Innovative Ideas & Technologies

THE STATE OF AUTONOMOUS VEHICLES

The state of autonomous vehicle technology seems likely to advance with or without legislative and agency actions at the federal level. However, the manner in which autonomous vehicle technologies progress and will eventually be implemented depends heavily on these efforts. Intelligent planning, meaningful vision, and regulatory action and reform are required.

- "Preparing a Nation for Autonomous Vehicles: Opportunities, Barriers, and Policy Recommendations," Eno Center for Transportation

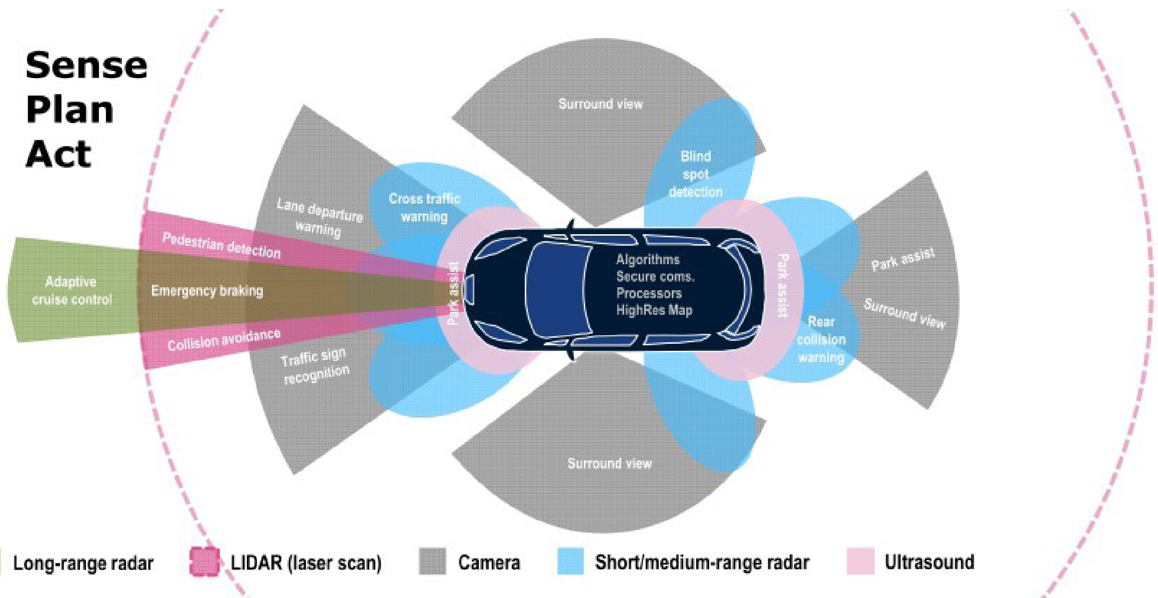
Autonomous Vehicles

Automated and connected vehicles have the potential to change all aspects of mobility – from driver safety and insurance liability to car ownership and how Americans commute. It has the potential to disrupt both public and private transportation as we know it. As Google, Uber, the automobile industry, and other organizations continue to make rapid technological advances, it is vital that the City of San Antonio (along with its federal, state, and local government partners) establish policies, laws and regulations that account for these disruptions. Of utmost importance for the City is finding a balance between guarding public safety while still leveraging the many positive mobility impacts that automated and connected vehicles can provide.

Definitions

Fully automated cars, also referred to as driverless cars, autonomous vehicles (AV) or self-driving cars, are capable of sensing their environment and navigating roads without human input. They rely on technologies like GPS, LIDAR, and radar to read their surroundings and make intelligent decisions about the car's direction and speed. Both the National Highway Traffic Safety Administration (NHTSA) and SAE International have defined levels of vehicle automation, ranging from driver assistance for a single vehicle function, to full automation with no driver required.

Connected vehicle (CV) technology is being developed concurrently. Connected vehicle applications provide connectivity:(1) among



Source: http://www.internationaltransportforum.org/Pub/pdf/15CPB_AutonomousDriving.pdf vehicles to enable crash prevention, (2) between vehicles and the infrastructure to enable safety, mobility and environmental benefits, and (3) among vehicles, infrastructure, and wireless devices to provide continuous real-time connectivity to all system users.[1] Examples of connected vehicle technologies can be found on the US Department of Transportation's website.

