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BETTER ROADS
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MOVING TEXAS

MOBILITY FORWARD THROUGH INNOVATION AND TECHNOLOGY

TEXAS PARTNERSHIP CHOSEN AS PROVING GROUND FOR AUTOMATED VEHICLES

TTI PROVIDES FHWA A NEW WAY TO TEST CV/AV TECHNOLOGIES

NCTCOG SEEKS PARTNERSHIPS FOR AUTOMATED VEHICLES

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- TxLTAP -

The Local Technical Assistance Program (LTAP) is a nationwide effort financed by the Federal Highway Administration and individual state departments of transportation. Its purpose is to translate into understandable terms the best available technology for roadways, bridges, bicycle and pedestrian facilities, and public transportation for city and county roadway and transportation personnel. The TxLTAP, operated by the University of Texas at Arlington, is sponsored by the Texas Department of Transportation (TxDOT) and the Federal Highway Administration. This newsletter is designed to keep you informed about new publications, techniques, and training opportunities that may be helpful to you and your community.

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MOVING TEXAS

MOBILITY FORWARD THROUGH INNOVATION AND TECHNOLOGY

Texas is on the move again leading the way in the transportation of people, goods, and information. The Texas Technology Task Force (TTTF) was established by the Texas Department of Transportation (TxDOT) in 2013 to develop a vision for the future of Texas' transportation system. The TTTF is committed to advancing the development of a high-performance transportation system to position Texas as the leading nexus of economic activity and technological innovation.

The TTTF's mission is to support TxDOT by outlining clear, actionable strategies and enhancing the delivery of quality transportation services. The TTTF offers services in the following areas:

PEOPLE

Form a core knowledge group and network of subject matter experts.

PORTFOLIO

Identify emerging technologies and analyze potential impacts.

PLAN

Develop key strategies to integrate and advance critical technologies.

Texas is on the move again, leading the way for the transportation of people, goods, and information.

WHY IS IT IMPORTANT TO BUILD AWARENESS OF EMERGING TECHNOLOGIES?

Emerging technologies have the potential to save lives, time, and money. Texas cannot afford to rely upon business as usual to solve its traffic problems.

HOW DO WE ACHIEVE A COMMON VISION?

By engaging with all stakeholders, TxDOT strives to develop an integrated action plan that reflects the needs of the state's growing population. Broad participation is sought out from public agencies, industry, and research to generate unity of purpose.

WHAT ROLE WILL EMERGING TECHNOLOGIES PLAY IN THE FUTURE OF THE TEXAS TRANSPORTATION SYSTEM?

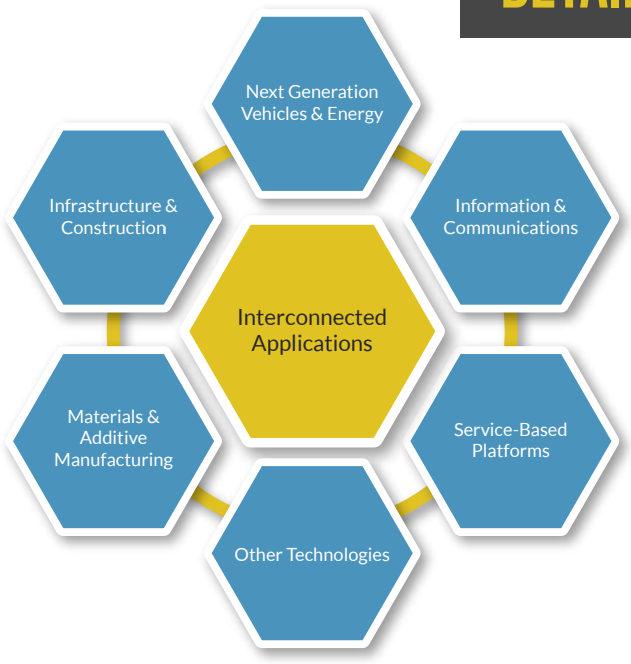
Technology is a tool that enables TxDOT to better serve the traveling public. Through research and innovation, TxDOT is dedicated to improving the safety, economic competitiveness, and quality of life for all Texans.

WHO IS RESPONSIBLE FOR IMPLEMENTING THE PLAN?

Every individual who believes in moving the Texas transportation system forward may be considered a champion for change. In order to fully realize performance benefits, TxDOT commits to involving its stakeholders in planning and implementation.

The Emerging Technology Portfolio developed by the TTTF focuses on six broad categories: Next Generation Vehicles and Energy; Infrastructure and Construction; Information and Communications; Service-Based Platforms; Materials and Additive Manufacturing; and Other Technologies.

DETAILED EMERGING TECHNOLOGY PORTFOLIO



Next Generation Vehicles & Energy
Autonomous Vehicles
Connected Vehicles
Electric Vehicles
Unmanned Aerial Vehicles

Service-Based Platforms
Location-Based Services
Transportation Subscription Services

Infrastructure & Construction
Infrastructure Enhancements
Construction Techniques
Equipment

Materials & Additive Manufacturing
Self-Healing Pavements
Nanotechnologies
3D Printing

Information & Communications
Cloud Computing
Crowdsourcing

Other Technologies
Google Glass
Virtual Reality

Continue on the next page.

TTTF HAS DESIGNATED TEN AREAS AS CRITICAL TECHNOLOGIES.

UNMANNED AERIAL VEHICLES (UAVS)

Unmanned Aerial Vehicles (UAVS) have potential applications in law enforcement, border control, agriculture, traffic control, and freight. Rapid delivery of lightweight commercial products using UAV's has been proposed by Amazon and Google X's program known as "Project Wing". Policymaking is underway concerning the civil applications of UAVs and the FAA has selected six states to host test sites.

AUTOMATED FREIGHT

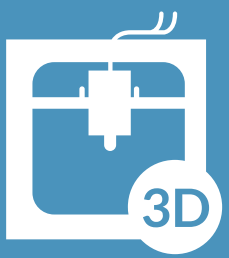
The use of autonomous long-haul trucks (ALHTs) could add up to a multibillion-dollar opportunity for companies throughout the trucking value chain, and in turn, lower prices for consumers. Combined with 3D printing and last-mile solutions, Texas has the opportunity to overcome urban freight challenges, reduce the impacts on its infrastructure, and grow the state's economy.

BIG DATA

Cloud computing and crowd-sourcing technologies are revolutionizing transportation. Companies from IT service providers and OEMs are making advancements in the collection, storage, management, and integration of data. Application programming interfaces (APIs), smartphone platforms, and open data portals are enabling consumers to share information with one another and public agencies.

CONNECTED VEHICLES

Connected vehicles will directly impact areas of safety and mobility. Using cellular or DSRC technology, vehicles may connect with one another (V2V) and/or with the infrastructure (V2I). When applications such as collision warning, automatic incident reporting, and emergency vehicle signal priority are combined, connected vehicles have the potential to move Texas towards a goal of zero traffic fatalities.



3D PRINTING

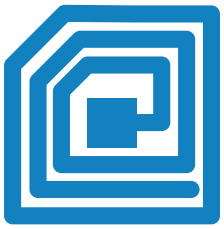
3D printing allows for mass customization, express manufacturing, and rapid prototyping. Major OEMs are incorporating 3D printed components, while Local Motors and others are fully 3D printing the car chassis and body. When 3D printing combines with cloud computing, decentralized production and distribution may be achieved, alleviating congestion and lowering the impact of freight vehicles on the roadways.

OPEN DATA PORTALS

Creating a centralized repository of information enhances the efficacy of multiple stakeholder operations. By integrating and standardizing data, port community systems and traffic management centers can break down silos and encourage the development of a multimodal interface. Open data may also enable third parties to leverage the data through the creation of applications and services that address public and private demands.

ROBOTICS

Advanced robotics has the potential to affect $6.3 trillion in labor costs globally. From collaborative welding in automotive manufacturing to automated loading and unloading operations at port terminals, increasingly sophisticated robots are improving productivity. As the labor market continues to evolve, robotics skills will play a crucial role in modernizing the Texas economy to take advantage of industry growth opportunities.



