NJTPA LONG RANGE TRANSPORTATION

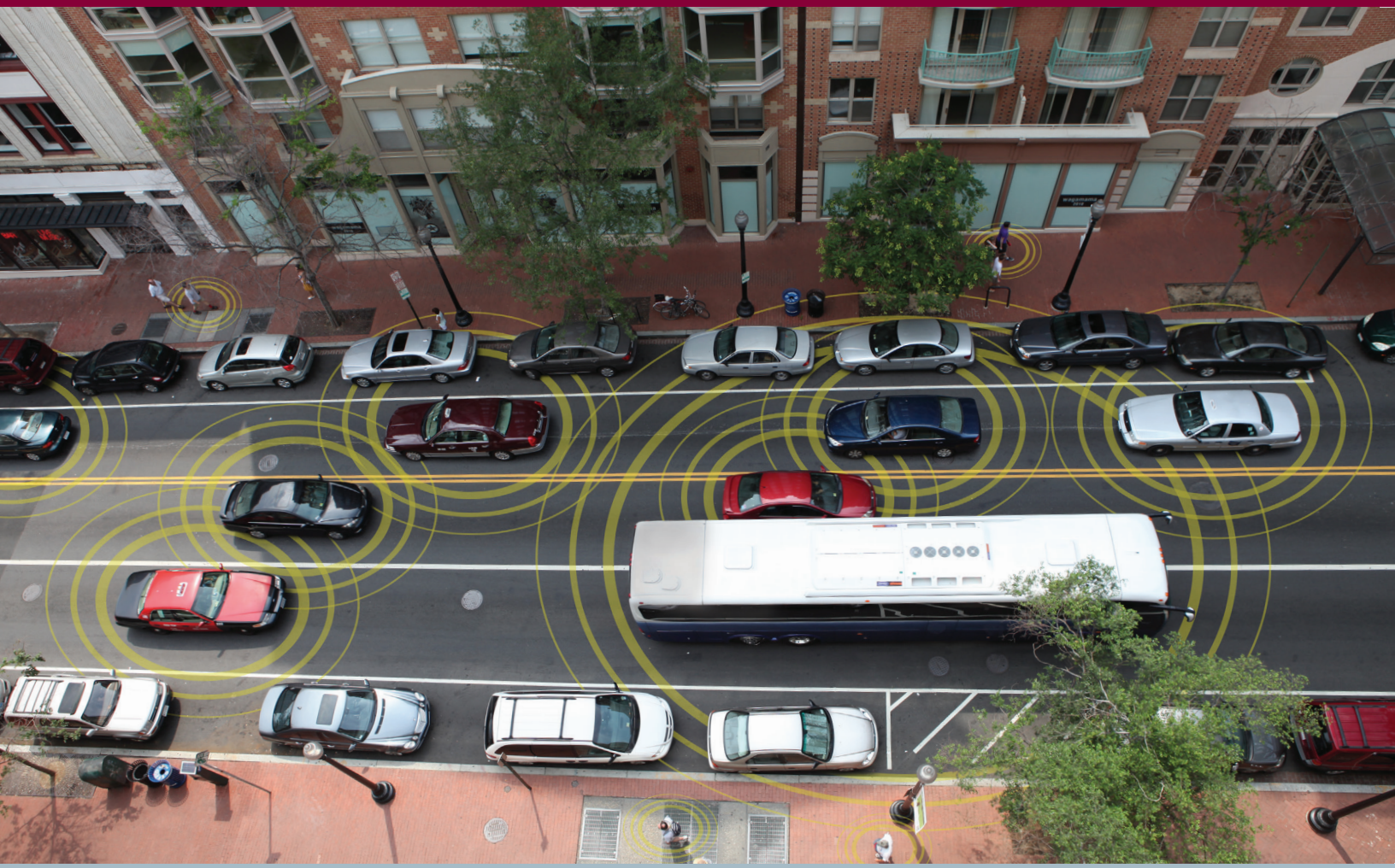
PLAN 2050

Transportation ▸ People ▸ Opportunity

PLAN 2050 BACKGROUND PAPER

Transportation Technology

DECEMBER 2020



NJTPA NORTH JERSEY TRANSPORTATION PLANNING AUTHORITY

Contents

About the NJTPA

The ***NJTPA*** is the federally authorized Metropolitan Planning Organization (MPO) for 6.7 million people in the 13-county northern New Jersey region. Each year, the NJTPA oversees more than $2 billion in transportation improvement projects and provides a forum for interagency cooperation and public input. It also sponsors and conducts studies, assists county planning agencies and monitors compliance with national air quality goals.

