January 2024

ITS Technology Use Case Library

Digital Infrastructure Use Cases

The Intelligent Transportation Society of America
1100 New Jersey Ave SE, Suite 850
Washington, D.C. 20003

ITS AMERICA

INTRODUCTION

The Intelligent Transportation Society of America (ITS America) is the nation's leading advocate for the technological modernization of our transportation system by focusing on advancing research and deployment of intelligent transportation technology. Founded as an official advisory board on road technology to the U.S. Department of Transportation, ITS America represents state and city departments of transportation, transit agencies, metropolitan planning organizations, automotive manufacturers, technology companies, engineering firms, automotive suppliers, insurance companies, and research and academic universities. Our members come to one table – ITS America – to shape the next generation of transportation and infrastructure driven by intelligent transportation technologies; one that is safer, greener, and smarter for all.

In the fall of 2023, ITS America began collecting use cases of ITS technologies from our members, with the goal of highlighting projects that have a tangible impact on communities across the country. This library, which will be updated periodically, contains 23 successful deployments of ITS technologies from across the United States. We have showcased a variety of technologies including connected vehicles, AI-powered traffic management, adaptive signals, smart work zones, automated vehicles (AVs), transit signal priority, rapid transit planning, smart data centralization, and more. From digital messaging improving traffic flow in California to connected vehicle alerts for EMS in Washington, DC and AVs bringing mobility to those with disabilities in rural Minnesota, we are proud of our members' accomplishments over the years and look forward to many more successful deployments in the years to come.

If you have any questions or would like to contribute your own use case to our library, please reach out or visit our website itsa.org.

Contact:
Bobby McCurdy
Senior Director of Policy & Advocacy
bmccurdy@itsa.org

TABLE OF CONTENTS

Digital Infrastructure (DI)

Digital Infrastructure

ITS AMERICA

Artificial Intelligence Crash Response Management

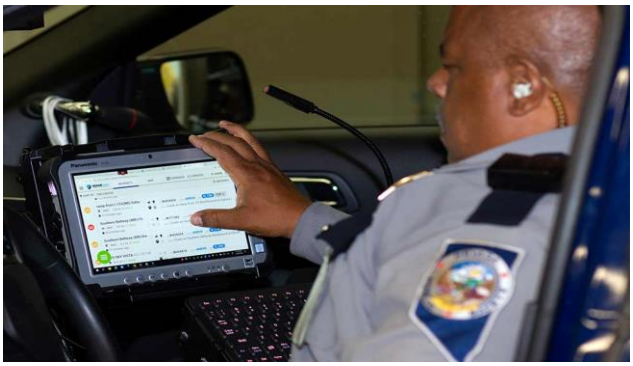
Southern Nevada

Decreasing the number of traffic crashes and improving police officer response times to emergencies are critical to the health and well-being of communities across the U.S. Using cloud-based software and artificial intelligence (AI), public safety agencies can share traffic data and real-time emergency updates, helping police and emergency services reach destinations faster. Monitoring traffic patterns, real-time crashes, and road closures not only speeds up response times, but it prevents more crashes from occurring.

The Challenge

When a crash occurs, officers may receive incident alerts solely from 911 calls routed through a traditional computer system, but these could include cases of misreported locations, lack of crime reports, and incorrect information. Traffic crashes can happen on highways with little to no location markings, making it difficult for emergency personnel to reach the location on time. Accurate information can help dispatchers send the right number of officers to the right locations in a timely manner.

As public safety officers respond to 911 calls, they must contend with the same traffic slowdowns, construction zones, and road closures that everyone in the community faces. With police officer response times increasing across multiple cities, every second counts in keeping people safe. [1]



The Nevada Highway Patrol (NHP), a division of the Nevada Department of Public Safety, is responsible for law enforcement across the entire state of Nevada. Its Southern Command in Las Vegas shares a dispatch center with the Regional Transportation Commission of Southern Nevada's (RTC) and Freeway and Arterial System of Transportation (FAST), the division responsible for monitoring and controlling traffic in the Southern Nevada region.

NHP, RTC, and FAST shared a dispatch center, but each agency used different software systems, making communication cumbersome. Without a common system, the agencies were unable to effectively share real-time information hindering their ability to be prepared and respond to incidents quickly.

Technology Solution

Nevada Highway Patrol selected Rekor Command™ because it is fully cloud-based and accessible to NHP users through their mobile digital computers, tablets, and desktops. The platform allows NHP, Nevada Freeway Service Patrol (FSP) Units, and Roadway Maintenance to communicate together seamlessly, with every agency accessing the same information at the same time, improving response times and coordinating efforts. Rekor's live map technology shows active crashes, traffic slowdowns, construction zones, road closures, and more. Additional map layers showed the location of other NHP Officers, Nevada FSP Units, and other public safety officers. The software also incorporated CCTV footage, giving officers another viewpoint when responding to incidents. Officers receive alerts through icon notifications, and when they click on the incident alert, all relevant details appear, including the precise incident location, a 20-second looped GIF, geofenced CCTV footage, insights on current road conditions, as well as relevant notes.

Outcomes & Benefits

Rekor's technology has reduced crashes on roads, improved response times, and even helped agencies lower spending related to emergency responses and crashes. [2,3]

18% crash reduction rate

43% of crashes detected faster than 911

9–12 min. decrease in emergency response time

43% reduction in spending

Conclusion

With the use of emerging AI technology in traffic management and emergency responses, crashes can be prevented, and countless lives can be saved. Beyond improving traffic flow and congestion problems, public agencies can use AI to lower police and EMS response times and strengthen information gathering necessary to keep motorists and pedestrians safe. This program in Nevada is a prime example of how innovative private and public partnerships can lower spending costs for government agencies, improve road safety, and increase public trust in police and EMS departments. When every minute saves lives, this shows the importance of technology solutions as a part of the safe systems approach to post-crash care and safer roads for all.

Participants involved in this use case include Rekor, Nevada Highway Patrol, Regional Transportation Commission of Southern Nevada

Sources:
[1] NPR
[2] ITS America Digital Infrastructure Forum, June 2022
[3] Rekor

ITS AMERICA

Traffic Management and Optimization

Detroit, MI

Local transportation systems are the lifeblood of cities, connecting residents to jobs, critical services, family, and friends. Decreasing the time that people sit in traffic and improving the operational health of municipalities are critical aspects to ensuring the functionality of local transportation systems. Using cloud-based software and remote traffic management systems, cities can decrease travel times, improve roadway efficiency, and reduce spending on transportation maintenance costs. Monitoring traffic patterns and intersections not only reduces congestion, but also lowers associated emissions and reduces financial burdens on drivers.

