

Preparing for the Future

Transportation agencies, including DelDOT, must prepare now for the coming technologies that will fundamentally change how people move and interact with their surroundings. The actions that DelDOT and the State of Delaware can take to prepare for CAV include:

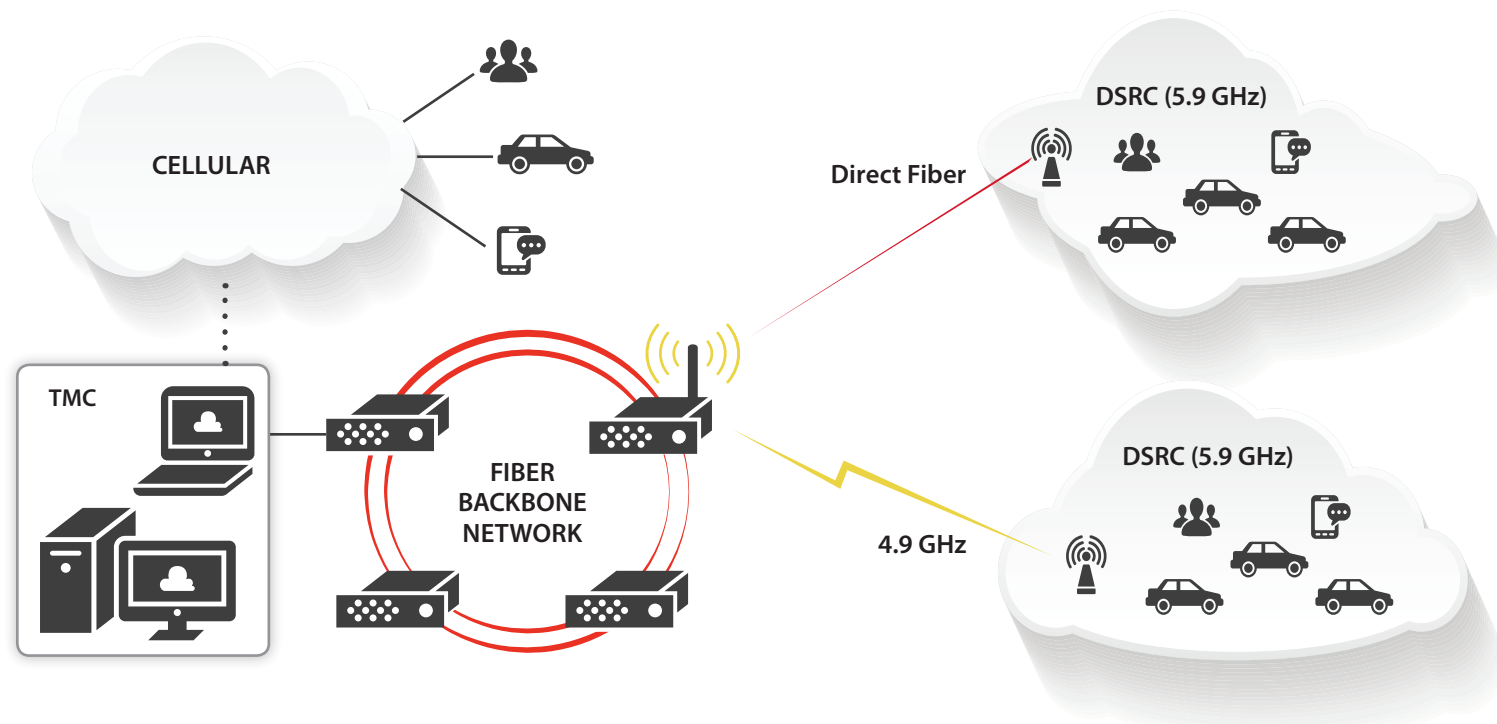
- Providing the digital infrastructure required (which Delaware has already taken the lead on, through ITMS)
- Training staff, within DelDOT and other governmental entities, at the municipal, county, and state level
- Understanding the design requirements for operations and maintenance of automated vehicles
- Preparing existing infrastructure for CAV (taking into account future needs)
- Ensuring data security (vital for public acceptance of the technologies)
- Forming partnerships with the diverse actors involved in CAV, such as transportation providers (Uber), data collectors (Waze), auto manufactures, and “all-of-the-above” firms (Apple, Google)