The relationship between connected and automated vehicles is still yet to be determined. Most driverless cars under development today use technology that exists solely within the car, along with satellite positioning systems; this technology can read standard traffic signs, identify bicyclists' hand signals, sense pedestrians, etc. Connected vehicles, on the other hand, rely on two-way communications (e.g., traffic signals communicating with cars). Connected vehicles could be driverless, but that is not a necessity. Driverless cars may have connected vehicle features, but that's not a necessity.

Connected and Automated Vehicle Timeline

Google, Uber, every major auto maker, and other organizations are investing significantly in the advancement of automated technology (some focused on full automation while others are introducing it incrementally). The United States Department of Transportation (US DOT) has invested in connected vehicle pilots around the country and they are investing in research for both connected and automated vehicles. Many research institutions are partnering with automakers to provide research support and testing sites, among other things.

Industry experts and stakeholders have wide-varying opinions on when driverless and connected vehicles will be available. Automakers and technology developers estimate that driverless vehicle technology will be publicly-available in the 2018-2020 timeframe; however, there are other factors that will influence the driverless vehicle timeline, including consumer acceptance and adoption, government regulation, privacy and security regulations, and insurance industry adjustments. Anthony Foxx, US DOT Secretary of Transportation, stated "I am very optimistic that we will see [driverless cars] everywhere in the world in ten years ."[2]

Because the greatest benefits of connected vehicle technologies can only be achieved with broad fleet penetration and an interoperable system across all manufacturers, regulatory action is required. NHTSA announced in early 2016 that a draft Notice of Proposed Rulemaking (NPRM) requiring vehicle-to-vehicle (V2V) technologies to be installed in all new light vehicles has been sent to the White House for approval, and the proposed rule is anticipated to be circulated for public comment in the second quarter of 2016. This process is anticipated to result in V2V technology deployed in all new production vehicles as early as the 2018 model year. However, various industry estimates indicate a nearly 15-year cycle to turn over the majority of the nation's vehicle fleet. Given this long timeline, it's likely that aftermarket systems will play a role in accelerating deployment

NATIONAL POLICIES RELATED TO AUTONOMOUS VEHICLES

"On February 4 [2016], driverless cars took one step closer to becoming mainstream when the National Highway Transportation Safety Administration stated that computers could be considered legal drivers of vehicles...

With both technology companies and automakers busy developing driverless cars, it falls to state and national policymakers to draft a set of regulations that pave the way...

The money and effort being put into developing the technology, both in industry and now in government, makes near-term arrival increasingly likely. Policymakers and consumers should start preparing for a world with much fewer human drivers."

- "Driverless cars could arrive sooner than you think", J. Karsten, D.M. West, Brookings Institute Tech Tank

[1] http://www.its.dot.gov/connected_vehicle/connected_vehicles_FAQs.htm, January 21, 2016

[2] http://www.faz.net/aktuell/wirtschaft/unternehmen/verkehrsminister-foxx-selbstfahrende-autos-in-10-jahren-standard-13811022.html, January 21, 2016

SUSTAINABILITY PLAN

A desired outcome of the SA Tomorrow Sustainability Plan is for San Antonio to have new development that is affordable, mixed-use, transit oriented and is designed for walking, biking, and electric vehicle infrastructure.

The Sustainability Plan also encourages San Antonio to lead by example by: Providing incentives to CoSA employees who commute to work using clean sources and introducing a "Green" city fleet of vehicles and habits to reduce fuel use.

once sufficient equipped vehicles are present in the fleet to obtain benefits from the system.

While the relationship and potential confluence of connected and driverless vehicle development remains unclear, it is clear today that the evolution of both of these technologies will continue in parallel for some time. Some industry experts see connected vehicles as an important evolutionary step towards a driverless car society, some see connected vehicles as the end goal, while others believe driverless cars can be developed and fully integrated into society without any connected vehicle features.

CV/AV Impacts

The potential impact of autonomous vehicles on society is vast, with both positive and negative implications. Generally, public safety is the largest positive impact cited – with the potential elimination of 90 percent of automobile accidents that are caused by human error.[3] Other potential positive impacts include: greater roadway efficiency, more efficient land use, reduced parking requirements, and improved mobility for the elderly, disabled, and youth. Potential negative impacts include: increased vehicle miles travelled (VMT) (which could increase road congestion and travel times), increased urban sprawl, and job loss in certain sectors.