The Challenge

The City of Detroit is synonymous with transportation and the automotive industry and has been a leader in innovation since the early 20th century. Today however, Detroit lacks effective in-ground connectivity when compared to other major cities, making cross-device communication more difficult than necessary. This frequently leaves technicians unaware of issues they could otherwise fix. With a majority of their traffic budget devoted to manual signal checking and repairs, minimal funds are left to address emergency response times and public transit reliability. According to a 2020 study, Detroit drivers spent $3 billion in congestion costs collectively, with each driver spending 35 hours in traffic per year. [1, 2] Congestion like this creates excess fuel consumption and more auto emissions in a city that has been plagued by poor air quality. [3] Data-driven solutions and innovative traffic management tools will help make driving more efficient and improves repair processes.

35 Hours

Amount of time each Detroit driver spent in traffic in 2020

$3 Billion

Collective congestion costs in 2020

Technology Solution

The City of Detroit overcame its challenges by implementing a remote traffic management system based on TrafficLink, an intelligent Amazon Web Services (AWS)–based transportation system platform from Miovision. Relying on intersection data and livestreaming, the city can monitor each intersection and make data-driven decisions to improve traffic. TrafficLink can alert engineers via email or SMS about signal problems, such as light outages, signal timing issues, or signal failures. Traffic engineers can also use Miovision Traffic Insights, a web-based analytics suite, to evaluate signals based on real-time data.

The city deployed the remote traffic management system at 450 intersections and recently added advanced analytics capabilities to 30% of those intersections. Additionally, the Detroit uses analytical data from the Miovision solution to count vehicle traffic and pedestrian volume. This data is used to optimize specific traffic corridors and recognize the impact of road closures. The city and Miovision implemented traffic signal priority and preemption to shorten EMS response times through using pre-existing GPS technology already present in the city's EMS vehicles.

Outcomes & Benefits

Miovision's platform reimagined intersections in Detroit, leading to improvements in maintenance time and costs, as well as travel times at major intersections across the city. Previously, the city had an extensive third-party maintenance contract but now leaders can focus internal resources where they're most needed by taking advantage of connected traffic signals. This partnership continues to keep drivers, pedestrians, and other road users safe in Detroit.

20%
Reduction in traffic signal maintenance costs

30%
Decrease in travel times at major intersections

75%
Reduction in time to resolve traffic signal issues

$1B
Potential savings from less congestion

Additionally, Miovision's systems optimized Detroit's intersections, tracking both driver and pedestrian data to inform the city's systems. For example, their system can recognize when a pedestrian or cyclist is in a dilemma zone and extend the green timer to give them adequate time to cross the road. By creating these pedestrian heat maps, they have generated a blueprint for intersection monitoring that keeps everyone safe no matter how they choose to move. By enhancing Detroit's digital infrastructure, Miovision's technology has improved transportation outcomes for the city and its residents.

Conclusion

By deploying cutting-edge traffic monitoring and optimization tools, we can achieve multiple benefits that extend beyond transportation and improve the health of local economies. These tools achieve the goals of lower congestion, reduced emissions, and enhanced efficiency of travel times, while lowering costs for municipalities. These savings could be redirected to support critical community needs that would otherwise go unmet. Through Miovision's traffic management solution, Detroit was able to upgrade their digital and physical infrastructure in a cost-efficient manner, while improving congestion at intersections and making roads safer. ITS America encourages the implementation of similar traffic optimization and management tools in cities across the country so that we can help people get to their destinations safely and efficiently.

Participants involved in this use case include Miovision and the City of Detroit

Sources:
[1] Texas A&M University Transportation Institute
[2] Miovision; AWS
[3] American Lung Association

Improving Bridge Travel Times With Lane Management

Richmond, California

The management of traffic patterns on highways is critical to the ease of travel and congestion costs for motorists and surrounding communities. When it comes to toll-based bridges, too much traffic can lead to even greater congestion on the bridge and surrounding highway arteries, potentially leading to more crashes, higher vehicle emissions, and slower travel times. With the correct digital tools, agencies can improve travel times on bridges.

The Challenge

The Richmond-San Rafael Bridge connects the city of Richmond in Contra Costa County with the city of San Rafael in Marin County, through a narrow section of water between the San Francisco and San Pablo bays. It remains the second longest bridge in California, with a length of four miles. For much of its length, the structure has upper and lower decks rather than having side-by-side decks. Westbound traffic is carried on the upper deck while eastbound traffic is carried on the lower deck.

The Richmond-San Rafael Bridge is the **2nd longest** in California

In 2015, the bridge carried an average peak daily traffic flow of about 82,000 vehicles. This increased to 87,000 vehicles in 2017. During a typical weekday, travel demand on the bridge is highly directional, with traffic mainly moving westbound towards Marin County in the morning and eastbound towards Richmond during the afternoon peak. The width of the bridge can accommodate three lanes of traffic in each direction with no emergency shoulder. The eastbound side however experienced a significant increase in congestion during the afternoon due to increased traffic. In this case, the congestion was primarily caused by a reduction in the number of traffic lanes as the right most lane converts to an exit near the bridge's end. Traffic merging onto the freeway through a very short acceleration lane also contributed to the problem. Opening the shoulder as a third lane in the eastbound direction during the PM peak to ease bridge congestion required innovative digital infrastructure and active traffic management systems.

Average peak daily flow of **87,000 vehicles** in 2017

Congestion costs drivers **billions** of dollars each year

Technology Solution

To communicate the operational mode of the lanes, a set of Lane Use Signs (LUS) were installed over the three lanes at 20 locations. These LUS indicate a green arrow, if the lane is open to traffic, and red X if the lane is closed to traffic. In some instances, the LUS display a yellow X, to indicate that traffic should merge with the adjacent lane. The LUS change based on a pre-configured sequence whereby each set of LUS is delayed by a configurable period relative to the previous set for each change in mode and direction.

In addition, there are two full matrix Variable Message Signs (VMS) on the west end of the bridge that communicate traffic and road conditions to the motorists. The VMS are also used to convey hours of operation when the third lane is open or closed on the bridge. The VMS are controlled automatically and manually and will be synchronized to the operations of the LUS. This active traffic management system is managed by operators using the region's ATMS at the Caltrans Traffic Management Center (TMC) and Bay Area Toll Authority's (BATA's) Regional Operations Center (ROC) in San Francisco.