RFID

Radio frequency identification (RFID) may be used for radical improvements in intelligent transportation systems. To address the issues of congestion, security, and air quality, ports can utilize RFID transponders to expedite the identification and authentication process. RFID may also be used as part of a major multimodal smart card system that incorporates local, regional, and state infrastructure to provide Texas travelers with seamless connectivity.

CYBER SECURITY

By the year 2020 it is projected that more than a billion connected M2M (machine-to-machine) devices will be in highway transportation, of which more than half will be road vehicles. With the new insights promised by big data, there are also concerns about the privacy and security of these devices. Public agencies will need to protect their citizens and infrastructure by minimizing risks to safety and mobility systems.

SMART CITIES

Transportation is the key to developing a network of smart cities. As urban populations continue to grow and consumer behavior shifts towards e-commerce, municipalities will need to work closely with the freight industry to address logistical challenges. By using transportation investment as a catalyst, Texas can fuel sustainable development for citizens' energy, water, communications, health, and public safety.

TTTF is working to develop an innovation and technology strategy designed to move Texas mobility forward. Both private and public sector staff from across the State are working together to develop a statewide partnership to transform the vehicle technology initiative and create an opportunity for Texas to lead the initiative to improve transportation through technology and foster economic development.

TEXAS PARTNERSHIP CHOSEN AS PROVING GROUND FOR AUTOMATED VEHICLES

The U.S. Department of Transportation (USDOT) has named Texas a national Automated Vehicle (AV) Proving Ground for the testing of connected and automated vehicle technologies. The designation establishes Texas as a leader in the research and development of new transportation technologies that could make roads safer and less congested.

The Texas AV Proving Grounds Partnership includes the Texas Department of Transportation (TxDOT), Texas A&M Transportation Institute (TTI), The University of Texas at Austin's Center for Transportation Research (CTR), Southwest Research Institute (SwRI) and 32 municipal and regional partners with a shared interest in the mobility and safety challenges facing the introduction of autonomous and connected vehicles to public roadways.

"With five of the nation's 15 fastest-growing cities in Texas and our population expected to potentially double by the year 2050, Texas must be a leader in new technology that addresses transportation challenges," said Texas Department of Transportation Deputy Executive Director Marc Williams. "This partnership puts Texas at the forefront of automated vehicle technologies that likely will shape the future of transportation around the world."

Selected from an applicant pool of more than 60, the Texas AV Proving Grounds Partnership joins nine other designees in a community of practice that will be instrumental in helping the DOT provide critical insights into optimal big data usage and further develop guidelines for developing automated vehicle technologies. In working collaboratively, the ultimate goal is to offer services that connect people to places of opportunity.

"The partnership of CTR with TTI, SwRI, and TxDOT in this AV proving ground effort is recognition of the cutting-edge research and academic-public agency-industry collaborative efforts being undertaken in Texas in the area of connected and automated vehicles," said Dr. Chandra Bhat, Director of UT Austin's Center for Transportation Research.

"There are many technology, policy, regulatory, privacy, legal, and security challenges that still need to be resolved, and the proving ground is an important and exciting opportunity for us to identify and resolve these challenges before going mainstream with AVs. In the long run, the proving ground will enable us to have a progressive vision to inspire new pathways to addressing safety, mobility, resiliency, and reliability considerations on our transportation systems, and ensure an equitable, inclusive, system that enhances the quality of life for all Americans."

Texas offers a full and varied range of testing environments, from high speed barrier separated managed lanes to low speed urban environments such as university campuses, medical districts, transit bus corridors and border crossings. Both closed course facilities and real world urban and freight test sites will be used in evaluating emerging transportation technologies. By implementing a pilot-learn-scale model of deployment, Texas is prepared to safely conduct testing and operations in an iterative manner as the technology develops.

The partnership builds upon the momentum of USDOT's Smart City Challenge and is a direct outcome of the Texas Mobility Summit held on December 1 – 2, 2016. The Summit, hosted by TxDOT's Texas Technology Task Force, brought together nine teams representing 10 cities and three research institutions to galvanize key leadership in developing innovative solutions to the state's mobility challenges. The resulting alliance is dedicated to openly sharing best practices as a cornerstone of the effort.

Members of the Texas partnership are contributing their facilities, expertise and talents as a part of a larger Texas network of proving grounds and test bed sites. Proving grounds offer controlled environments on research campuses where the complete life cycle development of AVs can be assessed and include the Texas A&M University System RELLIS Campus and Texas A&M's Proving Grounds, The University of Texas at Austin Campus and the SwRI Campus in San Antonio. Urban and freight test beds in the following cities offer real world environments where a variety of scenarios may be explored:

- Austin Area – Austin - Bergstrom International Airport and Riverside Drive corridor
- Houston Area – Texas Medical Center, Houston METRO HOV lanes, and Port of Houston
- Dallas/Fort Worth/Arlington Area – UTA campus, Arlington streets, I-30 corridor and managed lanes
- San Antonio Area – Fredericksburg Road/Medical Drive corridor and bus rapid transit system
- El Paso Area – Tornillo/Guadalupe Port of Entry

The rapid rate at which this technology is progressing will ultimately require a formal testing plan to be developed and approved by the appropriate state and local agencies, including the Texas Department of Public Safety and the Department of Motor Vehicles. Until then, initial testing will take place on closed research proving grounds.

One of the strengths of the Texas partnership is that AV testing, for both TxDOT and private companies, is already underway at the research proving grounds, well ahead of the USDOT's January 2018 launch goal.

For additional information on this project, contact the following people:

Texas A&M Transportation Institute: Dr. Christopher Poe, P.E., Assistant Agency Director, Connected and Automated Vehicle Strategy, cpoe@tamu.edu; (972) 994-2206

The University of Texas at Austin Center for Transportation Research: Dr. Chandra Bhat, Director, Center for Transportation Research, The University of Texas at Austin, bhat@mail.utexas.edu; (512) 471-4535

Southwest Research Institute: Michael Brown, Engineer, Michael.brown@swri.org; (210) 52203104

Texas Department of Transportation: Becky Ozuna, Media Relations, MediaRelations@txdot.gov; (512) 463-8700.

A PLATFORM FOR CHANGE:

TTI PROVIDES FHWA A NEW WAY TO TEST CV/AV TECHNOLOGIES

Self-driving cars. Seamless communication between vehicles and the roadside. The ability to multitask while driving from point A to point B reliably, safely and on time.

It all sounds a bit like the George Jetson future we were promised in the 1960s, minus the flying cars. The difference is that the connected vehicle/automated vehicle (CV/AV) revolution is happening now. But to help make it a reality, the technologies need to be vetted, validated and successfully deployed. And before that can happen, we must have a reliable, standardized way to test those technologies.

The Texas A&M Transportation Institute (TTI) has developed an augmented-reality environment where real entities (e.g., vehicles and traffic signal operation) are combined with simulated traffic and displayed on a screen. This is similar to a Pokémon Go app, but instead of showing Pokémon, the screen shows simulated vehicles superimposed on the roadway. The first-of-its-kind approach — called CONVAS (CONnected Vehicle Assessment Simulation) — marries the cost-effectiveness of computer simulation with actual roadway operations to produce an efficient yet dependable evaluation mechanism for the Federal Highway Administration (FHWA). TTI has been developing the platform since January 2014.

"The limitations of traditional simulation come from having to model every entity to be as realistic as possible," explains TTI Research Engineer Srinivasa Sunkari, principal investigator on the project. "For example, operating agencies can assess CV applications using a simulation environment that can accurately represent a mix of real vehicles with simulated vehicles simultaneously in real time."

Continue on the next page.

To mitigate the effects of modeling while improving reliability under actual driving conditions, Sunkari and his team used hardware-in-the-loop (HITL) simulation. This approach introduces hardware components into the simulation model. In HITL, devices like traffic signals are fed information (e.g., simulated data indicating a vehicle is passing a detector), and the signals react in real time. That reaction is then fed back into the simulation model, and the simulated vehicle proceeds or stops accordingly.

Sunkari and his team developed an enhanced HITL simulation in this project by incorporating an actual CV on a roadway network into a simulation model and displaying simulated CVs inside the real vehicle at the same time. This enables development and testing of advanced CV applications or strategies by allowing assessments of how CVs respond to each other. This is the first time HITL simulation has been applied in this way.