A Metropolitan Planning Organization (MPO) is a federally mandated and federally funded transportation planning agency made up of representatives from local government and key transportation agencies. Congress created MPOs to give local elected officials a stronger role in guiding federal transportation investment and to ensure that these decisions are based on a continuing, cooperative and comprehensive ("3C") planning process.

This paper was prepared by staff of the NJTPA. Design: Dralyn Veech, *Senior Graphic Designer*. Cover and illustrations: NJDOT. Photos: VDOT, p3; Ed Murray, pp 12, 18; Bill Wittkop, p 15; Steve Hochstein, p 20.

Introduction

Driverless vehicles and other technological advances will transform the transportation system in the coming years. While these technologies promise safer and more efficient travel, public agencies like the North Jersey Transportation Planning Authority (NJTPA) must ensure they are applied equitably and respond to the region's mobility needs. North Jersey has one of the nation's most heavily traveled transportation networks and has much to gain from these emerging technologies if they are successfully implemented.

Technology such as adaptive traffic signal systems, traffic operations centers and multiagency incident response networks is already helping reduce traffic congestion and its enormous economic costs while also improving safety. On the transit network, technology is giving riders real time information on the location and arrival times of buses and trains.

These innovations are examples of Intelligent Transportation Systems (ITS). For decades, government grants and federal programs have laid the foundation for ITS, with growing involvement from the private sector. Promising ITS applications have attracted multibillion-dollar investments by technology companies, major automakers and start-up firms around the world.

The pace of investment and research in ITS has ramped up tremendously in recent years, with particular focus on connected and automated vehicles (CAV). These vehicles could have a dramatic impact, including reducing or even removing human error from the driving equation. Many first-generation automation features to assist drivers—such as blind spot information systems, pre-collision systems that detect pedestrians and vehicles, lane departure warning and adaptive cruise control and headlights—are available in the latest vehicle models.

As development proceeds and vehicles are equipped with new features, it will principally fall to the federal and state governments to see that technologies are introduced in an orderly fashion with adequate safeguards to serve the public interest. Extensive preparation is already underway through

technical standard setting, development of "architectures" and other measures. The National Highway Traffic Safety Administration (NHTSA) developed a ***tool*** where autonomous vehicle systems developers can submit information about their testing.

However, ultimately, the opportunities and challenges of ITS and CAV systems will play out on the local and regional level, on transportation networks in each metropolitan area, each with its own character and dynamics. For this reason, Metropolitan Planning Organizations (MPOs) such as the NJTPA have a role to play in helping guide where and how systems are deployed and preparing for their impacts. MPOs also can help engage and educate the public – especially as systems are first introduced.

This paper provides an overview of the NJTPA's technology-related planning activities and offers recommendations for how the agency can help shape future technology deployment through its next Long Range Transportation Plan, looking out to 2050.

ITS

A host of ITS systems and applications are being implemented throughout the country. The most common *categories* of ITS technologies include traffic management, traffic signal control, information dissemination, vehicle management, infrastructure-based safety warnings, road weather management, parking management, electronic toll collection, and commercial vehicle operations management. Technical standards and communication protocols for ITS systems have been developed cooperatively by the *U.S. Department of Transportation* and non-profit organizations —notably the Institute of Electrical and Electronics Engineers , the Association of State Highway and Transportation Officials (AASHTO) and the Society of Automotive Engineers (SAE)—device manufacturers and others.

Data capture and management

The standards are part of a national "ITS Architecture," established under *federal law*, that guides development and deployment of these technologies. Each state and region of the country is also required to develop its own ITS Architecture to ensure that various transportation technologies can work together smoothly and effectively.

Many ITS systems draw on data collected in real time from roadway and rail systems. Roadside sensors, vehicle counters, and cameras have traditionally been maintained by public agencies. They have been supplemented by systems for gathering position and speed data from smart phones as people travel. Companies such as INRIX compile and distribute this anonymized data for use by transportation agencies. Once compiled and interpreted, the data are the basis for information distributed to the public through travel apps, media traffic reports and 511 traveler information systems, which identify incidents and delays in real time. Transportation Management Centers use ITS technology to coordinate responses to traffic incidents.

On the transit system, data collected by GPS-equipped buses and trains provide travelers with real-time arrival and departure times on station displays and smart phone apps. Positive train control systems (PTS) being finalized nationwide use GPS technology,

Wi-Fi and high band radio transmission to automatically control train speeds and movements, thereby reducing the risk of crashes due to human error.

