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ITS Technology Use Case Library

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

Connected Vehicles (CVs)

05 Connected Vehicle Applications for School Buses

07 Cooperative Adaptive Cruise Control for Freight

09 CV Technology with Rapid Transit

11 Digital Alerting for EMS

13 Digital Alerting for Roadside Workers

15 CV Technology Improvements in Rural Areas

Digital Infrastructure (DI)

18 AI Platforms for Crash Response

20 Urban Traffic Management & Optimization

22 Bridge Lane Management

24 Flex Routes & Dynamic Lanes

26 Congested Highway Traffic Management

28 Wrong Way Driving on Expressways

30 Smart Work Zone Systems

32 Safety on Rural, Tribal Roads

34 Freight Weigh Station Optimization

36 Centralized Transportation Data Hub

38 Modern Traffic Management Systems

40 Roadway Illumination

Automated Vehicles (AVs)

42 Rural AV Shuttle Deployment

44 AVs for Last Mile Mobility

46 AV Shuttles for Medical Testing

48 Accessing Recreation with AV Shuttles

50 Preparing for the Future with AVs

Connected Vehicles

ITS AMERICA

Connected Vehicle Applications for School Buses

Alpharetta, Georgia

Improved safety and efficiency for school buses are two critical components of ensuring the well-being of students, both in terms of providing a safer journey for students and in ensuring access to education. By deploying connected vehicle technology in our school bus fleet, we can create a secure and efficient environment that promotes the overall well-being and academic success of school children across the country.

The Challenge

Each day in the United States, 26 million children are transported to and from schools on 480,000 school buses. While school buses are generally a safe mode of transportation for children once they are on the bus, the most dangerous time for students is boarding or deboarding the bus. [1]

One of the most significant dangers to onboarding or offloading students is drivers who illegally pass stopped buses and may be unable to stop in time to avoid hitting a student crossing the street from their bus to their home. Through the 2018-2019 school year, one study found that these illegal passings took place roughly 17 million times in the United States, and that **six students were killed by illegally passing drivers over a six-day period in October 2018 alone.** [2] Each of these deaths represents a tragedy that could be mitigated or prevented by transportation technology solutions, such as connected vehicle technologies.

26 million children transported by bus to and from school each day

About 17 million illegal bus passings in the U.S. in the 2018-2019 school year

Technology Solution

Connected vehicle technologies, such as cellular vehicle-to-everything (C-V2X) devices, provide critical alerts to both oncoming vehicles and bus drivers that communicate important safety information in real time. With C-V2X direct communications technology, the driver of an oncoming vehicle receives a direct message alert in the dashboard of their vehicle, providing an early notification that they are approaching a stopped school bus with its stop arm extended. The driver receives the alerts even when the school bus is not visible to the driver. Additionally, the school bus driver receives an alert of the approaching vehicle during a school bus stop as well as a warning if a vehicle is potentially approaching too quickly to be able to stop in time. This provides the school bus driver with critical information to make an informed decision on safety. The bus driver can then delay opening the door if the vehicle cannot stop or alert children outside the bus to remain on the curb and avoid the oncoming vehicle. In each of these scenarios, connected vehicle technologies provide a digital layer of safety to keep students safe getting to and from school.

Outcomes & Benefits

While safety improvements are a critical outcome of connected vehicle technologies, they also improve trip efficiency and lower emissions. In 2022, a consortium of public and private stakeholders led by Applied Information Inc. launched a School Bus Priority Connected Vehicle Student Safety Pilot Program in partnership with the city of Alpharetta, GA, and the Fulton County School System which was designed to test whether connected vehicle technologies would improve safety and mobility in school buses. The deployment leveraged C-V2X solutions provided by Qualcomm and Commsignia to test roadside units from Applied Information, which were mounted in flashing speed limit signs near school zones. The initial testing included an electric SUV and algorithms from Audi to test bus to personal vehicle connectivity. Connected vehicle technology was deployed on buses and at traffic signals along the school bus routes to provide green light pre-emption to the school bus as it approached each traffic signal.

The pilot program led to the following efficiency and sustainability benefits [3] :

13%
Decrease in travel times

18%
Increase in average speeds

40%
Decrease in # of signalized stops

10%
Decrease in fuel consumption

Beyond these environmental and operational improvements, bus drivers noted that students were better behaved on the bus due to fewer stops since students are not permitted to get up when the bus is in motion. Drivers also expressed a lower level of stress, and the district was able to manage more routes with limited resources.

Conclusion

By deploying connected vehicle technology in our school bus fleets, we can achieve multiple benefits that extend beyond the transportation system with one technology solution: improve student safety, enhance efficiency of travel times, improve fuel economy and reduce emissions, and create an environment that promotes the overall well-being and academic success of school children across the country. A study commissioned to analyze the results of the pilot noted that consistent and earlier school arrival times may lead to more students participating in free breakfast programs, for example. ITS America encourages school districts across the country to deploy connected vehicle technologies in our school bus fleets as well as associated infrastructure so that we can realize these safety and societal benefits.

Participants involved in this use case include Audi, Navistar, Applied Information, Blue Bird, Qualcomm, City of Alpharetta, GA, Fulton County School System

Sources:
[1] New York School Bus Contractors Association.
[2] National Association of State Directors of Pupil Transportation Services
[3] Applied Information Inc.

Cooperative Adaptive Cruise Control for Freight

California

Streamlining freight operations and making traffic flow more efficient for trucks can have positive impacts on trucks' tailpipe emissions and operating costs. Through connected vehicle technologies like adaptive cruise control and freight platooning, fleet operators can reduce travel time on the road, limit fleets' impact on congestion, and save money on fuel costs. This creates a greener and safer transportation network for all road users regardless of vehicle type.

The Challenge

Medium- and heavy-duty trucks contribute 23% of transportation's greenhouse gas (GHG) emissions in the U.S., an amount that is expected to grow in the future. Trucking's CO2 emissions contribution from international trade is expected to grow to 56% by 2050, impacting efforts to combat climate change. Efficiency goes hand in hand with sustainability, and traffic congestion on U.S. highways added $94.6 billion in costs to the trucking industry in 2021.[1] Innovative solutions like platooning can ease and ultimately result in lower fuel costs and more on-time routes.

Beyond sustainability and efficiency, safety remains a key priority for the freight industry. Highway freight crashes contributed to 4,965 fatalities in 2020, a 21% increase from five years prior. [2] It is imperative that the highway freight industry take much needed steps to reduce this number. Effects of truck Cooperative Adaptive Cruise Control (CACC) on traffic operations were studied for an interstate highway in Southern California (I-710 northbound). This corridor connects the Port of Long Beach to the Interstate highway system and includes a large truck volume. The truck traffic %age varies between 10% to 19%.