Outcomes & Benefits

The introduction of digital Lane Use Signs and Variable Message Signs has resulted in decreased congestion on the Richmond-San Rafael Bridge and improved travel times for drivers. The extra traffic lane has increased eastbound peak hourly flow across the bridge by 13-26%. The added peak-hour capacity has ended congestion on the Marin County approach to the bridge, resulting in peak travel times from the US-101 to the toll plaza dropping by 13-14 minutes on weekdays, 10-14 minutes on Saturdays, and 6-8 minutes on Sundays.

Weekday afternoon peak travel times along Sir Francis Drake Boulevard have dropped by up to 4 minutes, while traffic volumes have increased by over 300 vehicles/hour. The opening of the eastbound shoulder to traffic has reduced by approximately 70% the frequency of incidents on the eastbound bridge approach. With such improved traffic flows on the bridge and surrounding highways, the bridge has seen improved driver experience.

13-26%
Increase in eastbound bridge hourly flow

70%
Decrease in incidents on eastbound approach

13-14 Min.
Decrease in peak weekday travel times

Conclusion

Changing traffic patterns through digital infrastructure tools such as Lane Use and Variable Message Signs can result in lower travel times, less congestion on highways, and financial savings for motorists. As these digital tools improve traffic flow on the Richmond-San Rafael Bridge, drivers may face fewer backups, decreased idle fuel use, and the potential for fewer crashes. ITS America supports the implementation of active traffic management systems and innovative technological solutions that ease congestion on bridges, such as these tactics employed by California, so that we can realize a world with safer roads, fewer crashes, less congestion, and stronger transportation networks.

Participants involved in this use case include Caltrans District 4, Metropolitan Transportation Commission (MTC), Bay Area Toll Authority (BATA), Contra Costa Transportation Authority (CCTA), and Transportation Authority of Marin (TAM).

Sources:
[1] Caltrans

Using Active Traffic Management & Dynamic Lanes

Southeast Michigan

Improving safety outcomes on roads and decreasing travel times is critical to easing congestion and maintaining a region's economic competitiveness. Congestion on highways and inefficient lane use can have significant impacts on driver and pedestrian safety, as well as negative effects on the environment and fuel costs. Using advanced active traffic management (ATM) tools and upgrading digital infrastructure on highways can lead to improvements in safety and roadway efficiency.

The Challenge

Highway congestion adds time to commutes and leads to billions of dollars in collective costs to drivers every year. Without proper traffic management, these problems can compound and impact arterial roads as well. In 2022, drivers across the U.S. spent an average of 51 hours in traffic jams, costing the average driver over $800 in lost time. Overall, Michigan households collectively face $5.5 billion in annual traffic congestion costs. [1] As congestion increases, so does the likelihood of crashes and tailpipe emissions from vehicles.

Michigan saw over 293,000 crashes in 2022, which is 15% higher than in 2018. [2] The state, like many others, faces an urgent need to reduce crashes and fatalities on its roadways. Easing congestion through innovative, flexible shoulder lanes and digital tools, the state is making progress toward lowering the number of crashes on its highways and improving travel times in busy regions.

293,000 crashes in 2022 in MI

Over **$5B** in congestion costs for MI households

Technology Solution

ATM aims to dynamically manage recurrent and non-recurrent congestion based on prevailing and predicted traffic conditions. The Michigan Department of Transportation (MDOT) opened a Flex route on US Route 23 in 2017 to mitigate peak-hour congestion, reduce incident response times, and improve safety. The route uses large shoulders as dynamic lanes, spanning over 8 miles long. MDOT manages the corridor with variable speed controls and queue warning systems, opening the shoulder lanes in both northbound and southbound directions during peak traffic. This includes recurring peak travel times, as well as non-recurrent times such as holidays and local collegiate sports games. MDOT's Flex lanes on US Route 23 operate with the main goal of reducing travel times, improving congestion, and lowering the number of crashes on the highway. Another goal was to keep speeds along the US-23 dynamic stretch at 60 mph when the Flex route is in operation to accommodate 66,000 vehicles per day.

Outcomes & Benefits

This is an ongoing, permanent fixture on US Route 23 in the metropolitan Detroit region, but so far, the Flex route has improved driver safety, reduced travel times, and has received public praise from road users. Incident response times from emergency personnel improved along the route, as well as general congestion in both directions. Using before and after analysis, researchers found the following results of the Flex route: Crashes were reduced by 50% in the southbound direction during peak operational times and 17% in total after the Flex route was put in place. After the Flex route went into operation, average travel times during peak periods were reduced by 16.5% and 11.2% in the southbound and northbound directions, respectively. The introduction of the Flex route saw more traffic flow as well, with the maximum throughput in the northbound direction increasing by 11% and in the southbound direction by 35.4%.

MDOT
Michigan Department of Transportation

50% reduction in southbound crashes

16.5% decrease in southbound travel time

11.2% decrease in northbound travel time

35.4% increase in southbound traffic flow

Conclusion

By implementing a Flex route and accompanying digital infrastructure on a busy highway, MDOT was able to reduce travel times, congestion, and improve safety outcomes. With lower congestion, drivers can lower fuel consumption and potentially save money as well. Using ATM is just one of many ways of using digital infrastructure tools and ITS technologies to strengthen transportation networks and move closer to achieving Vision Zero. ITS America supports the continued use of ATM tools to reach these Vision Zero goals and a world where transportation is safer, greener, and smarter for all.

Participants involved in this use case include Michigan Department of Transportation

Sources:
[1] Fox 2 News
[2] Click on Detroit
[2] ITS JPO

Optimizing Traffic Flow on Congested Highways

Bay Area, California

Throughout the country, highway congestion in metropolitan areas remains a challenge for state and local transportation and planning authorities. Traffic backups make commutes longer, lead to more tailpipe emissions, and have the potential for more crashes. With the help of ITS technology and digital infrastructure tools, agencies can better manage traffic flow, detect and prevent incidents, and get people to destinations safely and efficiently.

The Challenge

Highway congestion adds time to commutes and leads to billions of dollars in collective costs to drivers every year. In California, 87% of urban Interstate highways are considered congested during peak hours, the highest share in the U.S. Additionally, vehicle travel on California's Interstates increased 17% from 2000 to 2019. The Interstate 80 (I-80) corridor in the California Bay Area has continuously ranked as one of the most congested corridors in the entire San Francisco Bay Area. As of 2007, with traffic volumes reaching 312,000 vehicles per day and an average of 20,000 hours of delay daily. The freeway is at or near capacity during peak periods with many segments of the corridor operating poorly. The congestion on the roadway network contributes to an increase in crash rates, including rear-end crashes on both freeway and local arterials. The combined effect of the crashes and the congestion hinders efficient response ties and creates secondary crashes.

