Flex
IOO ..... Infrastructure Owner Operator
ITS ..... Intelligent Transportation Systems
ITS America ..... Intelligent Transportation Society of America
ITS JPO ..... Intelligent Transportation Systems Joint Program Office
LiDAR ..... Light Detection and Ranging
ML ..... Machine Learning
OEM ..... Original Equipment Manufacturer
P3 ..... Public-Private Partnership
R&D ..... Research and Development
RSU ..... Roadside Unit
SIRI ..... Service Interface for Real Time Information
SMART ..... Strengthening Mobility and Revolutionizing Transportation
TSMO ..... Traffic Systems Management and Operations
U.S. DOT ..... United States Department of Transportation
V2I ..... Vehicle-to-Infrastructure
V2VRU ..... Vehicle-to-Vulnerable Road User
V2X ..... Vehicle-to-Everything