23% of U.S. transportation emissions come from trucks

Traffic congestion cost trucking industry **$94.6 billion** in 2021

There were **4,965 fatalities** from highway freight crashes in the U.S. in 2020

Technology Solution

CACC provides an intermediate step toward a longer-term vision of trucks operating in closely-coupled automated platoons on both long-haul and short-haul freight corridors. With CACC, only truck speed control will be automated, using vehicle-to-vehicle (V2V) communication to supplement forward sensors. The drivers will still be responsible for actively steering the vehicle, lane keeping, and monitoring roadway and traffic conditions. While truck platooning systems have relied on a Constant Distance Gap (CDG) control strategy, CACC has relied on a Constant-Time Gap (CTG) control strategy, where the distance between vehicles is proportional to the speed. The test route started from the UC Berkeley Richmond Field Station (RFS) in Richmond, via I-580 (to Emeryville), SR 24 (to Walnut Creek), I-680 (to Pleasanton), I-580 (to Livermore), and ended around Westley on I-5, about an 84-mile distance. After arriving at Westley, the drivers took a short break at a parking area near a truck stop and then returned to RFS via the same route, for a total traveling time of more than 3 hours.

Outcomes & Benefits

Trucks can reduce fuel consumption by **5% to 6%**

Avg. VMT in certain time span can increase by close to **6%**

Trucks could see over a **19%** increase in avg. speed

Adaptive cruise control leads to safer roads, both for truck drivers and other motorists. Predictive driving from trucks makes the road safer for other drivers and smaller gaps between trucks do not allow for smaller vehicles to weave in and out of the platoon. When the heavy trucks are driven using CACC at the tested time gaps between 0.6 seconds and 1.5 seconds, a three-truck platoon pulling conventional well loaded dry goods van trailers can save a total of between about 5% to 6% of its fuel consumption. Truck CACC increased Vehicle Miles Traveled (VMT) in certain time frames as well as average speed for both trucks and passenger cars. For trucks, average VMT increased by 5.8% and average speed increased from 33.3 mph to 39.7 mph, a 19.3% increase. The use of truck CACC can produce noticeable congestion reductions when used on a moderately congested urban freeway corridor with a substantial %age of heavy truck traffic. The relief of traffic bottlenecks saves significant time and fuel for the trucks, with modest congestion relief effects for the cars that share the freeway with the trucks

Conclusion

Cooperative adaptive cruise control for heavy-duty trucks has the potential to make freight travel more efficient, reduce congestion on highways, and expand the possibilities of freight shipping. As seen in this California case study, fuel and time savings can be realized by implementing CAAC within a fleet. While not fully reaching the concept of freight platooning, this connected technology and travel arrangement in California is well on its way to making freight travel smarter, more sustainable, and safer for other road users. ITS America fully supports the expanded use of CACC across the country so that we can builder a smarter, greener future in freight.

Participants involved in this use case include Caltrans, PATH Program at UC Berkeley, Volvo, FHWA.

Sources:
[1] Freight Waves
[2] NHTSA
[3] ITS JPO

Traffic Signal Integration for Rapid Transit

St. Petersburg, Florida

Building a successful rapid transit bus system not only requires community support and sufficient physical infrastructure, but also digital infrastructure tools to keep roadways operating smoothly and safely. With tools such as traffic signal priority and connected vehicle communications, bus systems are able to move passengers efficiently, safely, and between more destinations that once seemed out of reach for public transit. By deploying rapid transit with accompanying technology, cities and counties can reach new heights of mobility.

The Challenge

Anticipating and preparing for significant residential and commercial growth in the downtown St. Petersburg and South Pasadena areas, including supporting portions of the St. Petersburg Plan2050 long-term planning, the Pinellas Suncoast Transit Authority (PTSA) and the City of St. Petersburg identified the need for a new Bus Rapid Transit (BRT) service to enhance mobility between St. Pete Beach and downtown St. Petersburg along 1st Avenues North and South. The objective was to provide public transit service to support projected growth areas within 1⁄4-mile of stops along the routes with the potential to expand transit-supportive zoning practices up to and beyond a 1⁄2-mile where transit connectivity can be fostered and continuous. The corridor had no direct transit service linking communities and attractions in central St. Petersburg to South Pasadena or St. Pete Beach in the west. One of the other key objectives for the BRT is providing transit service for events at Tropicana Field, home of the Tampa Bay Rays Major League Baseball Team.

A new rapid transit route such as this required significant upgrades to road and intersection digital infrastructure, including traffic signal integration. The new ITS solution also had to seamlessly integrate with the existing dispatch system while controlling the traffic signals and providing traffic signal priority (TSP) to the SunRunner BRT buses. In addition, the new solution needed to provide center-to-center capabilities for BRT management coordination with two Traffic Operation Centers (Pinellas County and City of St. Petersburg).

Technology Solution

To accommodate and provide the new levels of traffic signal management required, the existing Advanced Transportation Management System (ATMS) software application was upgraded to a cloud-based ATMS that includes a Connected Vehicle (CV) route-based TSP capability to provide the BRT signal priority along the east and west corridors for the City of Saint Petersburg and Pinellas County. The upgraded ATMS includes Signal Performance Measures for 51 signalized intersections along the SunRunner BRT routes. With this technology implemented, buses SunRunner receives signal priority, working in tandem with the bus dispatch system and EMS dispatch to make intersections and bus service more efficient. In addition, the city made upgrades to the intersections, including 21 new traffic signal cabinets, and 50 CV-ready traffic signal controllers to support the new ITS communications and signal priority systems. This ITS technology upgrade has helped the new rapid transit system provide safe, efficient transportation in Pinellas County.

Outcomes & Benefits

Within the first year of operation, the SunRunner BRT has provided new levels of mobility for one million riders. It has also provided schedule reliability of bus stop arrivals at or below average travel times along the routes, particularly at high traffic volume times. The TSP call acceptance rate is better than 99.75%. This has enabled the SunRunner BRT bus service to maintain a service reliability frequency of 15 minutes on average.

As a result of the headway reliability performance, the SunRunner BRT also provides a 35% reduction in travel time compared to the Central Ave. bus trolley service along the parallel corridor in downtown St. Petersburg. In addition, the SunRunner BRT sees a 70% rider increase for the Tampa Bay Rays baseball game days over regular commuter day ridership with minimal change to service frequency or headway reliability, which is an indication that the BRT, combined with the ITS solutions, is providing a viable and sustainable mobility alternative for the entire community.

35%
Reduction in travel time compared to older trolley

15 MIN.
Average headway time for SunRunner service

1 MILLION
Number of riders in first year of operation

PSTA PINELLAS SUNCOAST TRANSIT AUTHORITY

ECONOLITE

st.petersburg www.stpete.org

Highway Safety Devices

Conclusion

The SunRunner BRT features many of the latest ITS software solutions and systems integration, including TSP and SPM technologies. TSP allows SunRunner buses to communicate with traffic signals along the route to maximize green lights as the buses approach each signalized intersection while SPM enables the PSTA and the City of St. Petersburg to continually optimize traffic signal programming for transit schedule reliability. Moreover, the updated ATMS with TSP and SPM, as well as the technology infrastructure upgrades help future proof the SunRunner BRT service.

These connected vehicle and digital infrastructure tools allow SunRunner BRT to operate at maximum efficiency and safety, providing reliable transportation to residents and visitors of Pinellas County. ITS America supports the continued adoption of such technologies across the country. Our nation, through digital infrastructure investments, is on the cusp of a great opportunity in how we define our 21st-century transportation system, one that can provide greener communities, increased opportunity and equity, and safer streets for all Americans.

Participants involved in this use case include Econolite, Pinellas Suncoast Transit Authority (PSTA) City of St. Petersburg, FL, Highway Safety Devices, Inc.

Sources:
[1] Econolite

Preventing EMS Collisions with Digital Alerting

Washington, D.C.