Various regulatory and industry entities are attempting to determine the best guidance for state and regional DOTs, and it is incumbent upon DelDOT to keep up with technological developments, make strategic investments, and maintain future flexibility. This will require enhanced staff education and training, new plans and programs, and legal and regulatory adjustments. For example, traditional roadway technologies presume regular maintenance schedules and a gentle slope for lifetime utility. In the short-term planning horizon, CAV infrastructure may increase the level of uncertainty over the cost of constructing and maintaining roadways. In addition, the development of CAV architecture should be consistent with the statewide transportation planning process and with any existing or planned ITS strategic planning efforts.

In addition, there exists the possibility of significant changes to the entire transportation system and overall economy if fully automated vehicles become the standard form of personal travel. The implications of such a transformation are difficult to predict at this time but developments, while potentially dramatic, will not happen overnight – there will be a period of adoption and adaptation before true acceptance occurs. Considering that American consumers purchase 17.5 million vehicles and drive over 3 trillion miles every year, impacts of widespread CAV deployments will be profound.

V2I Networking Concept

Leverage Existing Backbone Fiber network and future 4.9GHz connections to tie in 1,700+ field network nodes

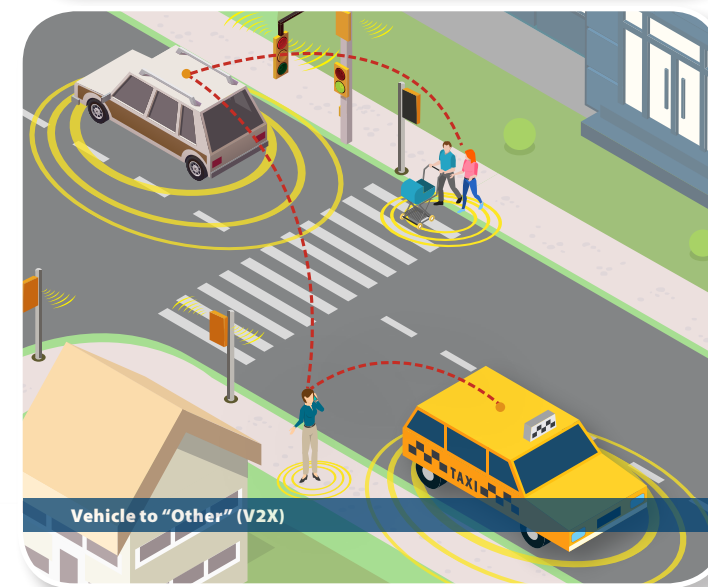
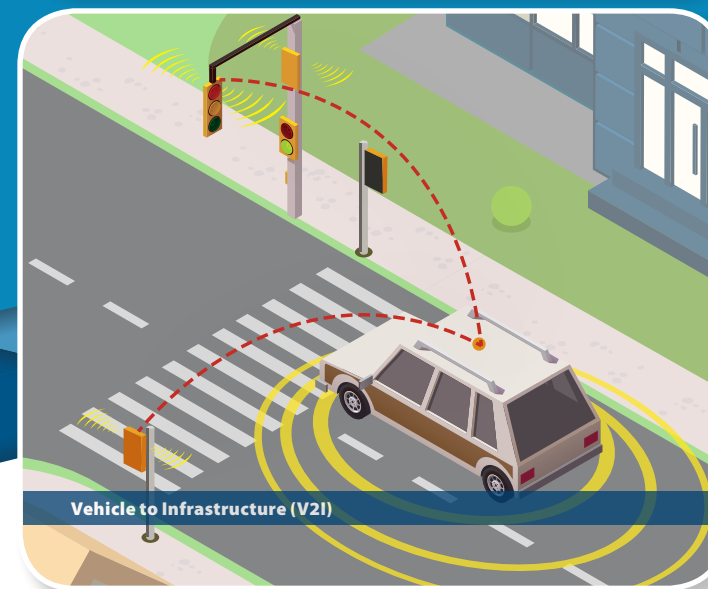
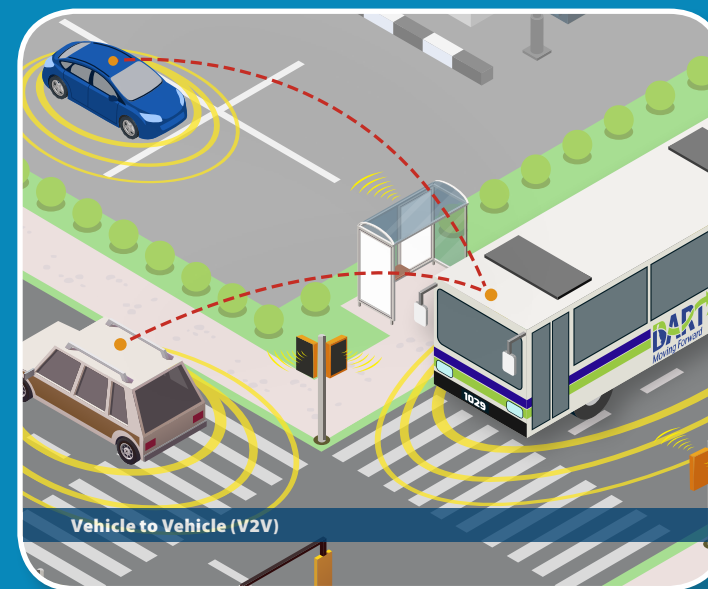