To more accurately represent CV communications, TTI researchers integrated the commercial microscopic traffic simulator VisSim with the open-source wireless network simulator ns-3. Doing so enables simulated vehicles to adapt to variability in the communication environment, providing a more realistic assessment of CV applications in the simulation model. Similar to its application of HITL simulation, TTI's integration of the two simulators had also never been done before.

"CONVAS provides the most advanced, realistic evaluation tool for emerging CV/AV applications that rely on wireless communications," says Sunkari. "And in the future, that'll be just about every aspect of our transportation system."

On June 22, 2016, Sunkari and his research team demonstrated CONVAS to visiting FHWA sponsors at The Texas A&M University System's RELLIS Campus. The field test confirmed the successful integration of the Vissim and ns-3 simulators and showed the seamless data flow between the simulation model and the test vehicle's onboard unit.

With the delivery of CONVAS in December, FHWA now has a way to test the realistic impact of wireless communications on the performance of large-scale CV applications while minimizing evaluation costs. Through simulation, technologies can be fine-tuned, and engineers can use the results to design advanced algorithms that, in turn, will govern how vehicles drive tomorrow's roadways. In short, thanks to CONVAS, the wireless solutions connecting our future transportation system will be safer, more dependable and less expensive to build.

"The technology used in developing this platform will bring benefits in CV research for many years to come as we work to improve our transportation network to become a more intelligent, more reliable and safer system," says FHWA Highway Research Engineer Peter Huang, who manages the Turner-Fairbank Intelligent Intersection Traffic Control Laboratory.

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FHWA EVERY DAY COUNTS

It seems like an unbeatable challenge. Your small community is quickly growing. Congestion is getting worse, intersections are at gridlock, and you don't have the resources needed to find answers. It's a scene that is being played out in many communities and counties across the Lone Star State.

Texas is one of the fastest growing states in the nation. According the United States Census Bureau, Texas has experienced an 11% increase in population since 2010. Experts say that trend will continue as people spread across the state in search of new opportunities.

While it's great news for the state's economy, the population explosion can present big challenges to smaller communities and counties on limited resources. Handling congestion, reducing crashes, and meeting the needs of drivers are just some of the issues smaller governments are having to face, and often with limited funding and few ideas on how to solve them.

Fortunately, you don't have to battle these problems on your own. The Federal Highway Administration (FHWA) offers powerful and free tools to help you solve your Texas-sized transportation challenges in ways you may have never thought possible.

The "Every Day Counts" program, or EDC, introduces transportation planners, engineers, and designers to innovative ways of solving problems. Whether you're struggling with a small county bridge, working to reduce pedestrian fatalities, or trying to tackle a major interstate highway interchange, the EDC program can help you come up with innovative and time-saving solutions.

Communities across the nation are discovering how simple changes through the Every Day Counts program can save lives and improve safety.

One of the most popular innovations being introduced in cities are roundabouts. Since 1990, approximately 4,000 roundabouts have been constructed in the United Sates.

Roundabouts are essentially traffic circles in which motorists travel counter-clockwise around an island. Drivers entering the roundabout must yield to other drivers already in the roundabout.

The City of Fort Worth and the Texas Department of Transportation recently opened two roundabouts at the U.S. 287 and Harmon Road interchange. They are the first modern roundabouts on the Texas highway system. Each costing $600,000 to install, the roundabouts significantly reduced delays and eliminated the need for a bridge widening.

Roundabouts can make for safer intersections. There are generally less contact points for drivers and speeds are greatly reduced. Research shows some traditional intersections that have been converted to roundabouts have seen up to a 76% reduction in crashes. Crashes that do occur are most often low-speed collisions. Many cities and communities have incorporated smaller roundabout type designs on their streets to help reduce speeds.

Slimming down roads with a "road diet" has helped Santa Monica, California reduce crashes. After unsuccessful attempts to reduce crashes and speeding, the city, with a population of approximately 94,000, temporarily converted a four-lane divided road to three lanes with a two-way center turn lane. While it removed one lane in each direction, the new design reduced the number of crashes by 65%. Speed studies showed motorists drove 10 miles per hour slower due to the changes. The change was so successful that the city made them permanent.

EDC innovations helped Louisiana develop a strategy in selecting locations for major roadway safety improvements. Using the latest crash and roadway analysis software, the state was able to strategically place more than 100 miles of cable barrier in areas most vulnerable to wrecks. Louisiana plans to install another 180 miles of barrier by using new technologies available through the EDC program.

Every Day Counts is kicking off 2017 by promoting a new round of 11 innovations to help communities and states improve their roads and transportation management efforts. They range from new concrete designs to fresh strategies of when and how to apply pavement preservation techniques. Others include how to better manage traffic during highway incidents, and how to successfully manage transportation projects to promote safety and revitalize communities. These innovations are but a few of the many opportunities available for any transportation planner.

Whether it's putting your city street on a road diet, or looking for new ways of improving safety on a major highway, the Every Day Counts program could be the answer to helping you solve some of your transportation challenges.

No matter the size of your community, there is a good chance you will find an innovation in the EDC's past and present toolbox to help you solve a transportation challenge.

For more information on the FHWA's Every Day Counts program, visit www.fhwa.dot.gov.

NCTCOG SEEKS PARTNERSHIPS FOR AUTOMATED VEHICLES

NCTCOG recently issued requests seeking partners interested in transportation data sharing to advance automated vehicles and accelerate their integration into the transportation system. Several vehicle manufacturers and travel navigation services are testing technology that will take data from infrastructure and convert it to information that will make travel easier.

Many vehicles already contain sophisticated sensors and computers that offer navigation assistance, remote starting and automatic braking. Automobiles connected to the internet also provide blind-spot warnings to drivers and assistance with parking.

Technology is evolving so rapidly that the vehicles of tomorrow will offer even more automation. Soon, there could be technology that will help you more easily navigate city streets. There is a continuing effort across the country to use data to improve mobility.

The City of Frisco recently demonstrated an in- vehicle application from Audi that indicates to drivers when a light will turn green, how long a red light will last and what speed they could drive to optimize their chances of getting green lights at intersections. This is one application of sharing traffic-signal data.

Path to Vehicle Automation

To facilitate the advancement of vehicle automation, NCTCOG plans to:

- Maintain current infrastructure, with special attention to lane markings.
- Make transportation-related data accessible in real time.
- Support shared-mobility services.
- Factor automated vehicles into planning decisions.
- Support automated vehicle pilot deployments.
- Focus on automation's social and economic development opportunities.

Through its requests for partners, NCTCOG seeks to encourage developers of applications and auto manufacturers to help the region assume a leadership role in the deployment of automated-vehicle technologies. Additionally, North Texas is a partner in the Texas network of automated vehicle proving grounds.

Arlington, with the presence of a major university, well-developed street grid and Interstate Highway 30 (with a protected managed lane) is thought to be a good candidate for the testing of automated vehicles at different speeds.

Continue on the next page.

NCTCOG's role in automated technologies will be multifaceted

Billions of dollars are being invested in vehicle automation by the public and private sectors in part because of the many potential benefits of the technology, an important factor in a region like North Texas seeing continued population growth and limited resources to expand the system.

Potential vehicle automation benefits include:

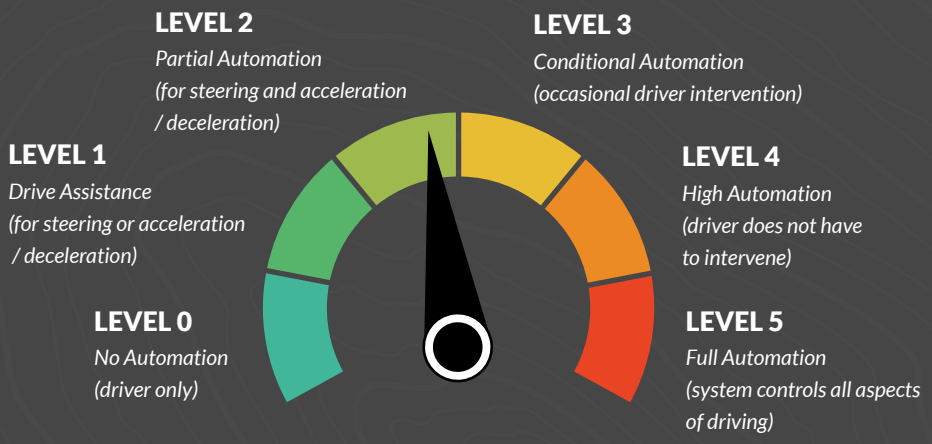
- **Safety** – Human error results in 90 percent of crashes on the roads. Travel by air or rail is statistically much safer than driving. Automation could reduce the crash rates on the roads.
- **Efficiency** – Highway performance has not changed much in generations. Automation could help North Texans travel more effectively through improvements such as more efficient routing.
- **Environment** – Shared mobility, especially micro- transit, can move more people in fewer vehicles, reducing the demand for parking lots and expansion of highways.
- **Access and equity** – Shared mobility and automation could help provide more transportation options to more people with fewer vehicles, reducing transportation costs and improving access to jobs.
- **Demand** – It is difficult to know how vehicle automation will impact demand, but the efficiencies realized through this technology could allow more vehicles to travel farther.