Every day, emergency first responders work tirelessly to keep people safe in communities across the country. It is important that our roadways are not adding more challenges to an already demanding occupation. With statistics showing that first responders are facing more road issues than ever before, we must continue innovating to keep them safe. Digital alerting technology in vehicles can help reduce crashes and improve responder safety so they can continue to serve our communities well.

The Challenge

For decades, fire crews and first responders everywhere have relied on lights and sirens to get the attention of motorists, but statistics show that responders on the road are facing more danger than ever. Emergency Service Vehicle Incidents (ESVIs), including collisions and struck-by incidents, are the second leading cause of US firefighter fatalities, accounting for well over 450 deaths since 1994. Responder-to-Responder (R2R) ESVIs, although less frequent, are another form of ESVIs that pose a significant risk to responders, especially given the speeds and sizes of the vehicles involved and the impact a single collision can have on a responding agency's staff and resources.

Did you know?

From 1996 to 2010, **over 22%** of first responder ESVI fatalities were caused by road-side struck-by incidents.

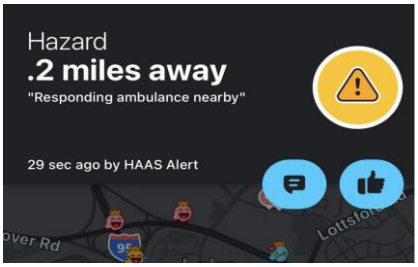
Washington, DC ranks as one of the most congested cities in the country, with a population of more than 685,000 living and working in a dense urban environment that is less than 70 square miles. A crew of 1,900 firefighters, EMTs, and paramedics serve at DC Fire and EMS Department which responds to all hazards in the city including traffic incidents and injuries, fire prevention and suppression, homeland security activities, and more. DC Fire and EMS serve the community through a fleet of over 400 vehicles and must navigate congested roads. Innovative digital infrastructure tools such as in-vehicle alerting can help DC's first responders reach destinations safely and quickly, guiding other vehicles to move over and mitigating the chance of a collision between responders.

Technology Solution

HAAS Alert's collision prevention service Safety Cloud enhances emergency alerting on the road by alerting nearby motorists inside their vehicle that an emergency vehicle is nearby. To equip the service, fleets connect a small transponder named the HA-5™ to the emergency lightbar and mount the device to the vehicle dashboard. When activated, Safety Cloud delivers real-time digital alerts over cellular networks to nearby approaching civilian motorists. These alerts, called R2V (Responder-to-Vehicle) alerts, are received through navigation apps and connected car systems already in use by hundreds of millions of drivers, including WAZE. Safety Cloud offered DC Fire and EMS Department a novel solution for reducing the risk of civilian collisions that their fire crews had to face on every run. But the service also provided another option that was particularly useful to firefighters in DC: in addition to alerting civilians, Safety Cloud could also alert other responders. R2R alerts are received inside the emergency vehicle cabin through a small LED unit mounted to the A-Frame of the vehicle. When Safety Cloud detects a likely or imminent intersection between two equipped apparatus, the LED begins flashing, providing the vehicle operator with early warning of the potential hazard so that they can reduce speed and prevent a collision.

Outcomes & Benefits

Over the course of a year on Safety Cloud, DC Fire and EMS Department initiated nearly 444,000 emergency vehicle deployments in response to more than 212,000 911 calls. According to internal data, 20% of the DC fleet was equipped with the technology, leading to more than 630,000 digital alerts sent out during that year. **A detailed analysis of R2R alerting also confirmed that alerting responders of nearby emergency vehicles helped to reduce the risk of those collisions as well.** Data revealed that DC Fire and EMS Department apparatus operators reduced their speed by an average of 25% within the first second of receiving the alert. Such speed reductions are vital to avoiding crashes and keeping vehicles and pedestrians safe on the road.



The success of DC Fire and EMS Department year-long pilot of Safety Cloud R2V and R2R alerting led department leadership to keep Safety Cloud equipped on its vehicles. Today, the department's emergency vehicle specifications now include a requirement that all new emergency vehicles be equipped with Safety Cloud R2R and R2V alerting.

20% of fleet equipped with Safety Cloud

630K alerts sent in one year on DC's fleet

25% speed reduction within first second of alert

HAAS ALERT

Conclusion

Emergency personnel from the Washington DC Fire and EMS Department are now benefitting from an extra digital layer of protection through HAAS Alert's Safety Cloud. Digital alerting systems on both fleets and personal vehicles creates safer and more efficient roads, protecting drivers, pedestrians, roadside workers, and emergency personnel. After this initial deployment, HAAS Alert now delivers even more alerts to many personal vehicles and through the Waze app. ITS America supports the adoption of digital alerting infrastructure and connected technologies for EMS fleets across the country as we look to reach our Vision Zero and reduce fatalities and crashes. EMS workers are vital to the health and safety of not only our American roads, but our American communities. Without mechanisms in place to keep them safe, our communities would suffer.

Participants involved in this use case include HAAS Alert, Washington D.C. Fire and EMS Department

Sources:
[1] HAAS Alert

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Protecting Roadside Workers with Cloud-Based Alerts

Connecticut

Whether they are EMS first-responders or work zone operators, workers on our highways and roads work every day to keep drivers and pedestrians safe. However, they are not immune to crashes and safety challenges of our roads, prompting the need for innovative solutions from state and local officials. Digital alerting technology on dashboards can help reduce crashes and improve responder fleet safety so they can continue to serve our communities.

The Challenge

Working on the road is a dangerous job, and safety is the number one priority for state DOTs. Limited visibility and impaired or distracted drivers are just some of the risks that can increase the likelihood of collisions and struck-by incidents on the highway. Hundreds of thousands of crashes occur each year involving road workers including work zone operators, emergency responders, and roadside assistance fleets. Since 2017, struck-by deaths in the United States have been on the rise; in 2021, 65 road workers were struck and killed on the road, setting a new annual record. These crashes can be deadly and costly for communities.

65 Road Workers Involved in fatal crashes in 2021 in the U.S.

The Connecticut Department of Transportation is responsible for over 3,700 miles of road in the state including state routes, state roads, and the National Highway System. The department operates a fleet of 15 service trucks that patrol the roadway every day, keeping roadways clear and drivers safe. Additionally, when dealing with the safety of an entire fleet, costs are often the first concern. New hardware, maintenance requirements, and compatibility factors can quickly increase the overall cost of adopting a new technology.

10.8% increase in work zone fatalities between 2020-2021 [1]

Technology Solution

Determined to address this challenge, the Connecticut took action to protect their workers. Department planners landed on digital alerting systems to keep workers safe. Digital alerting reduces the risk of collision by giving motorists and vehicles advanced warning of alerting hazards on the road, such as roadside assistance and emergency vehicles. The alerts are delivered over cellular networks to popular navigation applications and vehicle dashboards. The Connecticut DOT had already deployed a Samsara integration into their road fleet, which posed an opportunity for HAAS Alert Safety Cloud. Safety Cloud offers an activation for Samsara users to activate Safety Cloud on their vehicles without any additional hardware.