Dedicated Short Range Communication (DSRC) is a wireless capability that permits high data transmission critical in communications-based active safety applications.

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www.deldot.gov

DelDOT App for Smart Phones:



Connected and Automated Vehicles: The next phase of ITMS... ... We are ready!

Why We are Ready –

- The State of Delaware has continually upgraded and invested in its telecommunication and IT systems over the last 20+ years, including ITMS (Integrated Transportation Management System)
- The Transportation Management Center (TMC) supports the integration of multiple transportation, communication, and data systems
- The Mobile App, available since 2012, offers a wealth of real-time traffic and weather information
- DelDOT is a true multimodal transportation agency
 - Owns 90% of the roads
 - Owns most of the traffic signals
 - Operates the transit system
- DelDOT's computerized traffic signal system is a powerful tool for daily transportation management, and integrates with other data systems, such as traffic monitoring, incident management, and transit operations.

DelDOT will begin deploying the infrastructure (I) side of V2I in 2017.



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What are Connected and Automated Vehicles (CAV)?

Connected and Automated Vehicles (CAV) are vehicles that utilize technology to communicate with other vehicles, connected devices, and the transportation system.

Connected Vehicles

Simply stated, connected vehicle technologies allow vehicles to communicate with each other and the world around them. Navigation systems and mobile applications already include connected vehicle functionality, such as dynamic route guidance which utilizes probe vehicle data. The connected vehicle concept is about supplying useful information to a driver or a vehicle to help the driver make safer or more informed decisions. Connected vehicles can also serve as data collectors and anonymously transmit traffic and road condition information from every major road within the transportation network. Such data can provide transportation agencies with the information needed to implement active strategies to address challenges, such as relieve traffic congestion. Connected vehicles use wireless technology to connect vehicles' information and locations to one another (V2V), to infrastructure (V2I), or to other modes such as internet clouds, pedestrians and bicyclists (V2X). While the U.S. DOT defines Connected Vehicles as one that uses the ITS band of the 5.9GHz spectrum, other wireless technologies (cellular, LTE, wi-fi, satellite) may become increasingly employed, for safety and non-safety applications.

Automated Driving Vehicles

Some vehicles are already being deployed with autonomous functionality, such as self-parking or collision avoidance features. Until a vehicle can drive itself independently, however, it is not a true autonomous vehicle. A fully autonomous vehicle does not require a human driver, as they are computer-driven. The vehicle is designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip. By incorporating connected vehicle technology, autonomous vehicles will be safer and more efficient through coordination. Furthermore, virtually all autonomous vehicles will require some form of connectivity to ensure software and data sets are current. As autonomous vehicles rely on knowing the roadway they are traveling on, changes to the roadside such as new development or construction will require the type of real-time exchange of information that connected vehicle technology provides.