Real-time data from these systems are being compiled and archived, providing a resource for transportation agencies to better understand the operation of the transportation system and its needs. Archived data can be analyzed to show shifting volumes and travel patterns in response to improvements or events and emergence of long-term trends. The NJTPA and other planning agencies are increasingly using this "big data"—with the assistance of university researchers—to better understand and respond to traveler's needs on their transportation networks.

Connected and Automated Vehicles

Increasingly, those researching and developing ITS look toward a future in which Connected and Autonomous Vehicles (CAV) transforms the way people and goods across the nation travel. Numerous resources are available, including this Wired *article*, this MIT *report* and this federal *FAQ*, describing these technologies and their development. In brief:

Connected Vehicles use short to medium range communications to interface with infrastructure (V2I) and other vehicles (V2V), allowing coordination of movements to minimize crashes, reduce congestion and make more efficient use of road space, among other applications. Wider connectivity, known as vehicle-to-everything (V2X), includes pedestrians, bicyclists and other modes, and possibly buildings and non-transportation systems.

Intersection movement assist

Automated Vehicles provide varying levels of automation to reduce the role of drivers in directing vehicle movements. The automation ranges from driver assistance such as adaptive cruise control and lane assist (now on many vehicles), to self-parking and limited "auto-pilot" on highways (just emerging) to fully driverless vehicles (limited to experimental prototypes).

The technologies are transformative in that they promise to drastically reduce crashes—80 percent or more with fully automated vehicles—and open up a wide range of possibilities for more efficient transportation, new travel options, and even new options for reorganizing community land use. Among the possibilities are the following:

- Vehicles that brake or take evasive action to avoid impending crashes faster than drivers can react–near term (next 5 years)
- Devices at intersections that not only adapt signals to traffic levels but can orchestrate the movement of vehicles to reduce congestion or prevent collisions–mid-term (5 to 10 years)
- Coordinated adaptive cruise control systems that sync the speeds and locations of vehicles traveling

on highways, making possible platoons of cars and trucks traveling without active driver control – mid-term (5 to 10 years)

- Fleets of driverless vehicles available on-call for all travelers including those with disabilities, youth and others without access to a personal vehicle – long-term (10 to 20 years)
- Automated long-haul trucks that eliminate the restrictions on driver hours of service and shift active driving to only the beginning and end of trips – long-term (10 to 20 years)
- Transit stations served by driverless shuttles drawing riders from dispersed suburban and rural locations – long-term (10 to 20 years)
- Downtown main streets reduced to a single travel lane for automated vehicles, with space once set aside for personal vehicle travel and parking reclaimed for walking, biking, outdoor dining and other uses – long-term (10 to 20 years)

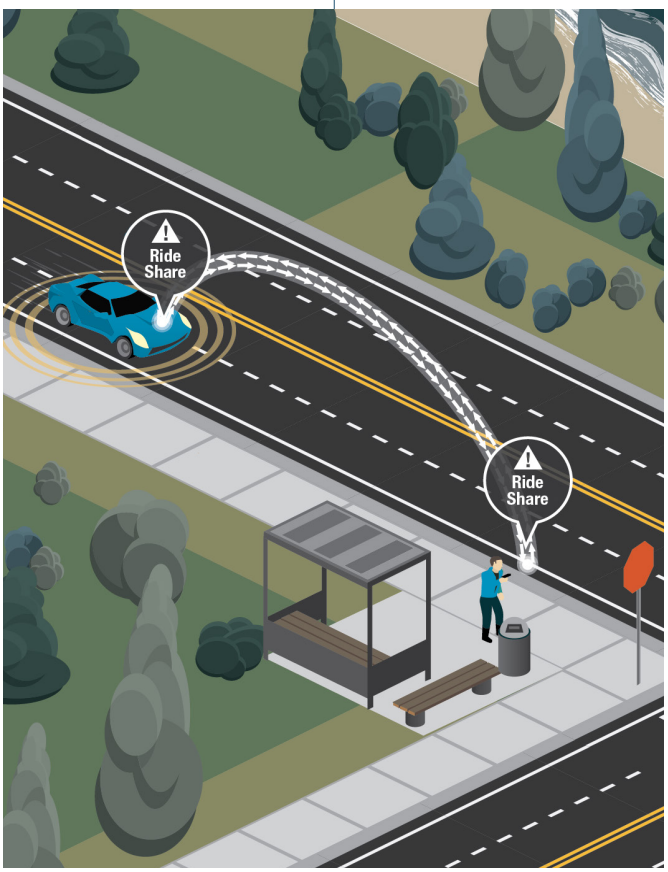
However, realizing these and other transformative benefits in North Jersey will require addressing a host of difficult challenges, including concerns about needed investments, funding, equity, land use and environment impacts.