Outcomes & Benefits

Connecticut DOT has been fully deployed on HAAS Alert Safety Cloud through Samsara since November 2021. The department is continuing to send out advance alerts to drivers and they are starting to see more cars moving over on the roads. By simply activating Safety Cloud through Samsara, Connecticut DOT accessed all the features of Safety Cloud in a quick, easy and cost-effective way. Digital alerts have been shown to lower the risk of a collision by up to 90% and reduce hard-braking near roadside incidents by 80%. Even without integration with Samsara and direct Safety Cloud through HAAS Alert, the Connecticut DOT could experience low-cost digital alerting for as a little as $1 per day. Safety has improved for the department with very little organizational input or effort. By simply activating Safety Cloud through Samsara, Connecticut DOT accessed all the features of Safety Cloud in a quick, easy and cost-effective way. Now their workers are benefiting from an added layer of protection.

Digital alerts lower the risk of collision by **90%**

Digital alerts reduce hard-braking by roadside incidents by **80%**

Conclusion

Roadside workers from the Connecticut DOT are now benefitting from an extra digital layer of protection through HAAS Alert's Safety Cloud. Digital alerting systems on both fleets and personal vehicles creates safer and more efficient roads, protecting drivers, pedestrians, roadside workers, and emergency personnel. After this initial deployment, HAAS Alert now delivers even more alerts to many personal vehicles and through the Waze app, ITS America encourages the adoption of digital alerting infrastructure on fleets across the country as we look to reach our Vision Zero and reduce fatalities and crashes. The partnership between the private and public sector in this example highlights the immense opportunity we have to create a digital ecosystem that improves safety while limiting financial burdens on the public sector.

Participants involved in this use case include HAAS Alert, Connecticut Department of Transportation

Sources:
[1] Federal Highway Administration

Improving Digital Alerts for Connected Vehicles

Wyoming

With weather adversely affecting road conditions, connected vehicle technologies and supporting digital infrastructure is needed to create a safer environment for drivers of all types of vehicles, large and small. By creating an efficient connected vehicle (CV) environment, state and local agencies can deliver potentially thousands of alerts to drivers every month, giving people critical information to make safe driving decisions.

The Challenge

I-80 is the major corridor for east-west freight transport through the U.S. and runs 402 miles along southern Wyoming. This section of I-80 is known for severe weather conditions, including ice, snowpack, and reduced visibility from blowing snow and gust wind, along with steep grades up to 7%. These conditions, coupled with the high percentage of truck traffic (around 47%), are the reason for many primary and secondary crashes with fatalities and serious injuries, as well as frequent road closures that cause safety and economic challenges for the state and drivers. Research showed that about 54% of truck crashes are due to ice conditions, while about 46% are associated with snow conditions. Most of the fatal crashes occurred in car-truck collisions. [1, 2] Additionally, about a third of drivers involved in crashes are licensed out of Wyoming, which shows unfamiliarity with the Wyoming winter driving conditions. [3] Alerts and advisory messages through applications such as situational awareness, weather impact warnings, and forward collision warnings could prevent a significant number of crashes caused by weather conditions. [4]

47% truck traffic on I-80

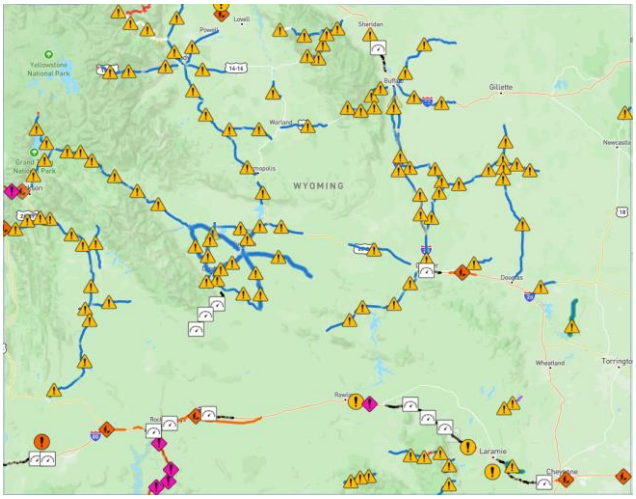
Icy roads cause **54%** of truck crashes

Steep grades up to **7%**

Technology Solution

To improve safety and efficiency and reduce the economic costs of road closures, during the Wyoming Connected Vehicle Pilot Project (WYCVP), defined goals were to reduce primary crashes and their severity, improve emergency response and prevent secondary crashes, and improve truck parking information and work zone information. To achieve these goals, the WYCVP needed dynamic Travel Information Messages to be broadcasted in-vehicle and warn drivers of road and weather conditions, road closures, and crashes. The first step was the installation of Roadside Units (RSUs) and Onboard units (OBUs) on state vehicles and partners' trucks. However, the price tag associated with RSU covering all 402 miles through rural areas without preexisting infrastructure increased state expenditures. Using the Public-Private Partnership, the WYDOT extended coverage through the Situation Data Exchange (SDX) and 3rd parties. [5] The SDX is a centralized data retention and distribution source for secured CV messages, including TIMs, Work Zone Data Exchange feed, and other types of messages as needed. Data from the SDX is further available to satellite radio, GPS navigation applications, or directly to OEMs to integrate into their infotainment center. The SDX also enables hands-free requests for traveler information from drivers who use Alexa skills on their smart devices.

Outcomes & Benefits



At the end of the 3rd phase of the project, WYDOT published the final system performance measurement and evaluation of the WYCVP. [6] The report summarizes the results of real-world demonstrations from January 2021 to April 2022 of applications developed to improve safety and mobility, including TIMs. Even though the study did not make a distinction between messages delivered over RSUs and through SDX, results showed promising safety benefits. **The report highlights increased speed limit compliance, especially during severe weather conditions, and a reduction in average crashes per year by up to 42% for all vehicles and up to 28% for truck traffic.** Moreover, in the transition period from the DSRC technology to the C-V2X, SDX has been actively providing TIMs with constant expansion of the capabilities.

On average, **40,000 messages** were delivered to drivers each month

42% reduction in average crashes per year for all vehicles

Conclusion

Emerging technologies such as CVs have a huge potential to improve traffic safety. However, deployments have many challenges, including data sharing and digital alerting systems on roadways that must adapt to connected vehicles. Solutions such as SDX are examples of how we need to consider all options to solve traffic safety and operation problems. ITS America supports the continued adoption of CV technologies in states, along with a strong digital infrastructure to support deployments. Without efficient data sharing and communication, CVs may not have their desired impact on driver and pedestrian safety.

Participants involved in this use case include Trihydro Corporation, Wyoming Department of Transportation, SiriusXM

Sources:
[1] ITS JPO
[2] WYDOT
[3] WYDOT
[4] ITS JPO
[5] Trihydro
[6] ITS JPO

Digital Infrastructure

ITS AMERICA

Artificial Intelligence Crash Response Management

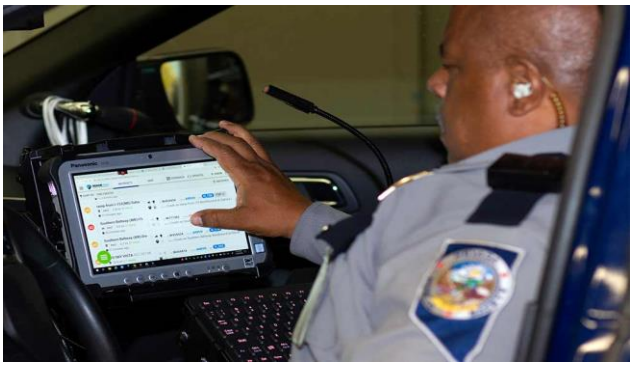
Southern Nevada

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.