Next Phase of ITMS Network

While the eventual widespread introduction and use of CAV technologies and vehicles will have a profound impact on all aspects of transportation, including the roles and responsibilities of government agencies such as DelDOT, it is important to view CAV as the next step in the evolution in transportation, not a revolution. As the Model T begot the Corvette and the early mainframe computer preceded the iPhone, Connected and Automated Vehicles will be the latest and greatest evolution of mobility technology, until the next evolution occurs.

DelDOT, through its existing Integrated Transportation Management System (ITMS), is uniquely positioned to fully integrate all the potential benefits of CAV into its existing data collection and assessment initiatives.

ITMS includes the planning, design, implementation, operations, and maintenance of the statewide intelligent transportation system (ITS). Through the Transportation Management Center (TMC), ITMS works with internal DelDOT divisions to manage incidents, events, emergencies, and detours; maintain and update the ITS as technologies advance and evolve; manage construction work zones; and ensure a safe and efficient traffic flow.

Data that flows from connected vehicles will help the TMC and DelDOT manage traffic and prioritize future investments, and important information from the TMC will go directly to connected vehicles, helping drivers make travel decisions. Similarly, the ITMS is well-equipped to integrate automated vehicles, however the technology evolves, into the existing data collection and information distribution.

What are the Potential Benefits of CAV?

BENEFIT	METHOD
Reduced crashes and improved safety	CAV has the potential to eliminate 80% of unimpaired crash scenarios, by reducing the possibility for driver error. According to NHTSA, more than 590,000 crashes could be prevented each year, just by deploying Left Turn Assist and Intersection Movement Assist, which are two of the many CAV applications currently under development, in addition to forward collision, blind spot, do-not-pass, and stop light/stop sign warnings
Substantial reduction in travel-time delays caused by congestion	CAV can allow vehicles to drive closer together, increasing roadway capacity
Increased travel time reliability	Smoother traffic flow due to fewer accidents
Improved priority road access for emergency vehicles	Enhanced signal prioritization and vehicle to vehicle communications
Better mobility options for non-drivers	Fully automated vehicles remove the need for human drivers
Lower emissions	Less fuel consumption, through vehicle platooning (reduces air resistance for following vehicles), traffic signal information (can lead to more optimized speeds), and less stop-and-go congestion / vehicle idling
Updated road / urban design	Improved vehicle safety could eliminate crash barriers, roadway signs could be replaced with in-vehicle information, lane sizes could be reduced, and less space would be needed for parking
Real-time data collection	Vehicles, bicyclists, pedestrians, and anyone with a cellular device can provide relevant information to DelDOT, including speed, weather / road conditions, and congestion delay

Timeline to CAV Introduction and Adoption

Limited V2V Availability

NHTSA aims to deliver a Notice of Proposed Rulemaking on V2V communications technology for light vehicles by the end of 2016. Equipment suppliers have indicated that they could have an adequate supply of readily available, mass-produced, internal components for a V2V device approximately 2.5 to 3 years after NHTSA moves forward with some type of regulatory action.

Self-Driving Vehicles

Widespread implementation of advanced automated vehicle technologies (where the vehicle has the capability of self-driving, with no human inputs) is still a number of years away, by most accounts.



2016
Early Automated Technologies
Currently, many vehicles on the road today are equipped with some automated vehicle technologies (where the driver is present and in complete control, but assisted with steering and/or speed control), such as adaptive cruise control, automatic braking, and lane departure warning.



2018 - 2030
V2I and V2V Implementation
In order to reach 95% of all registered vehicles with V2V or V2I technology, it will take a complete turnover of the vehicle fleet, which averages 8 to 11 years. Concurrently, DOTs, states, and municipalities should invest in V2I technologies that can take advantage of these advances in communications, many of which may not require full market penetration to demonstrate benefits to the transportation system.



2020 - 2035
“Shared Driving” Environment
While many vehicles on the road will have the capabilities for fully automated travel, it is likely that a mixture of “CAV permitted” and “CAV not permitted” environments will exist, where vehicles can drive autonomously in certain operating conditions—e.g., below a particular speed, only on certain kinds of roads, in certain driving conditions—and will revert to traditional, manual driving outside those boundaries or at the request of a human driver.