The region's geography, well-developed transportation system and desire to attract and retain talent in the automotive technology sector make Dallas-Fort Worth a potential leader in the industry. NCTCOG is prepared to assume a key role in the deployment of the technology and is ready to work with researchers, auto manufacturers and governments to advance the concept as it seeks safer, more efficient transportation.

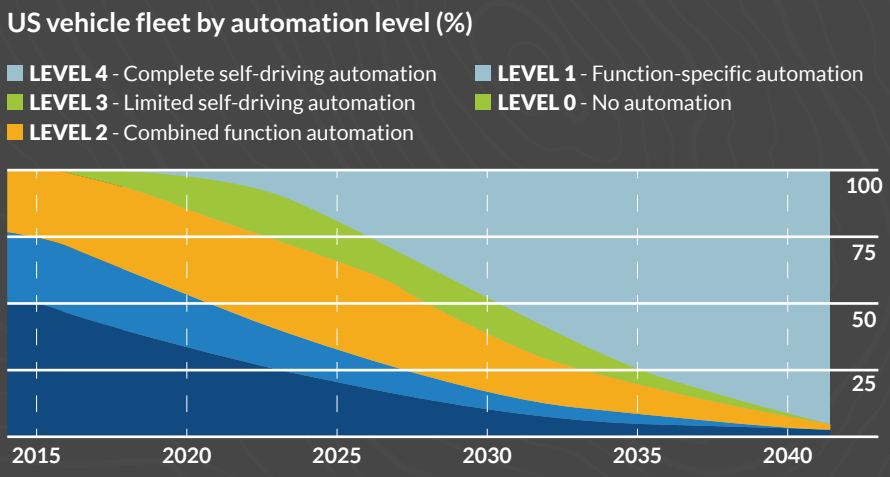
Here is a breakdown of the automated vehicle technologies:

- **Autonomous vehicles** – "Driverless cars."
- **Vehicle-to-vehicle** – The federal government has reserved a band of wireless spectrum for this technology, which would allow cars to communicate a basic safety message with one another to improve safety.
- **Connected-vehicle** – Connecting vehicles and infrastructure via cellular will support everything from infotainment to safety applications.
- **Vehicle-to-infrastructure** – Wrong-way driving, traffic- signal phasing and work-zone warnings.

LEVELS OF VEHICLE AUTOMATION



DRIFTING TO DRIVERLESS



Source: Transurban, University of Minnesota

UTA RESEARCHER EARNS TXDOT CONTRACT TO USE GEOCELLS TO IMPROVE PAVEMENT INFRASTRUCTURE

by Jeremy Agor

A researcher at The University of Texas at Arlington is working to determine the benefits of using recycled materials and geocells to improve Texas highways.

Anand Puppala, a professor in the Civil Engineering Department, is using a two-year, $360,000 Texas Department of Transportation interagency contract to test the performance of recycled materials and geocells in a highway-widening project in Johnson County, Texas.

This project will help TxDOT's Fort Worth District determine if the geocell concept can be used as an additional tool to provide an effective pavement structure for widening existing roadways.

Puppala is conducting experiments using recycled asphalt pavement or RAP in conjunction with geocells to find out if it is an effective way to recycle valuable materials. Geocells are modular structures that are arranged similar to a honeycomb, filled with aggregate, then compacted to support a drivable surface. Sensors in the pavement will collect data from traffic loading and other factors from the site for two or more years. Puppala then will use that data to develop specifications for the design of future projects.

"We are trying to learn if there is a benefit to using RAP and geocells at a four- to six-inch thickness versus using traditional materials," Puppala said. "If there is a slight slope, more traditional materials and a greater right-of-way will be required. This confined system uses recycled materials and does not require as much fill while holding the material in place, so there should be a significant cost savings."

The research is just one example of how UTA contributes to sustainable urban communities, a theme of the university's Strategic Plan 2020: Bold Solutions | Global Impact.

"Maintaining the state's extensive and massive investment in its road infrastructure costs millions of dollars every year," UTA Dean of Engineering Peter Crouch said. "Dr. Puppala's extensive work with TxDOT gives him a unique perspective on the department's needs and the unique problems posed by Texas weather and soil conditions, and I'm confident that his input will lead to significantly better road quality in the future."

"In addition to contributing to TxDOT's top priority of advancing traffic safety, the project has the potential to improve our ongoing efforts to extend the life of our assets," said Richard Williammee, lab engineer for TxDOT's Fort Worth District. "This would allow reallocation of limited maintenance funds toward congestion relief."

DRONE SURVEYS IMPROVE AUTOMATED ROAD CONSTRUCTION

by Charles Choi

When it comes to paving roads, mistakenly adding a quarter-inch of extra material over 10 miles can boost the final bill by a quarter-million dollars. To avoid such mistakes managers are increasingly seeking to improve the overall precision and accuracy of construction projects with automated machine guidance, or AMG.

AMG links construction equipment with onboard computers that use data from 3-D models and GPS to guide operations—saving time and money as well as improving safety and quality. Now the Oregon Department of Transportation, or ODOT, is exploring adding unmanned aircraft to help survey areas for construction efforts.

ODOT is starting out its unmanned aircraft program with a Aibotix Aibot X6 Hexacopter, which can fly programmed flight paths autonomously and carry 4.4 pounds of cameras and sensors.

"We're using traditional RGB cameras at this point, but it's capable of lifting a small LiDAR sensor," said Singh, who also manages all emerging uses of unmanned aircraft systems across ODOT. "Aibotix is working on adapting a LiDAR sensor for this particular hexacopter."

The drone navigates using GPS RTK (Real Time Kinematic) technology, and is designed to be controlled by a robotic total station. Singh and his colleagues are using the drone to generate 3-D maps from orthorectified imagery that accounts for topographical variations in the surface of the Earth and the tilt of the drone. Specifically, they produce digital terrain models via structure-from-motion technologies that estimate 3-D structures from multiple, overlapping 2-D images.

Continue on the next page.

"It's emerging as a good tool for us in surveying," said Ron Singh, who is chief of surveys at ODOT.

"From my perspective, a drone is like a tripod for surveying, only you can place it 200 feet in the air over a particular spot," Singh said. "It's a less expensive and quicker way of moving a sensor to the right position compared to a boom truck or a fixed-wing flight, and in many ways safer—we don't have to have crews rappel down bridges, but instead just fly a drone into a position where it can capture some data."

Learning Curve

Singh and his team are used to producing digital terrain models from high-altitude aerial imagery, but "we are finding anomalies that come from the use of a drone being so close to the ground, and we are learning to change our methodologies to correct for that," he said.

"Some of the anomalies come because we're using structure-from-motion technologies," Singh said. "For example, let's say we're producing a digital terrain model purely from imagery. If we have things like a vertical wall, and the imagery is coming primarily from a camera pointed straight down in the nadir position, then we find that the wall looks wavy. However, if we include some oblique images—if, for part of the flight mission, we turn the camera so it flies along that wall to produce more images of it—then we create a surface model of that wall that is much more correct, that is crisp and sharp."

Another set of anomalies comes from tall grass and bushes.