Planning Considerations for the City of San Antonio

Automated and connected vehicles have the potential to impact the City of San Antonio in a number of ways: traffic congestion and tax revenues may increase or decrease, VIA may need to be adapted, parking needs may decrease, and roadway infrastructure may need to be adapted (to name a few). The City of San Antonio needs to plan for these many changes and the ideal starting place is to incorporate CV/AV into the City's goals, especially if they can be aligned with a Vision Zero initiative, greenhouse gas reduction goal, transit cost-effectiveness goal, enhanced freight mobility, etc.

3 http://deepblue.lib.umich.edu/handle/2027.42/64993, Tri-Level Study of the Causes of Traffic Accidents, May 20, 2015

It is vital that the City of San Antonio stay informed about the state of this constantly-evolving industry. City staff should follow driverless vehicle developments – both in technology advancement and national policy development, in the United States and internationally. While many aspects of the technology are being developed confidentially, there is plenty of publicly-available information to learn from.

The following planning considerations are organized in the following categories: mobility, infrastructure, transit, and revenue.

Mobility. There are many factors that will influence the level of congestion within and around our cities. For example:

- People may continue to own their vehicles and mostly travel alone, or the shared economy model (e.g., Uber business model) may become more prevalent;
- More people may travel due to increased mobility options for elderly, disabled, and youth populations;
- People may be willing to live farther from the jobs (i.e., increased urban sprawl); and
- Cars will likely have shorter headways, roads may have more capacity, and parking circulation may be reduced

The City of San Antonio should consider the following planning and policy activities to manage the impact of CV/AV on the city:

Automated capabilities for personal automobiles and transit vehicles are being rapidly introduced into the current fleet.

» Update the City's travel demand model. The City's travel demand models should ideally reflect updated information regarding who is traveling (e.g., elderly and disabled may travel more due to AVs), where people are living and working, how many trips they are taking, people's value of time while traveling, what level of shared rides are occurring, and the vehicle ownership model. It should also capture any changes associated with freight delivery. This update needs to be on the City's horizon as the industry matures its approach to forecasting this new future

» Encourage open data sharing. While it is important to preserve people's privacy, open, anonymized data can improve the City's decision-making and help to develop more informed policies and plans.

» Introduce polices that can influence how driverless vehicles can affect VMT, urban sprawl, and/or parking requirements. Examples include tolls for single-occupancy vehicles, new HOV/HOT lanes, create and enforce urban growth boundaries, reduce (or even subsidize) costs and parking fees for shared ride services, and eliminate minimum parking requirements in zoning laws and encourage more pick-up/drop-off locations at developments

Infrastructure. Depending on the evolution of autonomous and connected vehicles, local infrastructure will need to keep pace. Specifically, local governments may need to update and reconfigure signage, speed limits, signal timing, roadways and parking spaces. Most forecasts and studies assume that vehicles of the future will utilize electric-powered vehicles. This technology is still evolving; however, it is likely that public infrastructure, including parking spaces and pick-up/drop-off locations could better support mobility by providing electric charging stations.

While the exact role of connected vehicle roadside infrastructure remains uncertain, there are a number of foundational things the City of San Antonio can do to prepare for connected vehicle opportunities in the near-term. For transportation agencies, the advent of connected and automated vehicles will mean a shift in organizational focus towards data and technology to a greater degree than today. A system will ultimately be needed to collect data gathered over CV systems, and to broadcast infrastructure-based messages (such as signal timing, or work zone information, or road weather warnings) to vehicles by multiple means. Message standards and system architectures are rapidly maturing to the point where forward-leaning agencies can begin deploying such systems in the near-term to prepare for the first wave of equipped vehicles, as well as by using an increasing number of mobile applications. It is recommended that this process start by 1) evaluating organizational capability to address this new technology, including identifying skill gaps and the means to fill them (internal/external), and 2) developing a plan and architecture for managing the CV infrastructure and back-end systems within the city's IT framework.