Caltrans

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

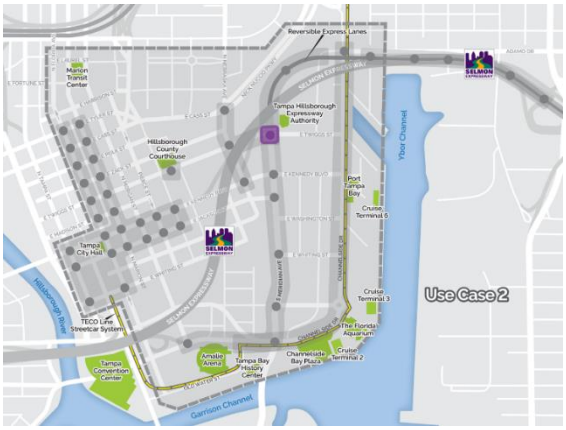
Wrong-way driving on expressways or other busy roads is a serious problem in both urban and rural areas, leading to crashes and fatalities. Drivers going the incorrect way on a road are often impaired through alcohol or other substances and are driving alone. With a robust digital infrastructure in place 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

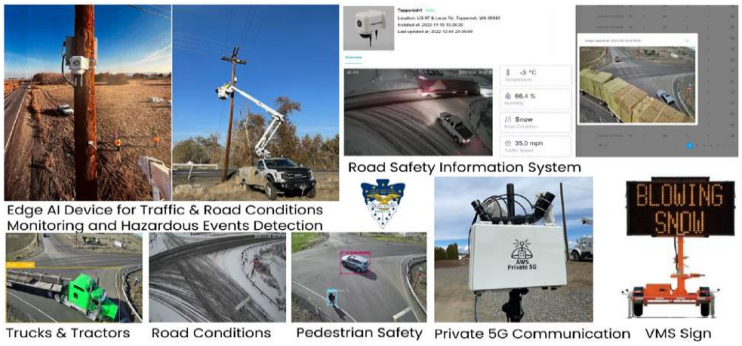
The MUST device can perform advanced processing and analysis of data directly at the roadside. This eliminates the need for continuous and costly data transmission to a centralized server or cloud infrastructure, reducing the dependence on a broadband connection and minimizing latency issues. The device 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

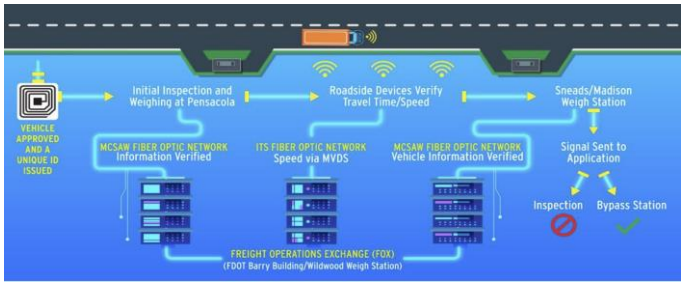
The Florida Department of Transportation (FDOT) has systematically developed and deployed technology solutions to provide the safe and efficient movement of freight. The solution deployed, the Freight Operations Exchange (FOX), serves as a central data management platform for driving advanced analytics 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

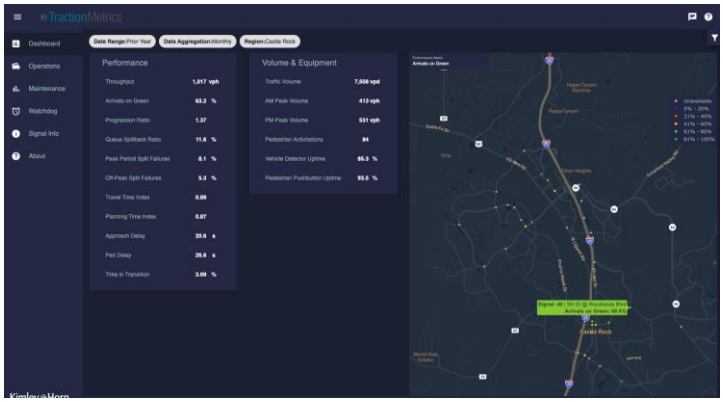
Technology Solution

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

ITS AMERICA

Automated Vehicles

ITS AMERICA

Improving Rural Mobility with Automated Vehicles

Itasca County, Minnesota

Access to safe, reliable transportation is not equal across the country, particularly in rural areas with low population densities. Efficient transportation solutions such as automated vehicles (AVs) are able to bridge this mobility gap, providing transportation to those who face accessibility challenges. With decreased potential for driver error in AVs, deploying automated technology can help make our communities safer and enhance the well-being of residents. By using AV shuttles as a mobility-on-demand option, we can improve well-being and economic opportunity.

The Challenge

Rural communities across the country face unique transportation challenges, including unpredictable weather, lower tax bases, and long distances between homes and businesses. With low population densities, cities may lack reliable fixed-route public transit options and face a shortage of resources to build sufficient infrastructure, especially for the disadvantaged. The elderly, low-income, and disabled communities are some of the most challenged when it comes to accessing safe, reliable transportation.

Rural communities, such as Grand Rapids, Minnesota, deal with challenging weather conditions, a lack of app-based rideshare services, and a socioeconomically disadvantaged population. For rural counties across the United States with no concentrated core population of 10,000 people or greater, 18% lived with a disability in 2019, a 17.71% increase from five years prior. In Itasca County, Minnesota, which contains Grand Rapids, 17% of residents lived with a disability in 2020. In the city, over 24% of residents are ages 65+. [2]

18.2% of residents are below the poverty line

17% of Itasca County residents live with a disability

24.6% of Grand Rapids residents are ages 65+

AV technologies are increasingly capable of helping rural residents access transportation options for grocery trips, medical appointments, jobs, social services, and more. AV shuttles help people maintain some independence while connecting them to that they need most in a safe, reliable manner.

Technology Solution

In fall of 2022, goMARTI (Minnesota's Autonomous Rural Transit Initiative) launched in Grand Rapids, MN as part of a partnership among the Minnesota Department of Transportation, City of Grand Rapids, The Plum Catalyst, Via, May Mobility, and other non-profit organizations. Using a hybrid-electric Toyota Sienna Autono-MaaS, Via's AI-based booking and routing algorithms match riders headed in the same direction to create flexible shared trips to more than 70 pick-up and drop-off locations throughout the city, including schools, grocery stores, resource centers, churches, and busy intersections. The automated vehicles, which can be dispatched by an app in minutes or by calling 211, are also free to ride, and operate Tuesday through Sunday. [3] The service is point-to-point, providing a safe means of transportation for those who may not have other reliable and affordable options.