"If we have a bare piece of ground such as a quarry site, where there is no grass growing that is tall, then using structure-from-motion technologies, you can get a fairly exact model with a couple of centimeters of vertical accuracy and a 95 percent confidence level," Singh said. "However, you may have grass, say, 8 inches high, and you can't see the ground, so the accuracy of the surface model will be off. Still, if we move to LiDAR and the grass is sparse enough so that the LiDAR can see through the grass to hit the ground, we may get better models."

The attraction drones hold for Singh is rooted in part in his experience in flight. His father was a fighter pilot in the Indian Air Force and Singh began flying when he was 14 in gliders pulled down airfields by cables on winches, aircraft that could soar aloft on thermals in Bangalore for long spans of time. Singh is now a private pilot who keeps a hangar behind his house—he built a Rans S12XL Airaile kit plane that he has piloted for 16 years and flew in air shows for eight years alongside other homebuilt planes—and he is currently building a Van's RV12 light sport aircraft.

"My flying has always helped me with my survey work at ODOT, since I had to deal with aerial imagery," Singh said. "Now that I'm managing the unmanned aircraft program for ODOT, it helps a lot that I already had good connections with the local FAA people."

"If I had not been a pilot, I would not have been as informed about what all the regulations are, and those are the biggest issues with drone work; if I had not been a surveyor, I'd have difficulty really knowing all the things you can and cannot do with drones in surveying," Singh said. "Also, as a pilot, I don't want to be hit by a drone when I'm flying, and I want to make sure my people understand that—I'm trying to get drone pilots to recognize that drone flying is a serious business."

3-D Everything

All in all, drone missions are part of "the quest for 3-D everything," Singh said. "We're trying to move from the 2-D design and construction world to a full 3-D world. We want drones to help survey terrain in 3-D, and design on a 3-D map that includes all the underground utilities on a site such as drainage and power lines as well as features on the ground such as trees and walls."

The 3-D data that construction projects generate are now increasingly loaded into machines to help automatically build roads.

"Almost any piece of heavy construction equipment can be automated, and in the long run, that's what we expect," said Singh, who also directs ODOT's engineering automation program.

"When a road wears or fails sooner than expected, our studies have shown that 70 percent of the reason for that failure was workmanship," Singh said. "It's not material, as in you got bad concrete or gravel or asphalt, but workmanship—maybe the material was laid down too thin. With automated machine guidance, you can build better roads, as well as curbs, sidewalks, walls and traffic islands. If you want a 6-inch-thick slab of concrete, you get it."

In the early days of AMG, the only construction machine that might receive it was the motor grader, which uses a long blade to cut, spread and level material, "but over time, more and more construction machines have gotten automated," Singh said.

"Let's say you want a concrete roadbed for a section of freeway," Singh said. "All in all, concrete paving can get to within probably 2 to 3 millimeters of vertical accuracy. You'll have a milling operation grinding up the old road, picking up material and putting it away in a dump truck and hauling it off. That can be automated; can be controlled by a total station or GPS. Then maybe behind it you'll have a concrete paving operation. That can be one big machine laying down a concrete roadbed maybe 10 or 12 inches thick, and that's got people on it, but they're managing the computers, not actually driving the machine. A few feet behind that machine you'll have another one finishing that rough concrete slab, and that will be controlled by total stations or GPS."

AMG is now dramatically improving construction projects in Oregon. "One contractor, K&E Excavating, has invested heavily in AMG," Singh said. "In 2010, they were only getting a few projects from ODOT, but now they're getting almost every project there is because they can get their bids lower. They're coming up with bids lower than our engineers' estimates."

"For instance, when it came to a project to rebuild an interchange on the interstate that was designed to be three years long, K&E managed to shorten it by one year down to two years," Singh said. "So that's less time and money, and less disruption to traffic, and one less year on a site where all sorts of traffic is trying to maneuver through a work zone, so the reduction of risk of accidents is huge.

We find that contractors that use AMG are getting jobs while others are not, and the others are scrambling to catch up."

"In my experience, Ron's approach toward automated machine guidance and drones is very unique in the world of departments of transportation—it's the most progressive I've seen," said Paul McDaniel, owner of Advanced Geodetic Applications

Lyons, Colorado. "Whereas most of the departments of transportation that I'm familiar with have taken the stance that this technology is an oncoming freight train that they can do nothing to stop, his approach is to embrace it, that this is technology that can be useful if we learn what its capabilities really are. I've found that to be a very refreshing approach. If you don't understand how this technology works, you leave yourself open to manufacturers and contractors taking advantage of you."

Oregon's tax and funding allocation structure means that ODOT "is better funded, and more dependably so, than a lot of other departments of transportation are," McDaniel said. "With that said, Ron has made very good use of the resources at his disposal, accomplishing the most with the least, whether that's dollars or manpower. Ron has tried to stay ahead of the curve when it comes to technology, and most governmental organizations I know of, whether local, state or federal, have let the curve get ahead of them."

Future Directions

Federal regulations still pose significant hurdles to what Singh would like to achieve with drones.

"We cannot fly drones over people, so if we're doing a project and we're mapping the highway system, we do work out in remote areas, and in areas where the traffic volumes allow us to," Singh said.

The level of accuracy Singh can currently achieve with drones also limits what construction projects he would like to do with them.

"Say you're building a concrete bridge deck—you need to get a vertical accuracy of plus or minus 2 to 3 millimeters, while if you're constructing a paved road, a vertical accuracy of plus or minus 1 centimeter is very reasonable, and if you're building ditches or shoulders that are dirt, a vertical accuracy of a few centimeters will do," Singh said. "With drones, right now, best-case scenario, we can get a vertical accuracy of plus or minus 2 centimeters. So for things like matching a road to an existing road, we wouldn't use a drone, we'd use a different tool in our toolbox, like a robotic total station, or LiDAR sensors."

Construction projects that required only drones might include quarry sites, Singh said. "Drones can also be used in progress reporting—for instance, when you're paying a contractor for moving earth, you pay for how much soil and rock they brought in, and you can use drones to look at that," he said. "Drones can also record images every week or every day just to have a record of what is happening for safety compliance and other things."

One major project of Singh's that he foresees drones could help with is the Virtual Transportation Corridor System.

"The goal is to take our entire state highway system, roughly 9,000 miles of road, and develop a digital representation of it in 3-D, with all our GIS information," Singh said. "The idea is that anyone in our agency, from the director to a maintenance person who needs to mow the grass in a median area, can look at this on a Web-based interface and zoom in on the map, and see anything they needed to make a decision—such as accident history, roadbed friction, guardrails, culverts, signs, traffic lights, vertical clearance—and flip on street view with 360-degree imagery if they wanted, just like Google Street View, or drop in 3-D models into the system as we are building projects."

"We're in the process of collecting all this data with survey-grade devices—we've done more than half the state so far," Singh said. "Drones could absolutely help us build the Virtual Transportation Corridor System. We'll use them where regulations allow us to, and where the use of fixed-wing airborne surveys would be too expensive or take too long. They'll help us get to our goal quicker."

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WILL TECHNOLOGY BRING AN END TO WILDLIFE COLLISIONS?

Collisions with wildlife can be deadly. Your likelihood of encountering animals on the road are not unique to rural areas, and in fact are common in most suburban environments. One of the most common animals that pose a driving hazard are deer. Deer are most often on the move during dawn and dusk- two times of day when visibility can be compromised. The Geico Insurance website cites some statistics from the Insurance Information Institute:

- 6 million deer-vehicle collisions occur each year
- 200 resulting in fatalities
- More than $3.6 billion in vehicle damage

The highest risk states for deer crashes are speckled across the country, from the southeast to northwest. The astounding number of deer-vehicle collisions is a prime example of the tremendous impact wildlife collisions have on driver safety. Yet deer are not alone in the large animal-vehicle collision threat category. Depending on where you are in the United States, there could be frequent encounters with elk or moose as roadway hazards.

So, what happens when a driverless car encounters wildlife? The Google car can interpret larger animals as it does pedestrians, but it cannot currently identify small animals with its sensors, and therefore does not react to them. While car to car collisions may be eradicated by autonomous vehicles, they may not be able to outsmart animals, whose behavior is difficult to predict. Lasers, radar, and cameras are all in use to identify hazards in the roadway, but only large animals can be detected in the same manner that the vehicles detect pedestrians. Simply speaking, if the animal is large enough to be considered a large, soft object (as it interprets humans), the vehicle will react accordingly. Unfortunately, small animals will not be easy for autonomous vehicles to avoid- simply because the technology to detect and negotiate them as an obstacle to be avoided does not exist.