Transit. As CV/AV technology evolves, everything from service coverage to vehicle technologies to labor requirements stands to change for VIA. VIA's leadership will need to completely re-think their services and fee structure in order to stay competitive in the new transportation environment. VIA might consider the following:

- Leverage private mobility companies to provide first/last mile solutions to longer-distance transit services;
- Transition the transit fleet to leverage driverless technology – potentially beginning with bus rapid transit and other services operating in protected guideways; AND
- Transition or subsidize paratransit services to private mobility companies

VIA will also need to re-evaluate its fleet management plan in order to incorporate driverless and connected vehicles in its fleet. This will have significant implications for labor requirements (and Union agreements), maintenance facilities, maintenance workers, safety and security of passengers, etc.

In the near-term, connected vehicle systems could begin to replicate or replace existing transit technology, such as Automated Vehicle Locator (AVL) and Transit Signal Priority (TSP) systems. As more vehicles and traffic signals are equipped with connected vehicle technologies, the Dedicated Short Range Communications (DSRC) radio technology could ultimately replace stand-alone AVL and TSP systems, reducing VIA's deployment, operations and maintenance costs. This potential should be considered as part of any evaluation of further AVL or TSP system investments.

Revenue. The City of San Antonio will have significant financial consequences associated with driverless cars. Examples of budget line items to consider are:

- Parking revenues (or alternate revenues associated with land previously used for parking)
- Speed ticket violation fees
- Tax revenues related to vehicle purchases, registration fees, and VMT
- Health and life insurance costs
- VIA costs and revenues
- Incident management costs
- Insurance costs
- Government fleet transition to driverless vehicles
- New enforcement activities
- Unemployment insurance

Driverless and connected vehicles may provide opportunities for municipal services to be delivered more cost-effectively as well. The City of San Antonio should understand the impact of this technology ahead of time and prepare accordingly.

Driverless and connected vehicle technologies are coming and they present great potential for mobility and safety improvements for our cities. The City of San Antonio has the opportunity to proactively establish regulations, policies, and plans that can continue to support the driverless car revolution while keeping the traveling public safe and providing a positive example for city governments around the world.

Transportation Network Companies

Technology with the potential to transform the transportation system has emerged in the form of a millennial friendly taxi industry. The most well-known companies of this market include Uber, Lyft, and other shared vehicle programs. Current operation of these companies is generally to provide transportation to a destination by the use of a mobile application, reducing the need for a personal automobile, and the hassle and costs parking sometimes creates.

The future of these markets alongside automated vehicles has the potential to completely change the transportation network. According to a recent edition of the Mobility Lab e-newsletter (September 2015), an article entitled "Uber's Plan for Self-Driving Cars Bigger than Its Taxi Disruption", portrays the potential for self-driving cars to affect the job market, car manufacturers, dealerships, transit, and the urban lifestyle itself. For instance, the report states:

"The ride-hailing company has invested in autonomous-vehicle research, and its [Uber's] CEO Travis Kalanick has indicated that consumers can expect a driverless Uber fleet by 2030. Uber expects its service to be so inexpensive and ubiquitous as to make car ownership obsolete. Such ambitious plans could make its disruption of the taxi industry look quaint in comparison . . . A study by Columbia University calculates that with a fleet of just 9,000 autonomous cars, Uber could replace every taxicab in New York City—with a passenger wait time of 36 seconds and a cost of $.50 per mile . . . Going further to an economy-wide perspective, Pricewaterhouse-Coopers estimates, as noted by writer and entrepreneur Zack Kanter that 'autonomous vehicles would reduce the number of vehicles on the road by 99 percent, and the fleet of cars in the U.S. would fall from 245 million to 2.4 million."

The sharing of autonomous vehicles for hire may reduce the number of vehicles somewhat (the 99% stated above may be high). Vehicle ownership, could very well be reduced significantly with the onset of autonomous TNC vehicles. However, the number of trips made on the network may be comparable to current levels. San Antonio will need to stay up to date with current industry innovations

Within a very short time, Uber and other TNC's have changed the "Taxi" industry, showing how quickly these "disruptions" can occur.

to prepare their transportation network for the possibilities and ramifications of Automated Vehicles and its potential positive and negative impacts.

Intelligent Transportation Systems (ITS)

Transportation networks can be managed much more efficiently when real time information about traffic conditions can be gathered and disseminated quickly to the system users. Intelligent Transportation Systems (ITS) is the implementation of innovation and technology to allow traffic management staff to monitor transportation network conditions and to respond accordingly.