Outcomes & Benefits

After the initial 18-month pilot deployment in 2022, GoMARTI has been extended for 3 years through the Federal Highway Administration's ATTAIN program and will continue to serve thousands of people from the Grand Rapids and Itasca County communities. The service has received positive reviews from riders and strong buy-in from the local community, with 88% of users being repeated riders. Given the safety benefits of AVs and the mobility-on-demand functionality, goMARTI has enabled safer and more reliable transportation for all residents, but most importantly those who have mobility challenges. About 10% of all rides on goMARTI thus far have been for people with wheelchairs, underscoring the impact on the disabled. The following statistics (since Sept. 2022) highlight how widely the service has been utilized in a city of just under 11,000 people, striving toward goals of transit efficiency and mobility for all:

5,456 Riders

88% Repeat Riders

34% HOV Rides

10 Minute Avg. Wait Time

Conclusion

Deploying AV shuttles in rural areas helps connect people to critical resources and community members, helping the local economy grow while bridging the mobility gap for disadvantaged residents. As the first rural large-scale launch of a public AV shuttle pilot, goMARTI is working to transform mobility in northern Minnesota. goMARTI shows how AV shuttle pilots and public-private partnerships can create safe, reliable, and affordable means of transit-on-demand in small towns across America. ITS America supports the continued deployment of AVs to create more equitable communities, help those with mobility challenges reach their destinations, and make our roads safer and more efficient.

Participants involved in this use case include the Minnesota Department of Transportation, City of Grand Rapids, MN, The Plum Catalyst, Via, May Mobility, Arrowhead Transit, Grand Rapids Area Chamber of Commerce, Itasca Economic Development Corporation, Blandin Foundation, MobilityMania, Grand Rapids Community Foundation, University of Minnesota, Itasca Community College, and Next Pathways.

DEPARTMENT OF TRANSPORTATION

DESTINATIONCAV

Sources:
[1] Bureau of Transportation Statistics, USDOT
[2] The Plum Catalyst
[3] Daily Yonder

Automated Vehicles for Last Mile Mobility

Columbus, Ohio

Decreasing the number of barriers to mobility and improving the safety and efficiency of roads in our communities are important goals but are not without challenges. Efficient transportation solutions such as automated vehicles (AVs) are able to bridge the mobility gap, providing transportation in the "last mile" to those who face mobility challenges and improving the efficiency of goods delivery. With decreased potential for driver error in AVs, deploying automated technology can help make our communities safer and enhance the well-being of residents, helping them reach food, healthcare, and family.

The Challenge

Changing commuter habits, population density shifts, lack of reliable public transportation can negatively affect cities across the United States. For example, Ohio residents who use public transportation spend an extra 76% of their commuting to work than those who do not take public transit options, an example of a common theme across America. [1] Mid-sized cities like Columbus, Ohio are no different and face their own set of transportation challenges. Beyond commuting challenges into the city, those within the city limits may face mobility challenges or not own a car, limiting their ability to reach healthcare, jobs, or other critical services. This may include tourists, who are less likely to have their personal vehicle with them and rely on local public transportation options. Residents in Columbus' Linden community, for example, live in a food desert, with above-average unemployment rates, and public health issues such as a high infant mortality rates. [2] During the COVID-19 pandemic, residents often lacked safe and reliable options to retrieve food, supplies, and other necessities.

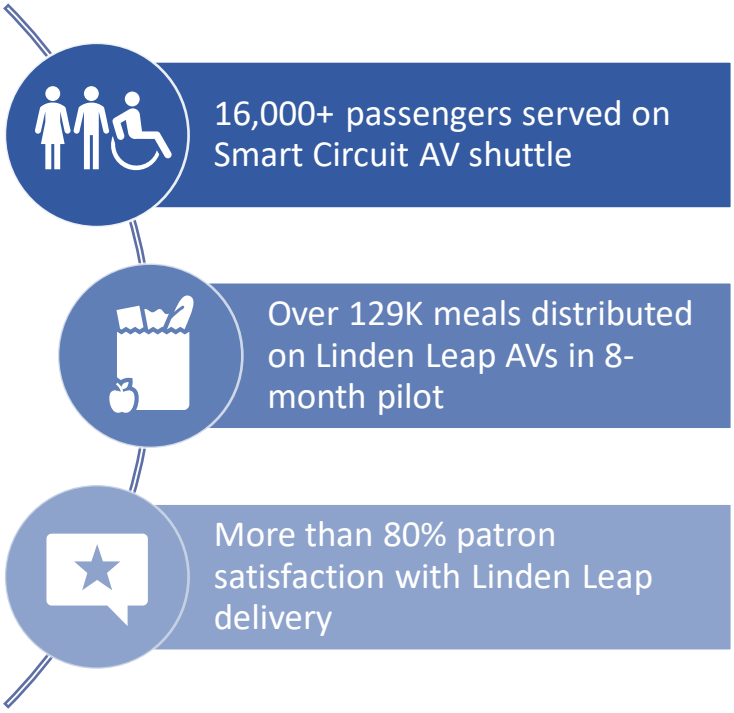
AVs have enormous potential to improve roadway safety and performance and contribute to more livable, vibrant, and equitable communities by providing more affordable mobility options and improving transit access. AVs can provide mobility options for people with disabilities and seniors, as well as access for underserved communities. They can complete last-mile deliveries more efficiently than traditional vehicles, and since they are often electric, with less tailpipe emissions as well. Columbus demonstrated that by deploying AV technology and being a leader in this space, these transportation challenges can be mitigated and overcome.

Technology Solution

As part of the Smart Columbus Program, two Connected Electric Automated Vehicle (CEAV) deployments of shuttles equipped with a suite of LiDAR sensors, 360-degree cameras, and GPS to achieve SAE J3016 Level 5 (Full Driving Automation) were demonstrated. The goal of the pilot was to aid travelers by improving access to downtown attractions and to provide better connection between existing transit routes and jobs and businesses.

The first CEAV deployment (Smart Circuit) was located along the Scioto Mile in downtown Columbus which served various attractions and cultural resources. The second CEAV deployment (Linden Leap) served first and last mile connection to transit in Linden, Columbus. During these pilot programs, trip data was collected to monitor performance, speed, autonomy, and safety of the AVs.

Outcomes & Benefits



With over 16,000 passengers served by the Smart Circuit shuttle, more Columbus residents and visitors were connected to downtown and other important cultural resources. As the state's first AV deployment on public streets, Smart Circuit was a great teaching tool for technologists, residents, and policymakers on the benefits of automated transportation technologies. Additionally, this pilot lays the groundwork for more mobility pilots to help increase access to transportation for those in need of critical healthcare.

The Linden Leap service launched in February 2020 and operated for two weeks, with 50 passenger rides. At the onset of the pandemic, the Linden Leap transformed its mission to be a food pantry delivery service, delivering food boxes from St. Stephen to Rosewind, a large public housing development.

During the demonstration period from July 2020 to April 2021, the shuttle service delivered 100 boxes of food per week, totaling over 129,000 meals for residents. This CAEV-enabled food delivery eliminated the two-mile walk to and from the pantry, providing relief to those who do not drive and/or have mobility issues, as well as limiting potential COVID-19 exposure. These AV deployments brought benefits to the Columbus community far beyond transportation efficiency, improving the health and well-being of residents and visitors.

Conclusion

Deploying AVs in urban areas helps connect people to critical resources and infrastructure, like jobs, groceries, social services, and healthcare. Columbus' pilot of CEAVs demonstrated how automated vehicles can efficiently transport food and other goods to those in need, while supporting transportation needs for the rest of the community and visitors. By serving cultural resources and other attractions, AVs and other public transit options can boost economic activity in a region, making areas more accessible for those without personal cars or those with mobility challenges. ITS America supports the safe deployment of AVs to create more equitable communities, help those with mobility challenges, and improve the safety and efficiency of our roads.