How does the driverless car handle large animals? The car either alerts the human occupant to assume control of the vehicle – or – the vehicle is programmed to respond itself. In the latter instance, the vehicle will make a decision based on what it believes the object in the roadway to be. In this scenario, the large animal will be interpreted in the same manner as a pedestrian, and the reaction would be to avoid colliding with it. As practical as this response sounds, it is not fool proof. Animals both large and small are unpredictable. The downside to the programmed response of the car is that the current position and speed of the animal is what the car will react to. If the animal has a change in speed or path, the car will not be able to adjust to those actions.

Predicting an animal's next move is likely going to remain impossible. No matter how much observation occurs, the results are too inconclusive to adequately program predictive capacities into driverless car software.

What's a driverless car to do?

Probably nothing. We likely need to put the responsibility back to the human in the vehicle. In order to reduce wildlife collisions, we may need to look beyond self driving cars and instead look to other technology that can provide information to drivers, such as roadway sensors. Underground cable sensors have been shown to be able to pick up on objects moving as far as 10 feet away. Smarter roadways such as those equipped with this type of sensor system could provide drivers with alerts that there is a potential hazard in their path, thus signaling the driver to react. Or, our vehicles can be equipped with large animal collision avoidance systems like the one about to be unveiled by Volvo. This feature has a large animal detection with auto brake system that uses a radar sensor, front facing camera, and software to detect animals in or near the roadway, much like the autonomous vehicle's pedestrian detection system. The difference is that we are still in a human driver situation with the ability of the car to override the driver actions- the vehicle uses its camera recognition technology, analysis, and processing with an image database- to get the car to decide whether to activate the system. This is the first car that combines large animal detection with auto braking.

If you are interested in more research about animal collision avoidance, please check the Western Transportation Institute's Road Ecology Program.

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FOLLOW THE LEADER: TWO-TRUCK AUTOMATED PLATOON TEST IS A WINNER

Can an automated, commercial two-truck platoon be deployed on specific corridors in Texas in the next five to ten years? Thanks to a successful test by the Texas A&M Transportation Institute (TTI), the Federal Highway Administration (FHWA) and the Texas Department of Transportation (TxDOT), the agencies are one big step closer to answering that question.

TTI hosted a first-of-its-kind two-truck platooning technology demonstration at The Texas A&M University System RELLIS Campus on July 22, 2016, highlighting one of the TxDOT Innovative Projects. TTI System Reliability Division Head Beverly Kuhn and a team of 15 researchers and in-kind private partners collaborated on the successful test. Representatives from TxDOT, FHWA, the A&M System, TTI leadership and Ricardo Rail, a private-sector partner, viewed the test. Besides Ricardo, the other private-sector partners involved in the project are Navistar, TRW, Denso, Bendix, GreatDane Trailer and Lytx. In addition, Argonne National Laboratory and the U.S. Army Tank Automotive Research, Development and Engineering Center are also participating.

The system successfully executed all platooning scenarios planned for the demonstration. Two Navistar 18-wheelers first linked up and traveled in a figure eight at about 40 mph, followed by an increased gap distance, and ended with left and right lane changes in both directions.

"I'm not surprised at all that this type of innovation is happening in Texas," says Al Alonzi, administrator of FHWA's Texas Division. "These kinds of partnerships — between TxDOT, TTI, USDOT [U.S. Department of Transportation], and private-sector contributors — are the glue to innovation where the rubber is really going to meet the road, and that's what makes me most proud. I have no doubt that the best is yet to come."

Platooning fits neatly into TxDOT's long-term vision for freight. "Freight improves the quality of life for citizens and businesses," says TxDOT Transportation Engineer Marco Cameron. "And commercial truck platooning provides a way for freight to be delivered in a more efficient and cost-effective way."

The demonstration project's unique features include combining lateral and longitudinal control to provide automated steering, acceleration and braking without the driver in the loop. When the system is engaged, the two trucks travel together as one, while maintaining a consistent driver-adjustable separation distance.

Each truck is equipped with radar, cameras, sensors, vehicle-to-vehicle communications and a driver-monitoring system. The combination of these technologies, along with control algorithms, allows the trailing vehicle to safely and closely follow the lead truck. The lead driver operates the truck manually. The second driver is present in the following truck and can take over control if necessary but isn't required to steer or control speed. The system keeps the trucks perfectly aligned.

"The benefits to this type of system are numerous," says Kuhn. "With safety as the primary driver for this technology, the average projected fuel savings is up to 12 percent, and highway throughput will be notably better as well."

TTI Research Scientists Mike Lukuc and Mohammad Poorsartep co-led this concept feasibility phase.

According to Lukuc, "Now that we've demonstrated that the platooning concept works, our phase-two focus will include fine-tuning the vehicle system, adding to the capabilities and robustness of this platform, and continuing the policy and concept-of-operations work that was done in the earlier foundational studies."

The ultimate goal in future phases of this research is to operate these vehicles on the road. The project identified candidate locations where two-truck platoons would provide benefits to the operators and a safe environment for other road users.

What Is Truck Platooning?

Truck platooning is an extension of cooperative adaptive cruise control and forward collision avoidance technology that provides automated lateral and longitudinal vehicle control to maintain a tight formation of vehicles with short following distances. A platoon is led by a manually driven truck and allows the driver(s) of the following truck(s) to disengage from driving tasks and monitor system performance.

SAFETY

By reducing the number of drivers making decisions, the incidence of driver error decreases, this increasing roadway safety for others.

ECONOMICAL

Projected fuel savings of up to 12 percent can drive transportation costs down, and that results in reduced prices at the grocery store.

ENVIRONMENTAL

With reduced drag on both trucks, fuel efficiency increases, bringing down carbon monoxide and other pollutants.

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NEW TECHNOLOGY FOR BACK-UP ALARMS

If annoyance level is an indication, backup beepers may be one of the most harmful noises. One alternative technology to the traditional backup beeper is the broadband beeper. This type of device has the same cadence as the conventional beeper but broadcasts a "white-noise" whooshing sound. An article in Colorado LTAP's newsletter discusses the technology.

Technologies that could mitigate problems from backup beepers have existed for over two decades. Nonetheless, the conventional single-tone backup alarm still dominates road construction and maintenance sites.

Advances in technology mean there are alternatives. One is the BBS-Tek® White Noise Reversing Alarm manufactured by Brigade Electronics. In contrast to the beeping sound of the old fashioned high-pitched pure tone alarm, the BBS-Tek® back-up alarm uses broadband sound, also known as "white sound." Because broadband sound dissipates at twice the rate of a pure tone sound, it doesn't cause noise nuisance to neighboring residents or other workers on site.

The white noise reversing alarm is also considered safer because unlike conventional alarms whose noise can be heard all around the work site, broadband is localized. This means the sound is directed only into the hazard zone and not everywhere else, which increases response to the alarm and diminishes the chance of it being ignored. In a busy working or urban environment, anyone in the danger zone can recognize that the sound is coming directly from the reversing vehicle nearby.

White noise reversing alarms have been approved for use in construction vehicles in all areas of New York City and were implemented on the equipment at the Town of Snowmass Village, Colorado.