Components such as traffic monitoring cameras and vehicle counting devices are used to collect traffic data for analysis. Dynamic message signs are used to inform drivers of expected travel times, incidents ahead, and relay other information that can help drivers make routing decisions. A communications network is used for both collecting and distributing information throughout the system.

Benefits of ITS include the following:

- Provide real-time information about traffic flow, roadway conditions, incidents, etc. delivered to the appropriate personnel;
- Recall historical information for traffic management staff to utilize for analysis, planning, and metrics recording;
- Ability to modify signal timing operations to adapt to expected or unexpected changes in traffic demand;
- Communication to travelers about roadway, traffic conditions, as well as public safety; and
- Incident management resulting in reduced response times, improved clearance times and more accurate information regarding incidents.

ATMS/KITS

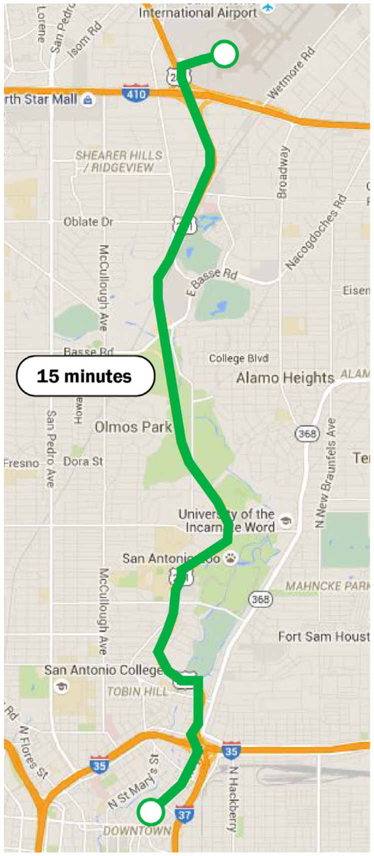
The City of San Antonio is currently undergoing a process to upgrade its ATMS (Advanced Traffic Management System) via the KITS (Kimley-Horn Integrated Transportation System) Central System software. This update allows the City to more closely monitor operations across the network - including traffic signals, arterial flow, incident monitoring, CCTV, and digital Dynamic Message Signs (DMS). This investment allows the City to better manage its available capacity, improve its ability to identify and respond to incidents, and continue to improve the system all from a central location.

The ATMS software has the potential to optimize traffic signal timing to balance performance benefits for safety and efficiency. The system is not intended to replace the need for sound traffic engineering, but rather to supplement the traffic engineer's toolbox with another tool that can handle fluctuations in demand and short and long-term changes in land use and traffic patterns.

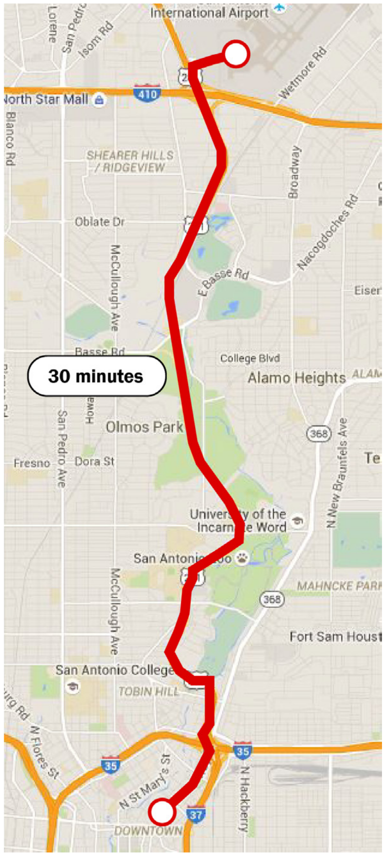
Incident Management System

Incidents such as crashes, debris, disabled vehicles, etc. are extremely disruptive to traffic flow. Traffic Incident Management (TIM) consists of a planned and coordinated multimodal disciplinary process to direct, respond to, and clear traffic incidents so that normal traffic flow may be restored as safely and quickly as possible.