Technology Solution

The primary goal of the I-80 ICM Project was to enhance the current Transportation Management System along the I-80 corridor.

87% of CA highways are congested during peak hours

312,000+ vehicles per day on I-80 corridor

This was accomplished by building balanced, responsive, equitable, and integrated system to monitor and maintain optimum traffic flow along the network, thereby improving the safety and mobility for all users, including transit riders. This project used State-of-the-Practice ITS technologies to enhance the effectiveness of the existing transportation network in both freeway and parallel arterials in Alameda and Contra Costa Counties. Caltrans and other local transportation authorities improved active traffic management systems, including variable advisory speed signs, lane use signs, and adaptive ramp metering to optimize traffic flow and decrease collisions. Additionally, the project implemented transit signal priority, coordinated traffic systems on arterial roads, changeable message signs, CCTV cameras, and other vehicle detection systems, all designed to optimize traffic flow, decrease travel times, and limit congestion from crashes.

The I-80 ICM project consisted of multiple systems and strategies, working collectively, to address congestion and mobility: including the challenges of imbalanced traffic flow in the corridor. Most of the systems were integrated into a single ATMS for unified management of the corridor and overall region. Since this corridor is constrained on both sides (by water and development), the most feasible congestion management alternative was to improve the efficiency of the total transportation system.

Outcomes & Benefits

The Project produced significant safety and travel time benefits despite significant traffic growth. The collected data shows that the I-80 SMART Corridor Project produced safety and mobility benefits by implementing advanced traffic management strategies, including ramp metering, traveler information and incident-related diversion facilitation. The benefits were most noticeable during the off-peak and fringes of peak periods. For the year, the I-80 SMART Corridor Project nearly halted increases in peak period congestion despite the increase in traffic demand and overall VMT on I-80. The project also reduced crashes in the westbound direction where traffic management activities are highest with the overhead gantries with lane use signs and additional changeable message signs. This contrasts the Bay Area trends where traffic collision incidents increased.

The project **nearly halted** peak period congestion on I-80

Traffic collisions were **reduced** on the SMART corridor

Traffic collisions in the westbound direction in 2017 were reduced when compared 2016. Westbound I-80 is where traffic and incident management activities were highest with the overhead gantries and electronic message signs. In comparison, in other parts of the Bay Area, there were increases in collisions, which averaged around 10 % in total over the last three years. The Project almost halted increases in peak period congestion despite the increase in traffic volumes and overall VMT.

Conclusion

With the help of active traffic management, lane use signs, and other ITS technology, Caltrans and local California transportation agencies were able to improve congestion and reduce collisions on the severely congested I-80 corridor in the Bay Area. ITS America encourages other agencies across the country, big or small, to implement similar measures to upgrade transportation digital infrastructure. With ITS technologies, we can reduce congestion on highways, prevent crashes, and look toward a safer future in highway transportation.

Participants involved in this use case include Caltrans District 4, Metropolitan Transportation Commission (MTC), Alameda County Transportation Commission (ACTC), Contra Costa Transportation Authority (CCTA), West Contra Costa Transportation Advisory Committee (WCCTAC), Alameda County Transit, and major cities along the corridor.

Sources:
[1] TripNet
[2] Caltrans

Decreasing Wrong Way Driving on Expressways

Tampa, Florida

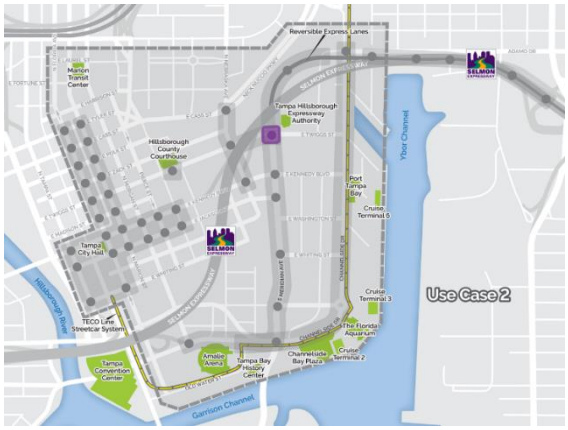
Wrong-way driving on expressways or other busy roads is a serious problem in both urban and rural areas, leading to crashes and fatalities. Drivers going the incorrect way on a road are often impaired through alcohol or other substances and are driving alone. With a robust digital infrastructure in place to alert drivers that they are entering the wrong way on a road, we can reduce crashes and make our roads safer.

The Challenge

According to the latest data analysis from the AAA Foundation for Traffic Safety, there were **2,008 deaths from wrong-way driving crashes on divided highways between 2015 and 2018, an average of approximately 500 deaths a year.** With 87% of wrong-way drivers operating the vehicle without a passenger, there is a need for a technological solution to alert drivers, especially those who may be impaired. The Tampa Central Business District has encountered a wrong way driving problem, putting drivers at severe risk of crashes. At the exit to the Reversible Express Lanes (REL) on East Twiggs Street, there is a relatively easy opportunity for a driver to become confused and attempt to enter the REL going the wrong way. There are no gates or barriers at the REL exit to prevent drivers from entering the REL going the wrong way. Drivers traveling on East Twiggs Street approaching the intersection where the REL ends and Meridian Street begins can mistakenly enter the REL going the wrong way. Drivers approaching this intersection coming from downtown can inadvertently make a left turn onto the REL exit. Additionally, drivers on East Twiggs Street approaching this intersection going towards downtown can inadvertently make a right turn onto the REL exit. Finally, drivers approaching the intersection on Meridian can potentially veer slightly to the left onto the REL exit.

Technology Solution

The Tampa Hillsborough Expressway Authority (THEA) is trying to eliminate wrong-way driving by working with other public and private partners to help keep drivers safe. To detect potential wrong way drivers, messages are broadcast at the REL/Twiggs/Meridian Intersection. Within the signal message, the revocable lane bit is set for the wrong way lanes. If a vehicle starts to move into the REL going the wrong way, the OBU Wrong Way Entry application (could this be said an on-board unit with a Wrong Way Entry detection application) determines the vehicle is entering a revoked lane and issues a warning to the driver that they are about to enter the Wrong Way. If the driver continues up the REL, the OBU Wrong Way Entry application alerts the driver they are going the wrong way. The purple square on the image shows where the Wrong Way project was implemented.