FHWA ANNOUNCES VEHICLE-TO-INFRASTRUCTURE GUIDANCE

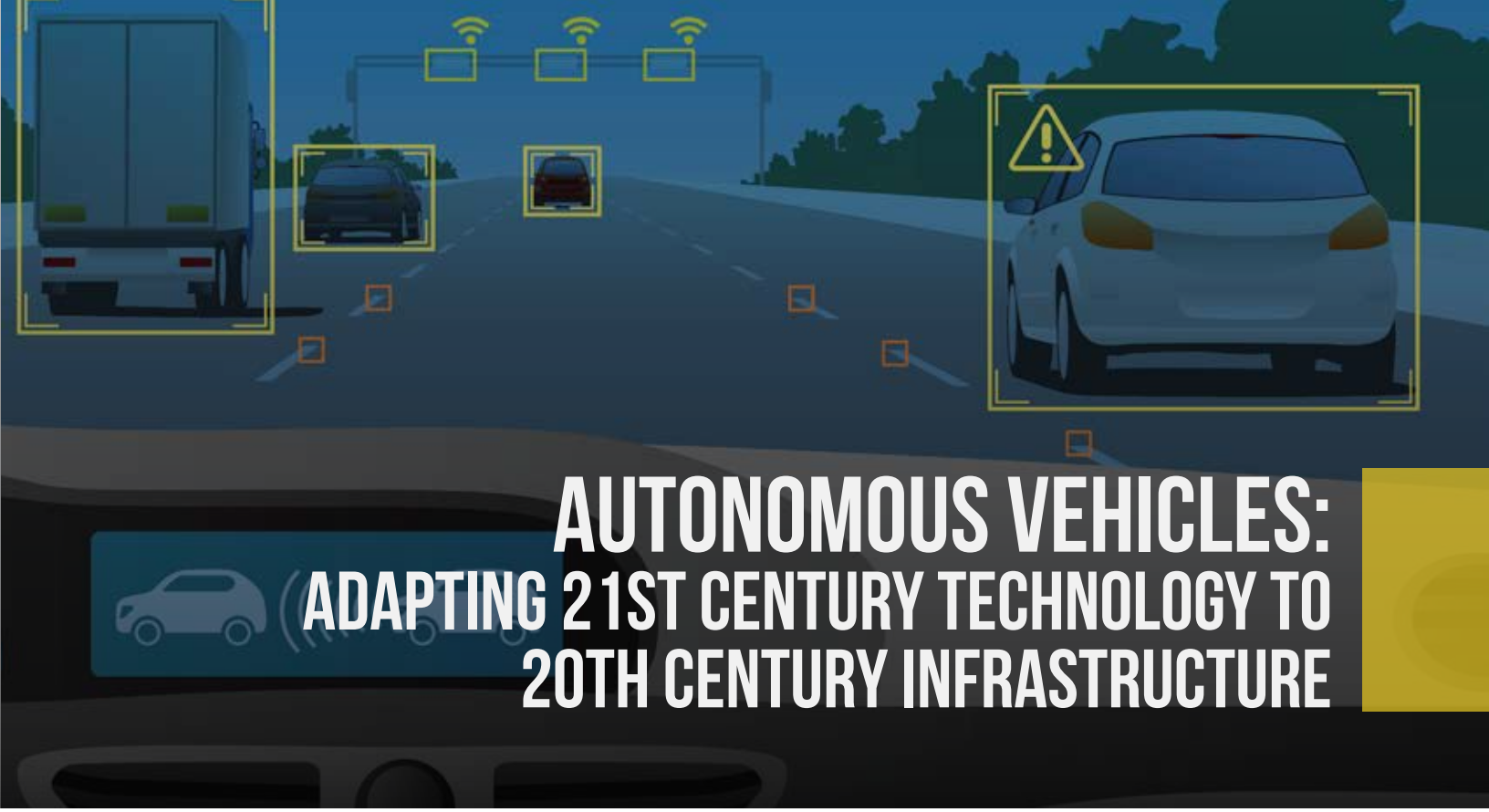
On January 19, 2017, Anthony Foxx, the previous U.S. Transportation Secretary announced new Federal Highway Administration (FHWA) Vehicle-to-Infrastructure (V2I) guidance that can improve safety and mobility by accelerating the deployment of V2I communication systems. The guidance complements the Department's efforts to reduce crashes by advancing (Vehicle-to-Vehicle) V2V communication technology announced in a proposed rule in December.

"V2I will make our roads safer and save lives," Secretary Foxx said. "This is an important step in deploying a connected vehicle environment."

V2I communication is a critical component of a connected vehicle environment—a system of hardware, software, firmware and wireless communication that enables the dynamic transfer of data between vehicles as well as between vehicles and elements of the roadway infrastructure.

"In addition to improving safety, vehicle-to-infrastructure technology offers tremendous mobility and environmental benefits," said FHWA Administrator Gregory Nadeau. "We took a big leap forward today by starting a national conversation about these topics, the future of V2I technologies and some of the bigger challenges facing us, such as privacy, security and interoperability."

FHWA developed the V2I Guidance to assist transportation system owners/operators as they deploy V2I technology. The Guidance can help transportation agencies and tollway authorities understand what a decision to deploy V2I technology could mean to their region, prepare for emerging V2I/V2V technologies and leverage federal-aid funds to deploy them. The guidance is available at http://www.its.dot.gov/v2i.



AUTONOMOUS VEHICLES:
ADAPTING 21ST CENTURY TECHNOLOGY TO 20TH CENTURY INFRASTRUCTURE

While driverless cars may have once seemed like an invention befitting only a science fiction novel, the reality is that the future is here and autonomous vehicles are already on our roadways. While the actual deployment of large scale fleets of autonomous vehicles (AV) is still on the horizon, many companies have already begun development, and are now testing on roadways. In the midst of the excitement and concern surrounding AVs, there are still questions and obstacles that the vehicles face at a number of levels, including regulatory, safety, design, and economic. The good news is that private companies and government entities are already working together to tackle the issues and ease the integration of this technology that is on the fast track to deployment.

Various studies and real world research efforts have pointed to autonomous and connected vehicles as having numerous travel benefits in addition to mitigating human error in driving. The California DMV defines an autonomous vehicle as "any vehicle equipped with technology that has the capability of operating or driving the vehicle without the active physical control or monitoring of a natural person". AVs thus will not only allow passengers to sit back and enjoy the ride, but may have the potential to reduce traffic congestion, improve highway safety and make even the far suburbs more convenient places to live. The dedication to improving the safety of our roads cannot be understated, however, given that according to the National Highway Traffic Safety Administration (NHTSA), "driver error is the cause of 94 percent of crashes". Autonomous Vehicles, especially working in conjunction with large scale fleets of connected vehicles have the potential of widely reducing traffic crashes.

On top of making commuting a more relaxing experience, AVs will likely help traffic flow more smoothly and efficiently, and ultimately cut down on travel times for commuters. According to the Texas Transportation Institute, "the typical driver spends about 42 hours a year stuck in traffic". AVs will likely take out other human functions in a car, leaving the vehicle with more consistent speeds and better communication with infrastructure and other vehicles, which can reduce congestion issues. As a result, less human drivers on the road may also reduce the need for engineered safety strategies intended to assist human drivers on the road, such as rumble strips or speed bumps. In addition to changing the way we commute and travel, AVs have the potential to change how and where we live. As the USDOT notes, autonomous vehicles "have the potential to transform personal mobility and open doors to people and communities - people with disabilities, aging populations, communities where car ownership is prohibitively expensive, or those who prefer not to drive or own a car - that today have limited or impractical options".

According to global consultant McKinsey & Company, "consumers will begin to adopt AVs starting in 2020, and AVs will become the primary mode of transportation by 2050". However, the future of AVs is still largely dependent on solving issues of safety, technology, cost, social acceptance, federal regulations, and other drivers. All of these are challenges that must be overcome before AVs are the new normal on the roads. As private companies continue research and development, some experts say that developing fail-safe software for driverless cars includes rethinking how software is even designed. Most of the software we use in our everyday devices - phones, laptops, and "smart"-accessories - are not intended to operate for long periods of time without crashing or freezing. In a driverless vehicle, such a software error would have larger consequences and even deadly results. The safety of autonomous vehicles remains a major issue and question for many; as the New York Times pointed out, "Google's self-driving car has already run into another perplexing safety problem: human drivers."

Continue on the next page.