While effective TIM is one of the most important ways officials can respond to traffic, there a few critical components that must be present. It is important to have well-developed TIM procedures documented so that there is a clear direction for officials. Each type and location of an incident can then be resolved with a minimized response time. The effects of delay due to an incident compounds over time the longer it takes for the roadway to clear. Also, incidents do not solely affect the freeway on which they occur; their impact reaches to surrounding roadways as well. Therefore it is important to identify alternate routes that can be utilized during an incident. The transportation network must also be outfitted with the appropriate ITS components so that officials can monitor traffic conditions and convey messages to travelers, while also dispatching incident responders (police, fire, EMS) to the correct location.



CURRENT



POTENTIAL FUTURE

RELIABILITY

The reliability of commute times are an integral part to how residents view the function of the transportation network. With the expected growth in population, commute times are forecast to almost double as compared to current travel times. Investing in the entire transportation system encourage use of alternative modes and enhance technology (such as ITS) to maintain consistent travel times is imperative.

When properly implemented, TIM is an essential component to traffic management. Crashes, debris, disabled vehicles, or other similar disturbances can severely impact the capacity and flow of a freeway. Taking appropriate TIM action can mitigate the effects, and help reroute vehicles in order to reduce congestion as much as possible. The benefit of an effective TIM system is improved reliability, reduced secondary crashes, reduced impacts to goods movement, and a reduction in air quality impacts.

The San Antonio Enhanced Regional Incident Management Techniques and Evaluation of Intelligent Transportation Systems developed in August of 2015 created the following vision for San Antonio Regional Traffic Incident Management (TIM): To rapidly clear all incidents and debris from the freeway travel lanes while ensuring safety for first responders, support teams, and the public. The mission of the program is to:

- Provide a safe and secure transportation environment for people and goods;
- Communicate and coordinate activities in advance to provide a consistent response; and
- Maintain as much transportation capacity and safety as practical during the incident.

Managed Lanes

With the increasing traffic demand in Texas, it is not always possible to provide a transportation network that operates at a desired level of service. However, providing a reliable route for travelers can be a valuable solution and allow drivers to have a more predictable travel time thereby, improving the reliability of the transportation system. Managed lanes are dedicated traffic lanes on a freeway facility whose demand and capacity are actively managed to provide a consistent travel time.

PRICE & DEMAND

Almost everything we purchase - from gas to the movies to buying a plane ticket to paying our bills - is priced based on demand. Managed lanes are a tool to value the available capacity at a higher rate during peak periods.

There are a multitude of ways that lanes can be managed, whether by just one of the following, or by a combination of the following:

- Lanes can be tolled at a cost per vehicle that is higher during congested times and lower during free flow conditions, also known as dynamic pricing;
- Lanes can allow high occupancy vehicles (2 or more passengers in a vehicle), either at no cost or at a discounted price;
- Lanes can permit only buses or trucks;
- Lanes can be reversible based on the peak direction of travel.

Managed lanes almost always require the implementation of ITS equipment to monitor use, display dynamic messages to drivers, collect tolling information, or count vehicles to evaluate performance. Managed lanes are a good solution in places where transportation funding is limited, but a reliable route is still desired by drivers.

HOV Lanes

Transportation professionals have a goal to move people, goods, and services in an efficient and safe manner. High Occupancy Vehicle (HOV) lanes are restricted to vehicles that are carrying two or more passengers. These lanes emphasize moving people efficiently by prioritizing and incentivizing vehicles with multiple passengers.

Not only do HOV lanes move people traveling together more efficiently, but it also encourages travelers to carpool, and thus decreases the total number of vehicles using the freeway. Historically these lanes also have less demand on them, and therefore typically operate at a higher speed.

There are also a few challenges to

successfully implement HOV lanes on a freeway. Enforcement is one of the biggest challenges. Depending on the projected violation rate, enforcement may focus on ensuring that only vehicles with the appropriate ridership are utilizing the lanes (although it should be notes that automated enforcement tools are being developed). HOV lanes also take some capacity away from normal main lanes, so the likelihood that travelers will actually adopt carpooling must be evaluated before they are implemented.

5 Year Action Plan

» Embrace tools that optimize available system capacity (such as development of new timing plans or programs to educate first responders on best practices with incident management).

» Leverage autonomous vehicle and TNC's (investments coming from others) to allow San Antonio to be a leader in the next generation transportation system.

» Dedicate a portion of funding towards implementing innovative technologies to the City's transportation system.

» Develop Smart Cities program to inform City staff of emerging technologies.

This page intentionally left blank