Participants involved in this use case include the City of Columbus, Ohio

Sources:
[1] Columbus Dispatch
[2] State Scoop

Automated Transportation for Medical Supplies

Jacksonville, Florida

Transformative mobility solutions like automated vehicles (AVs) not only move people from place to place, but also can move critical resources such as food and medical supplies. The COVID-19 pandemic impacted communities, disrupting transportation networks, health care systems, and everyday life. AV shuttles, like these in Florida, can help carry medical supplies to those most in need. Deploying AVs in health care settings can help keep the public safe and healthy, while ensuring efficient use of medical resources.

The Challenge

During the COVID-19 pandemic, communities faced unprecedented public health challenges, supply chain shortages, health care resource issues, and economic headwinds. The City of Jacksonville and the larger Duval County were no exception, with test positivity rates hitting as high as 19.1% in early July 2020, and average number of new cases per day often in the hundreds. [1] With testing demand surging nearly every day along with the number of cases, hospitals and laboratories faced worker shortages as their own staff became sick while taking care of patients or testing others. With resources low, hospitals and community organizations needed a way to conserve staff resources while also transporting critical medical supplies, including COVID-19 tests, to their proper destination.

Technology Solution

As movement in cities slowed down to the COVID-19 pandemic, the Jacksonville Transportation Authority (JTA) kept moving to support its residents. Through a unique partnership with the Mayo Clinic, the JTA transported COVID-19 samples on the medical facility's sprawling campus using the Ultimate Urban Circulator (U^2C), a Level 4 autonomous shuttle. The autonomous vehicles were fully operational during the pandemic and provided life-saving assistance to essential health care personnel. The JTA's partnerships with the Mayo Clinic, Beep, and NAVYA to use autonomous vehicles to transport COVID samples from a drive-thru testing location at the Mayo Clinic to a laboratory on the other end of the campus was a first in the nation. Five days a week from April through July 2020, the JTA's fleet of U^2C autonomous vehicles transported COVID-19 samples to the lab, freeing up the Mayo Clinic's essential health workers for more crucial tasks. In one week, the JTA's Technology and Innovation Division launched this program, something that would normally take one month to operationalize.

Using AVs, communities, hospitals, and governments have the potential to reshape the future of medical transportation and the movement of critical goods and services. AVs can complete last-mile deliveries more efficiently than traditional vehicles and play a critical role in keeping people healthy and safe. Driverless technologies enabled organizations to worry less about their workers getting sick during the pandemic, and they could focus more on keeping the public healthy and informed about the illness.

Outcomes & Benefits

AVs transported **30,000 samples**

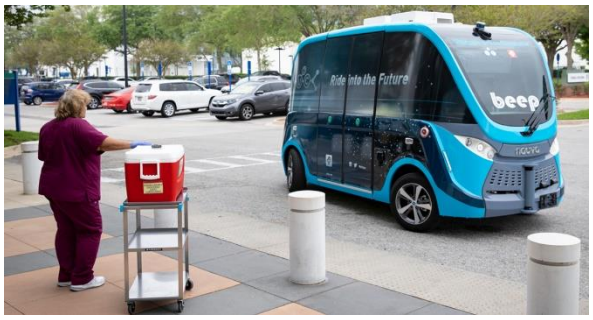
The shuttles made **227 runs** in four months

10,000 tests per month on average transported to laboratory

JTA's U²C program was reimagined for assisting the Mayo Clinic with critical COVID-19 testing operations, and the AV shuttles helped the hospital and city keep residents safe and informed about their health. Between April 1 and July 31, 2020, four driverless vehicles drove 200 miles and made 227 runs. In total these vehicles transported 30,000 samples, for an average of 10,000 tests per month. [2] With the help of the shuttles, the hospital was able to test thousands of people in the Jacksonville area, while also freeing up critical staff resources during a time where many faced illness and stressful situations. By reimagining the U²C program, JTA was able to assist during a time of need for the community. With driverless, electric shuttles, the program could transport COVID-19 test samples to the associated laboratory quickly and safely, without needing to use precious staff time. [3]

Conclusion

Innovative mobility solutions for business, healthcare, and other critical community functions can improve health outcomes for people and enhance quality of life. Beyond the traditional transporting of people from place to place, Jacksonville's U²C program during the COVID-19 pandemic is strong example of how AVs have many uses. ITS America supports the continued deployment of AVs in creative ways that strengthen communities, make health care operations more efficient, and keep people healthy and safe.



Participants involved in this use case include the Jacksonville Transportation Authority, Beep, NAVYA, and the Mayo Clinic.

Sources:
[1] New York Times
[2] Jacksonville Transportation Authority
[3] Navya

Providing First and Last-Mile Mobility with AVs

Cary, North Carolina

Efficient transportation services may not be equally available across the country, with smaller, less dense communities often in need of improved transportation options for those with mobility challenges. Efficient transportation solutions such as automated vehicles (AVs) are able to bridge this mobility gap, providing transportation options to those who may not have a car or are unable to walk. By using AV shuttles as a mobility-on-demand option, we can improve well-being, economic opportunity, and build more vibrant communities.

The Challenge

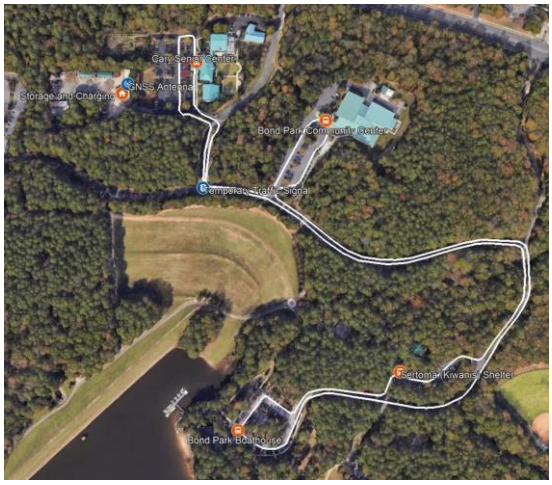
Accessing public lands, including parks and other nature areas, can be difficult for those without reliable access to transportation. With many recreation areas only accessible via private car, those who do not own one or cannot drive one may be left without an option to get around easily.

Additionally, the elderly face mobility challenges at higher rates, and may not be able to access public parks and entertainment on foot or with reliable transportation. **According to the U.S. Census, 36% of seniors had at least one disability, with 2/3 of them having difficulty walking.** [1] By providing shuttle services in recreation areas with stops at community and senior centers, communities can improve the quality of life for seniors and provide them with affordable and reliable mobility options.

AV technologies are increasingly capable of helping people access transportation options for grocery trips, medical appointments, jobs, social services, and more. AV shuttles can break down mobility barriers, bringing people to recreation, entertainment, and outdoor areas, all while increasing community ties and quality of life in a city.