Outcomes & Benefits

THEA's implementation of digital alerting has led to the detection and stopping of numerous wrong-way driving incidents, with lives potentially saved. Analysis showed in the PM peak period (3 p.m. to 12 a.m. weekdays), the application correctly warned drivers of entering the wrong way and identified 14 participants of 19 potentially true conflicts. The AM period (6 a.m. to 10 a.m. weekdays) did not experience a single wrong-way occurrence during the entire deployment. Adoption of this technology can make our roads safer during the day and night, with this urban deployment showcasing the ability to mitigate wrong-way incidents in crowded areas with numerous interchanges.

During a 9-hour period, the system detected **14** wrong-way drivers

Conclusion

The deployment of digital technology tools to limit crashes and stop wrong-way driving in its tracks has undoubtedly saved lives in the Tampa area. This technology, if deployed across the country, has the possibility of preventing more unnecessary injuries and deaths on our roads. The partnership between THEA and other private and public entities is a model for other organizations that wish to implement digital infrastructure tools and deploy ITS technologies. ITS America supports the deployment of such technology and the continued work of public agencies across the country as we look to reach our Vision Zero goal.

TAMPA HILLSBOROUGH EXPRESSWAY AUTHORITY

Participants involved in this use case include Tampa Hillsborough Expressway Authority, City of Tampa, Florida Department of Transportation (FDOT) District 7 (D7), HNTB, Yunex, Savari, Sirius XM, DENSO, Honda, Hyundai, Toyota

Sources:
[1] AAA
[2] THEA

ITS AMERICA

Smart Work Zone Systems

Clark County, Washington

Roadway work zones are necessary to maintain the transportation network for mobility, safety, and productivity. State and local agencies are able to make these zones more efficient through ITS tools. Technologies can detect and help mitigate queues, manage speeds, reduce worker exposure, gather performance data, identify and facilitate responding to incidents quickly, inform road users of traffic conditions, improve the visibility of traffic controls in work zones, improve road user and worker safety, and inform future work zone strategies.

The Challenge

Work zones play a vital role in improving our nation's roads and keeping infrastructure safe for users of all types. However, daily changes in traffic patterns, narrowed lanes, and other construction activities often create a combination of factors resulting in crashes, injuries, and fatalities. These crashes also cause excessive delays, especially in constrained driving environments. Between 2020 and 2021, work zone fatalities increased by 10.8% while overall roadway fatalities increased by 10.3%. [1] The American Society of Civil Engineers estimate that congestion caused by construction zones leads to $25 billion in costs in the U.S. alone, with the average American spending 54 hours in traffic congestion each year. [2] During construction on I-5 in Clark County, Washington, the project required southbound traffic to be reduced to two lanes during the daytime and one lane during nighttime operations for three weeks. As projects get longer and available lanes decrease, there is a chance of higher congestion, longer commute times, and crashes.

$25 BILLION

Annual cost of construction-caused congestion in the U.S.

10.8%

Increase in work zone fatalities between 2020 and 2021

Technology Solution

To address anticipated work zone-related queuing and associated delay and safety risks, adopting a smart work zone system can be used to mitigate the effects of temporary traffic closures. This long-term, stationary lane closure on I-5 southbound included the following ITS solutions: Travel Delay Information provided motorists with the most accurate real-time delay available; Traffic Queue Warning to alert motorists upcoming traffic backups – especially in the case of sight distance restrictions; Zipper Merge (Late Merge) was encouraged through messaging in advance of the merge and at the merge point.

Outcomes & Benefits

A smart work zone can bring many benefits to a busy highway or road, and this example from Clark County in Washington is no different. After implementing smart work zone tools, the I-5 project saw reduced queueing due to work zone activity, travel time savings, better congestion management, and safety improvements.

The I-5 smart work zone led to zero injuries from both workers and road users, improved travel times bolstered by a rolling queue, and an early finish to the project. This saved the Washington DOT $5.5 million in costs, easing burdens on the agency and taxpayers.

$5.5M SAVED

Construction finished 6 days ahead of schedule

ZERO INJURIES

No one (workers and road users) were hurt during the project

Conclusion

Washington's deployment of smart work zone technologies led to improved transportation outcomes along the I-5 route, with construction completed days in advance of its original target and travel times bettered through technology at the site. With advanced warning, drivers could choose alternate routes to avoid delays in work zones or be better prepared to brake for an upcoming slowdown. ITS America supports the use of digital infrastructure tools such as smart work zones to lower congestion and choke points at construction sites, maintain safety, and keep roads operating efficiently.

Participants involved in this use case include Washington State Department of Transportation

Washington State Department of Transportation

Sources:
[1] Federal Highway Administration
[2] UtilitiesOne
[3] WSDOT

Improving Safety on Tribal Roads

Toppenish, WA

Deploying life-saving ITS technology requires strong coordination between the public and private sector, along with ample funding for projects such as intersection cameras, new safety databases, and signal integration. However, many rural communities lack the resources necessary to implement these technologies. Therefore, there's an urgent need for a cost-effective roadside sensing and alerting system tailored to tribal and rural communities that can automate data collection, monitor traffic and road conditions, detect hazards, and issue timely warnings.

The Challenge

Tribal and rural communities face a disproportionately higher burden of safety challenges. According to NHTSA, the fatality rate per 100 million vehicle miles traveled was two times higher in rural areas than in urban areas (2018). The disparity becomes even more stark when considering Native American populations. In rural regions, the absence of essential infrastructure such as broadband internet and fiber optics impedes the deployment of advanced surveillance systems and conventional data collection methods. Moreover, they lack the technical personnel and technologies required for effective data management, visualization, and analysis.

The Yakama Nation reservation has about 1,200 miles of public roads, predominantly situated within rural agricultural settings. Unfortunately, Yakima County bears the highest rates of both motor vehicle and pedestrian fatalities for Native American and Alaskan Native (NA/AN) populations in Washington. Data scarcity hinders effective planning and decision-making processes. Moreover, when applying for grants or funding opportunities, the absence of comprehensive data undermines the credibility of their proposals and reduces the chances of securing financial support.

Did you know?

A Native American/Alaska Native active transportation user is almost FIVE times more likely to be a traffic death victim compared to all other races.