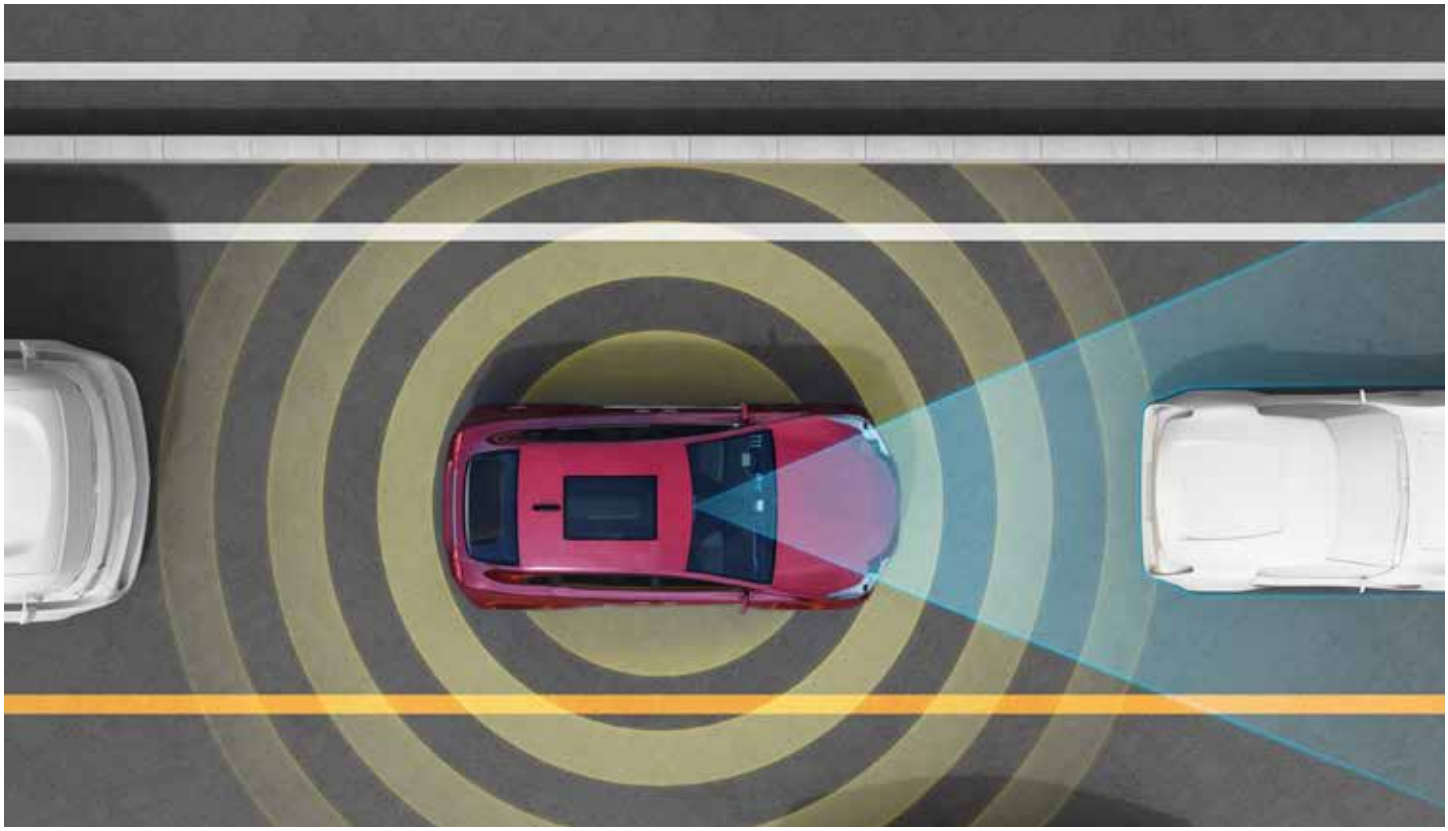
Although AV sensors are constantly being improved and refined for a smoother transition with human drivers, one of the biggest challenges facing automated cars is blending them into a world in which humans don't always follow the rules. While test cars like Google's fleet of autonomous cars have been programmed to follow the law exactly, human drivers who run a stop or even do not come to a full stop, can paralyze the AV sensors and cause a delay in the vehicles path; or worse, can cause a crash.

As developers continue to fine tune their product and technology, State governments have already started preparing for arrival of AVs. States such as California, Florida, Michigan and Nevada have recently passed legislation governing the use of driverless cars, and other states are considering or working on implementing similar legislation. In June 2016, Pennsylvania created the Autonomous Vehicles Testing Policy Task Force in order to "collaboratively develop guidance that PennDOT will use when drafting autonomous vehicle policy". PennDOT is chairing the task force, which is comprised of state, federal and private-industry officials such as the Federal Highway Administration, AAA, Carnegie Mellon University (CMU) and Uber Technologies.

From a regulatory standpoint, the most notable development in the world of autonomous vehicles is the US Department of Transportation release of the " Federal Automated Vehicles Policy" in September 2016. This policy was created in order to meet the "remarkable speed with which increasingly complex AVs are evolving" and "to take new approaches that ensure these technologies are safely introduced, provide safety benefits today, and achieve their full safety potential in the future". Overall, the policy is an agency guidance rather than a set of rules, which is meant as "a regulatory framework and best practices to guide manufacturers and other entities in the safe design, development, testing, and deployment of AVs".

The guidelines are broken up into four major areas of: Vehicle Performance Guidance for Automated Vehicles, Model State Policy, NHTSA's Current Regulatory Tools, and New Tools and Authorities. The Vehicle Performance Guidance for Automated Vehicles (or "Guidance") section outlines best practices for the safe pre-deployment design, development and testing of AVs prior to commercial sale or operation on public roads. The Model State Policy section confirms that states retain their traditional responsibilities for vehicle licensing and registration, traffic laws and enforcement, and motor vehicle insurance and liability regimes. The shared objective is to ensure the establishment of a consistent national framework rather than a patchwork of incompatible laws. The NHTSA Regulatory Tools section confirms that NHTSA will continue to exercise its available regulatory authority over AVs using its existing regulatory tools: interpretations, exemptions, notice-and-comment rulemaking, and defects and enforcement authority. NHTSA has the authority to identify safety defects, allowing the Agency to recall vehicles or equipment that pose an unreasonable risk to safety even when there is no applicable Federal Motor Vehicle Safety Standard (FMVSS). The New Tools and Authorities section identifies potential new tools, authorities and regulatory structures that could aid the safe and appropriately expeditious deployment of new technologies by enabling the Agency to be more nimble and flexible.

Overall, the collaboration between a number of involved parties, including state and federal policy makers, safety advocates, city planners, auto makers and insurers, software developers, and others needs to continue as both the product and the regulations that guide it are produced and refined. As the overhaul of our nation's transportation infrastructure continues to be realized, the importance of safety, regulations, and honest vehicle testing is greater than ever.



FLYBY DFW AIMS TO INSPIRE YOUTH TO TAKE FLIGHT

Aircraft maker Boeing has forecast 617,000 new commercial airline pilots will be needed over the next 20 years. Technicians will be in even higher demand. Boeing projects 679,000 new commercial aircraft maintenance workers will be required by 2035.

With this shortage in mind, the North Central Texas Council of Governments partnered with local aerospace companies and educators to develop FLYBYDFW, a game that allows participants of all ages to fly some of the most sophisticated aircraft in the world – and learn about key aspects of aviation while they are at it. Participants can pilot aircraft such as the F-35, built by Lockheed Martin, Bell Helicopter's V-280 and Airbus Helicopters' H155 and EC-255 through different levels that test their maneuvering abilities, as well as their industry knowledge.

The vast majority of today's youth play video games, whether by themselves or in an online community. According to a survey conducted by The NPD Group, a market research firm, 91 percent of children 2-17 spend time gaming on a variety of devices. Gaming could be an effective way to inspire the next generation to pursue aviation careers. FLYBY DFW takes players through three areas: Alliance Airport, Dallas-Fort Worth and Corpus Christi. The latter was selected because the game's sponsors wanted a setting on the water that would allow aircraft carrier landings. Participants amass points by collecting coins, completing airdrops, dodging other aircraft – and not crashing. They can also pick up bonus points at the end of each level by correctly answering a trivia question about aviation. Competitors start by flying the JG-16, a student-designed aircraft. As they progress, participants are able to unlock parts of different aircraft, from helicopters to fighter jets.

FLYBY DFW seeks to generate interest in aerospace and aviation careers for elementary, middle, and high school students in an effort to build the local talent pipeline for future employment opportunities.

With two major commercial airports, a significant military installation and aviation and aerospace companies with operations in the North Central Texas region, opportunities abound for the next generation to become involved in the industry. By embracing the educational side of gaming, the industry has found a way to reach those future aviators and aviation professionals.

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