Technology Solution

The North Carolina Department of Transportation (NCDOT) partnered with the city of Cary, NC and Beep, Inc. to bring a novel-design, all-electric, low-speed automated shuttle to Fred G. Bond Metro Park in Cary for a 13-week pilot through the Connected Autonomous Shuttle Supporting Innovation (CASSI) program. Beep operated a Navya Autonom shuttle on a 1.6-mile, four-stop route within the park that connected the Cary Senior Center, a large park shelter and amphitheater, a lakeside boathouse, and a community center. The shuttle was free and open to the public on weekdays from 10:00 a.m. to 4:00 p.m. during the pilot period. The pilot was the first under NCDOT's CASSI program to include Vehicle-to-Infrastructure (V2I) communications between the shuttle and a traffic signal on the shuttle's route. The Navya Autonom shuttle has 11 seats, and the shuttle includes a manual ramp to ensure access for riders using mobility devices. Each shuttle had an attendant present during automated operation.



Outcomes & Benefits

During the deployment, NCDOT collected data on ridership and provided riders with the opportunity to take a survey about their experience. Feedback from the rider survey indicated that most riders (92% of respondents) had a good experience using the shuttle. According to the survey, over 80% would ride the shuttle again, and most users got on and off at the senior center stop, illustrating how seniors and those who lack mobility options may have benefitted the greatest from the shuttle. With over 1,700 riders served on 494 trips, the automated shuttle provided first and last mile mobility to park-goers of all kinds, helping them reach different points and recreation spots more easily. After riding, riders indicated that they felt a higher degree of safety than they initially thought, and 88% said they supported more autonomous vehicle shuttles in Cary in the future. [2] Riders even indicated that some personal vehicle trips were replaced by the shuttle, and they were able to access new areas of the park than they had before.

1,718 Riders

494 Trips

92% good experience

Conclusion

By using AV shuttles in public parks and community hubs, cities and transportation agencies can bring people together and improve access to recreation for residents and visitors. By strategically locating a stop near the senior center, the CASSI program has been able to help seniors with first and last mile mobility to the surrounding park and entertainment options. Access to recreation and entertainment is vital to the well-being of residents and strong ties within the community of Cary. ITS America supports the continued deployment of AVs to create more equitable communities, help those with mobility challenges reach their destinations, and make our roads safer and more efficient.

Participants involved in this use case include the North Carolina Department of Transportation, City of Cary, NC, and Beep.

Sources:
[1] U.S. Census Bureau
[2] NCDOT

Piloting Shared AVs for Future Transportation Needs

Contra Costa County, California

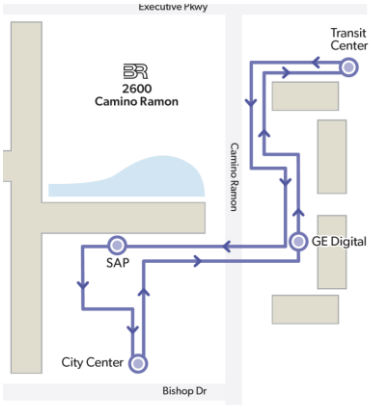
Providing efficient, last-mile mobility can be a challenge for cities and counties across the country, but by using shared automated vehicles (AVs) to expand transit options and connect people to commerce, local agencies can improve transportation networks and provide environmentally friendly, cost-effective transportation. Shared AV shuttle pilots can provide the foundations for greater mobility in a variety of areas, particularly urban ones, and are on the cutting edge of transportation technology that will improve efficiency and safety on roads.

The Challenge

Contra Costa County has a population of over 1.1 million residents in 19 cities and is located east of the San Francisco Bay. The county has an extensive transportation network, including major freeways, regional rail service, and various bus operations. Due to its strategic location, the county has experienced significant growth, resulting in a noticeable degradation in travel times, incidents, and transit service reliability. While transit options exist, reliable first and last mile connections to existing transit services and commercial centers are needed to better serve local communities and encourage mode shift away from single occupant vehicles. Shared autonomous vehicles (SAV) have the potential to address first mile and last mile challenges, while also helping to improve transit services for all users in a safe, cost-effective, and environmentally friendly manner.

Technology Solution

In 2016, CCTA sponsored key legislation enabling the testing of SAVs and obtained permission from the National Highway Traffic Safety Administration (NHTSA) to import the EZ-10 SAV for initial testing. The project team began testing the SAV in 2017 at GoMentum Station and later moved the pilot deployment to the Bishop Ranch Business Park, in San Ramon, California, to conduct tests in a real-world environment. The vehicles were in operation from March 2017 to August 2019 and collected over 1500 miles of data during testing and operation at the Business Park. For the purposes of Phase 2 testing, vehicle speeds did not exceed 12 MPH. While operating under these speed conditions, the vehicle was fully capable of performing basic driving operations with active braking system specifications, localization and navigation on pre-programmed fixed deployed trajectories.



The SAV program was reorganized recently and introduced as part of CCTA's PRESTO program, a new suite of mobility options, including bike share, scooter share, and express bus service, in addition to autonomous shuttles. Additionally, the SAV program is working to improve connectivity of vehicles (C-V2X) through the pilot. Beep was hired to supply and operate the two Navya SAVs that are currently serving CCTA's federally funded Mobility On-Demand project. As part of the PRESTO program, CCTA is running low-speed, autonomous shuttles at Bishop Ranch. The PRESTO shuttle service was initiated in April 2023 and will run through December 2024, providing free service to four key destinations within the Business Park. The PRESTO shuttle service is the first open-to-the-public SAV project in the Bay Area, and part of a series of autonomous vehicle pilot projects that will lay the groundwork for improving mobility and transit options for all.

Outcomes & Benefits

The operational analysis and feedback from passengers and project partners led us to create new key performance indicators to ensure the SAV operation can meet the expected performance, align with project objectives, and monitor the metrics most important to project stakeholders. The AV shuttles at Bishop Ranch will pave the way for increased mobility in the Bay Area and improved efficiency in the transportation network. The automated shuttles will help provide first and last-mile mobility to users in the designated loop, while keeping users and pedestrians safe. Lessons learned from the demonstration will help guide the development of future SAV projects in Contra Costa County. New key performance indicators from the project include:

Service Reliability

Ability to adhere to the schedule and provide consistent service. It includes metrics such as headway, on-time, and on-schedule performance.

Safety and Security

Record of incidents or crashes related to the shuttle service, ensuring the safety of passengers, and maintaining a secure environment.

Utilization

Average occupancy during operating hours to help determine efficiency of service and ability to accommodate passenger demand.

Service Availability

Percentage of time the shuttle service is operational and available to passengers.

On-Time Performance

Percentage of trips that start and finish on schedule.

Customer Satisfaction

Feedback from passengers regarding their overall experience.

Energy Efficiency and Environmental Impact

Measurement of shuttle energy consumption and environmental impact.

Conclusion

This AV shuttle testing and pilot program, alongside a wider suite of micro-mobility and transit options, will help Contra Costa County and the California Bay Area improve its transportation network. By developing new key performance indicators as well, the PRESTO program will help improve operational efficiency and ensure even stronger transit offerings in the future. ITS America supports the continued deployment of AV shuttles like this one in San Ramon to make road travel more efficient, bridge first and last-mile mobility gaps, and ensure that transportation is evolving and improving to meet the needs of consumers and businesses.

Participants involved in this use case include the Contra Costa Transportation Authority, Beep, the City of San Ramon, CA, and Bishop Ranch Business Park.

CONTRA COSTA transportation authority

beep™

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Sources:
[1] Contra Costa Transportation Authority