Native Americans in Washington bear a disproportionate burden of traffic crashes, with a fatality rate 4.1 times higher than non-Native Americans. [1]

Technology Solution

Yakama Nation DNR Engineering initiated collaborative efforts with organizations including University of Washington, Washington State Department of Transportation (WSDOT), and AIWaysion.

Leveraging the power of advanced sensing and computing technologies, they developed and implemented an innovative solution to monitor traffic and roadway conditions, driving environments, and enhance real-time warning systems. Yakama Nation installed AIWaysion's Mobile Unit for Sensing Traffic (MUST) devices, which is a cost-effective Edge AI sensing device, at the intersection where the highway meets local roads, as part of a pilot project to improve traffic safety on U.S. Highway 97. The MUST device is equipped with multi-sensing (i.e., camera, environment sensors, etc.), computing, and communication capabilities, making it ideal for monitoring traffic, detecting dangerous events, and providing real-time warning messages to road users. MUST devices can operate without relying on extensive infrastructure support, such as a broadband connection. This aspect is particularly advantageous in tribal and rural environments where access to reliable and high-speed internet connectivity may be limited or unavailable.

Outcomes & Benefits

The MUST device can perform advanced processing and analysis of data directly at the roadside. This eliminates the need for continuous and costly data transmission to a centralized server or cloud infrastructure, reducing the dependence on a broadband connection and minimizing latency issues. The device can efficiently process and analyze the collected data in real-time, enabling immediate detection of hazardous events and timely dissemination of warning messages to road users. Since the data processing and analysis occur locally on the device itself, there is no need for transmitting sensitive or personal data to external servers or cloud platforms. This ensures the privacy and security of the communities, as their data remains localized and within their control. The project successfully collected traffic safety data for local roads in the Yakama Nation, providing valuable insights into road conditions and potential hazards.

24/7 Real-Time Traffic and Roadway Information

- This reduced the need for unnecessary on-site visits, allowing for efficient remote monitoring and immediate responses to potential hazards.

Local Traffic Safety Data Owned by the Tribe

- Yakama Nation now possesses ownership of local traffic safety data that serves their specific needs, such as pedestrian safety, collision/near-miss events, semi-truck and agricultural vehicles activities, heavy fog/low visibility, adverse roadway surface conditions, etc. This data serves as a valuable asset for the tribe, supporting data-driven traffic planning initiatives.

The development of a Safety Data Portal enabled efficient management, analysis, and visualization of the safety data collected by the MUST devices, supporting evidence-based decision-making. The deployment also demonstrated the feasibility of cost-effective, low-power devices for real-time monitoring, contributing to a reduction in the need for costly infrastructure and high-speed internet connectivity.

Conclusion

It is critical that rural, isolated, tribal, or indigenous communities across the country leverage ITS technologies to implement safety measures on roads and mitigate costs. Effective collaboration and strong engagement with community stakeholders, including tribes, state and local DOTs, and the federal government are critical to the success and sustainability of ITS projects. ITS America supports digital infrastructure projects that make our roads safer like this one in the Yakama Nation and improves the lives of rural communities across the country.

Participants involved in this use case include AIWaysion, Yakama Nation Department of Natural Resources, University of Washington, Washington State Department of Transportation

Sources:
[1] Washington State Traffic Commission
[2} AIWaysion, Yakama Nation DNR

Streamlining Freight Weigh Station Operations

Florida

With an estimated $389 billion impact to the U.S. economy, trucking is a critical part of our nation's infrastructure and movement of goods. [1] Federal and state agencies ensure that freight operations and roads are safe and efficient, delivering for both local and the national economies. Improving freight operations through digital infrastructure will enhance cost savings for the industry, increase supply chain reliability, and improve the conditions of our roads.

The Challenge

The movement of goods by commercial motor vehicles (CMV) in Florida continues to grow and, according to the 2020 Freight Mobility and Trade Plan, is projected to increase over 33%, from 651,334 KTons in 2017 to 870,136 KTons in 2045. This creates a need to improve transportation networks (physical and digital) to continue to safely and efficiently move commodities. Currently, there is limited data exchange or management of connectivity between freight modes, namely seaports, airports, spaceports, rail terminals, distribution centers, and roadway infrastructure. With freight transportation contributing billions of dollars to the U.S. economy every year, comprehensive digital infrastructure is required to manage the travel of goods and ensure resources are used efficiently.

33% increase in goods movement by CMVs by 2045, putting more strain on roads

Weigh stations, which serve to protect the integrity, resiliency and safety of the transportation network, are a critical component of highway freight. Such stops, while important for safety, can increase trip times and lead to truck congestion on off ramps to the stations. In the past in Florida, CMVs were required to be screened for size and weight compliance at each encountered weigh station. This requires CMV to exit the roadway and enter the facility for verification of size and weight compliance. Further, when multiple weigh stations were encountered along a route, the CMV was required to be processed by each independent facility. Using robust data exchange networks and weight-in-motion (WIM) technology, trucks could bypass most stations, leading to less congestion, improved route performance, and greater roadway efficiency.

Technology Solution

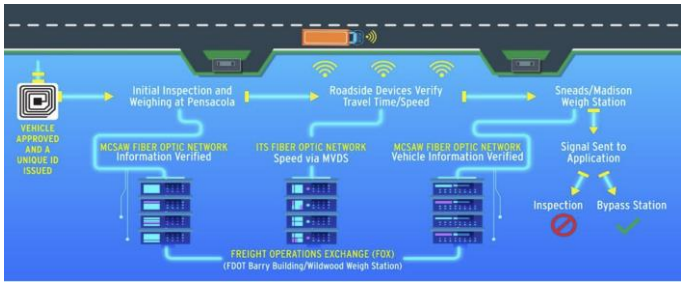
The Florida Department of Transportation (FDOT) has systematically developed and deployed technology solutions to provide the safe and efficient movement of freight. The solution deployed, the Freight Operations Exchange (FOX), serves as a central data management platform for driving advanced analytics in support of increasing the safety and mobility of commercial motor vehicles and multimodal connectivity. With this technique, FDOT can better monitor highway performance, truck communication, and freight weights.

FOX also included mainline WIM that includes license plate recognition, USDOT number readers, and over height detection for trucks. The FOX system reads, stores, analyzes and presents data for agency use in screening vehicles for inspection, reducing the workload of staff, even as CMV freight travel increases. By leveraging data as gathered through daily operations, algorithms are being developed that will allow trucks previously screened and found in compliance to bypass subsequent weigh stations.

Outcomes & Benefits

The initial goal of the solution was to increase the bypass of CMV found compliant with size and weight regulations from 31% as measured in 2019 and which only verified safety information provided by third party vendors, to 50% based on the aforementioned criteria. The initial results indicate that the mainline WIM is resulting in greater than 60% bypass of compliant vehicles. As the mainline WIM deployment continues and the FOX system expands, the ability to preprocess previously verified CMVs will be implemented. This will leverage other installations for information such as travel time between facilities. The effort has expanded to include a partnership between FDOT, Florida Highway Safety and Motor Vehicles and Georgia State Patrol to exchange information to increase the safety and mobility at a regional level.

60% of compliant trucks can bypass weigh station under the new digital system, a **93% increase** from 2019



The safety gains associated with this use case have not been measured. However, as fewer trucks are required to exit and re-enter the roadway network at the weigh stations, it is expected that there will be reduced chance of crashes. Additionally, environmental benefits, such as reduced noise and emissions, are expected as fewer trucks are required to start and stop at the weigh stations.

Conclusion

Building off the initial success of the integrated technology solutions, FOX is continuing development in support multi-modal goods mobility applications. Digital infrastructure such as FOX helps streamline weigh-in-motion systems, allowing more efficient transportation of freight on U.S. highways and less congestion at weigh stations. ITS America encourages more innovation and adoption in the digital infrastructure space so that our transportation system is safer, greener, smarter, and more equitable. Florida's new digital freight management platform and improvements to weigh-in-motion stations has made roads safer, improved freight efficiency, and strengthened the state's highway system.

Participants involved in this use case include the Florida Department of Transportation, HNTB, and Mettler Toledo

Sources:
[1] Bureau of Transportation Statistics, USDOT
[2] Florida Department of Transportation
[3] National Operations Center of Excellence

Creating A Centralized Transportation Data Hub

Utah

Proper data management and modern technologies are vital to the success of state and local transportation departments, creating a cohesive environment for collaboration and streamlining operations. By leveraging innovative digital tools, agencies can use advanced analytics to spot trends, solve problems, and improve safety and travel outcomes on all forms of transportation in a jurisdiction. A strong digital infrastructure keeps transportation networks operating smoothly and its users safe.

The Challenge

The Utah Department of Transportation (UDOT) is tasked with a broad collection of responsibilities relating to transportation within the State of Utah. From road construction and maintenance to traffic management, aircraft registration, and ski lift inspections, UDOT's activities are focused on the central mission of "Keeping Utah Moving." All of these activities create enormous amounts of data, but this data was stored in siloed structures. These siloes do not give the department the ability to perform high-level trend analysis or leverage technologies built around advanced analytics and machine learning.

Technology Solution

UDOT developed a strategy to centralize all their data into a new Advanced Data Analytics Platform (ADAP). Partnering with Atos (formerly CloudReach), UDOT created a Cloud Plan with Google Public Sector to implement ADAP. By harnessing and curating UDOT's distributed data, the team began to build a "Chain of Trust" from source systems to endpoint applications. Knowing what the data is, where it came from, when it was gathered, who is responsible for it, and how to gain access to the data is critical to providing the correct data in a timely manner for any use case. UDOT's Data Lake will provide a platform to store raw data, apply logical transformations to standardize formats and types, apply business rules to enhance quality and comprehension, capture metadata, and provide access. In addition to the management and quality enhancement of the data, access and exploration of the datasets will also be a core function of the platform.

As part of the overall strategy to centralize their data, UDOT is developing an analytics program that will support the agency's core functions. UDOT requires a platform that will support the volumes of historical information and the continuous flow of information they receive from roadways, partners, and business systems in order to accomplish this program. The analytics will be able to help UDOT resolve a number of issues, ranging from "Where can I store this information" to "What factors most impact congestion at Point of the Mountain on I-15?"

Outcomes & Benefits

In order to improve the utilization of resources, UDOT worked with Google Cloud to deconstruct data silos, improve the discoverability of assets, onboard large volumes of data, support complex and data-intensive analytics and modeling, and introduce artificial intelligence (AI) capabilities to all agency functions. The new ADAP provides an unprecedented environment for storing, cataloging, managing, and sharing data from across the entire agency with internal business groups, applications, other agencies, and the public. The cloud-based platform is scalable and provides the speed, storage, and processing capabilities needed for analytics use cases for today and the future. With the help of Google Cloud, UDOT will be able to create a centralized dataset to alleviate data gathering and curation efforts for public requests. This includes the following technical aspects:

Data science and modeling using the centralized platform includes: access to large quantities of data (statistically significant volume and history of data) and data sources (researching and testing factors that may influence the models); tools for analysis (Looker Studio, Looker Pro, R, Python, distributed file storage, distributed computing, visualization tools, etc.); computing power to test, modify, and iterate on the models (real-time data processing, distributed computing environment).

Using Jackalope, a software platform, they see the following benefits: Provides average annual daily traffic (AADT) information for 6,500+ segments of roadway; Receives data from continuous count locations (CCS) and short-term sensor locations; Applies annualized factors to data to alleviate inconsistencies in sensor data

Technical dependencies include: 1.5 TB, including historic records; The previous database shares hardware hosted with another application, slowing the speed of response and impacting other applications during large data queries

Conclusion

By standardizing the data interface across the UDOT portfolio of applications, downstream applications will be able to analyze and understand data at an accelerated pace. New insights, not currently realizable due to the siloed datasets, can be realized, and access to the data can be readily provided to external parties. More complete, easily accessible data can lead to more efficiency and safety on the road. ITS America supports the use of AI and innovative software solutions that will modernize an agency's digital infrastructure and strengthen their ability to respond to incidents and create a safe transportation environment.

Participants involved in this use case include Google, Utah Department of Transportation

Sources:
[1] Google

Building a Modern Traffic Management System

Colorado

Robust digital infrastructure is key to improving road safety, traffic management, and incident response in a state with a varied landscape like Colorado. Modernizing data storage and analytics platforms helps state DOTs and local agencies pinpoint issues on the road more efficiently and can keep the public informed about roadway conditions. Improved data management and collection can lead to reduced costs, efficient operations, and safer roads.

The Challenge

The Colorado Department of Transportation (CDOT) faced a significant challenge with their existing digital infrastructure. With the responsibility of managing over 23,000 miles of highway, overseeing the safety of more than 35,000 miles of county roads and 35 mountain passes, and handling approximately 3,000 vehicle crashes each year, system limitations impact everything from operational capabilities to traffic management, safety, and response times to incidents. The existing traffic management system, which is crucial for collecting and disseminating real-time traffic information, was built on legacy technology that limited data sharing and integration, creating data silos. Similarly, the existing database solution, essential for analyzing transportation data and supporting decision-making, was not able to process large volumes of data efficiently.

23,000 miles of highway

35,000 miles of country roads

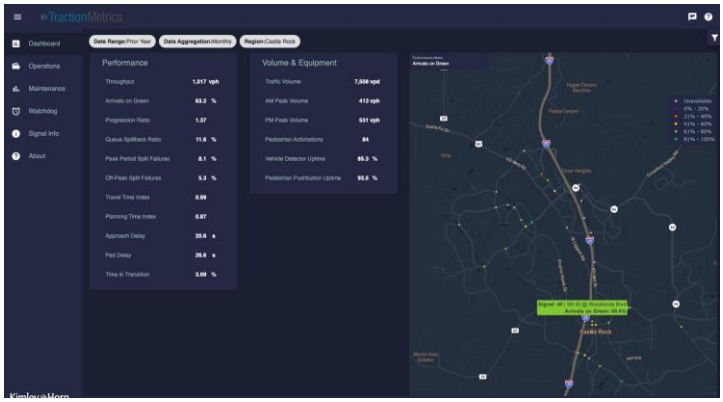
Technology Solution

To address these challenges, CDOT worked with Google Cloud to develop an up-to-date Real-Time Data Hub (RTDH) and Advanced Data Analytics Platform (ADAP) capable of handling the increasing demands of modern transportation management. These platforms created an intelligent transportation system designed to improve safety and mobility, utilizing cloud storage, BigQuery, and analytics capabilities from Google Cloud. By collecting data along their roadways to produce valuable digital information for intelligence and analytics.

CDOT was able to connect legacy datasets with new datasets, consolidate disparate data sources, and introduce multiple third-party data sources. The modernized RTDH now allows for seamless data integration from multiple sources, including traffic sensors, cameras, and weather stations. This integration is crucial for providing a comprehensive view of the transportation landscape in real time. The ADAP leverages advanced data processing capabilities and machine learning algorithms to analyze traffic patterns, identify trends, and support data-driven decision-making.

Outcomes & Benefits

CDOT integrated multiple platforms, including the Work Zone Sata Exchange (WZDx), Connected Vehicle Data Exchange, and Advanced Traffic Management System (ATMS) into a single common platform, allowing data to flow and insights to be generated across the department. **They were able to utilize information, analyze it, and make decisions from 23,000 lane miles of roadway, and 488 cameras converted to real-time monitoring and end-points.** With the ability to make data-driven decisions, CDOT was able to optimize roadways, improve traffic flows and increase safety. With the upgraded ADAP, CDOT can process and analyze large datasets more efficiently, leading to better-informed decisions and strategies. One of the most significant results is the ability to utilize analytics. By analyzing historical and real-time data, CDOT can now forecast traffic conditions with greater accuracy. This capability allows preemptive measures to be taken, reducing the likelihood of collisions and congestion and improving overall road safety



Conclusion

The Colorado Department of Transportation (CDOT) modernized its digital infrastructure using Google Cloud to improve operational efficiency, reduce costs, and improve safety. Implementing the modernized RTDH and ADAP has been a transformative experience for CDOT, positively impacting the safety and well-being of Colorado's traveling public. CDOT's enterprise data approach gives traffic operators a single integrated real-time view instead of 10 windows of various data. It has enabled data access, transparency, and usability, all while building for future data scalability. ITS America encourages further public agency and private sector partner collaboration in the realm of digital infrastructure, so that we can build a smarter, safer transportation system for all.

COLORADO
Department of Transportation

Google Cloud

Participants involved in this use case include Google, Colorado Department of Transportation

Sources:
[1] Google

ITS AMERICA

Improving Road Illumination with TxDOT

Fort Worth, TX

Roadway lighting is critical to the safety of motorist and pedestrians alike, keeping people and vehicles in sight. Maintaining and repairing a strong illumination system on highways is cost and labor intensive, requiring innovative solutions to improve the speed of repairs and keep costs to a minimum. Digital infrastructure tools can help state and local DOTs manage their illumination system and keep the lights on.

The Challenge

Roadway illumination is a critical facet of safety for drivers, pedestrians, and other vulnerable road users. Too much or too powerful lighting can be a distraction for motorists, potentially leading to crashes and congestion. Meanwhile, dim lighting or no illumination at all hampers visibility for drivers of pedestrians, other vehicles, road hazards, and sharp turns. While only one quarter of driving happens at night, close to 50% of traffic fatalities happen at night. [1]

Did you know?
We do only 25% of our driving at night, but 50% of traffic deaths happen at night.

Improving lighting where visibility is poor could lead to a 35% reduction in crashes.[2] Highway lighting installation is expensive and energy intensive, however, so it is important that installation and usage is done efficiently. In Fort Worth, Texas, the Texas Department of Transportation (TxDOT) noticed that in one year, over $2 million dollars' worth of copper wiring from lighting systems was stolen, resulting in a 40% loss of illumination from TxDOT managed systems. Replacing stolen materials and replacing outages requires an increase in night-time hours for workers, is often untimely, and happens at a substantial cost to the state.

Technology Solution

Electricians at TxDOT designed a prototype device to remotely read the voltage on a particular circuit, with a low voltage reading indicating an issue a particular light's illumination levels. Working with a private sector vendor, TxDOT developed an application to remotely sense outages in illumination, with the ability to see how many LEDs went out and where it took place. Alerts are then sent to local personnel for repairs. Using this innovative technology, testing can be done remotely, reducing the amount of time and physical resources needed onsite from TxDOT, lowering costs for the agency.

Outcomes & Benefits

The Fort Worth area saw an improved lighting on roadways, with less outages after the remote technology solution was put in place. The district has seen lower costs, and ultimately a decreased burden on taxpayers to repair outages and replace stolen wiring. **This includes an 89% increase in active lighting up-time and a 40% reduction in repair costs.**

Conclusion

By deploying an innovative technology, TxDOT was able to improve roadway lighting while reducing costs – a win for drivers and the agency. By detecting outages faster and accurately, they can spend less time traveling and repairing and could use money for other projects. ITS America supports a strong digital network to maintain our physical infrastructure and increase our road safety.

Sources:
[1] National Safety Council
[2] ITASS Research