These transformative CAV technologies are expected to emerge in stages over the next three decades. As noted, automakers are already actively pursuing new automated features on their vehicles. Many of the technologies needed for connected vehicles have been developed and deployed in limited applications—such as traffic signal priority for transit and emergency vehicles. Best estimates are that driverless vehicles will emerge in limited forms in the next decade, likely operating in constrained areas at low speeds. Fully capable automated vehicles may take decades more and may await breakthroughs in technologies and computing.

Changing Technology Landscape

There are a number of developments shaping the way transportation technologies will be implemented and used.

Shared or Ride Hailing Services—Companies such as Uber, Lyft, and Via have created new transportation options, often serving as an alternative to the private auto or taxi and in some cases providing rides where transit service is lacking or inconvenient. While these services are maintained and operated by private companies—relying on mobile device technology, as discussed below—they have been subject to regulation, especially in larger cities. The ride hailing companies have been joined by a variety of other companies in the business of on-demand transportation—including car, van, scooter and bike sharing.



Dynamic ridesharing

Some communities have been able to take advantage of the flexibility and responsiveness of the services to help fill transportation gaps or serve populations with special mobility needs. In New Jersey, Ryde4Life, a statewide program administered by EZ Ride Transportation Management Association, facilitates rides for seniors through Uber and Lyft.

It is expected that when driverless vehicles become available, they will be operated on a business model similar to ride hailing companies as the vehicles will be too expensive for individual ownership. This will create the need for local regulation and oversight.

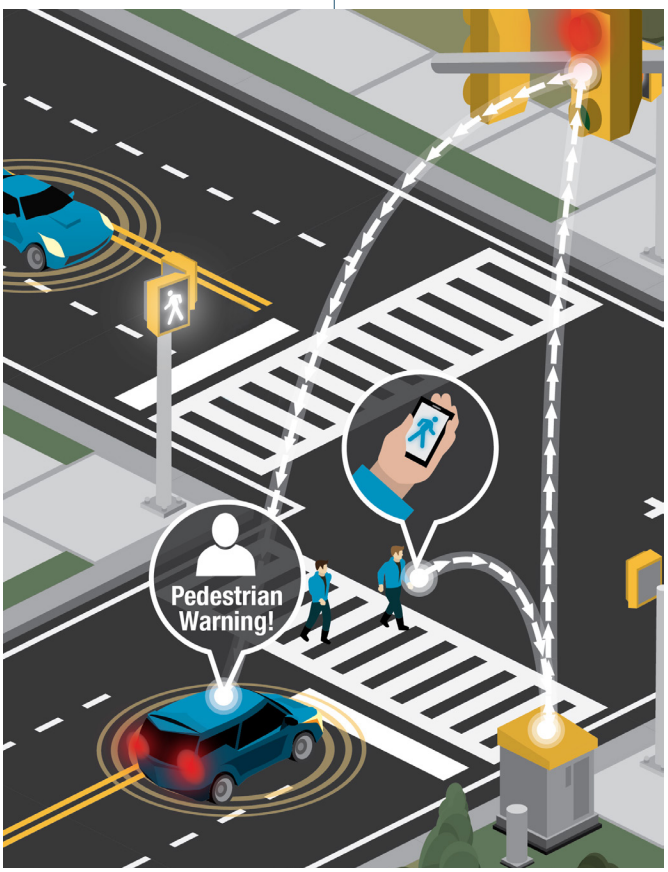
Electrification—Efforts to reduce the use of fossil fuels in favor of electric power are gaining ground in the transportation sector. These efforts are discussed in a separate NJTPA ***Climate Change background paper***. The NJTPA supports the implementation of electric vehicles and has developed guidance for local governments interested in supporting electric vehicle infrastructure or shifting to electric fleets. In addition, the NJTPA has awarded Congestion Mitigation Air Quality (CMAQ) grants for various electrification efforts, including electric port equipment and funds for the state's It-Pay$-to-Plug-In program, which underwrites charging stations. It is expected that by 2030, major

auto manufacturers will have fully committed to electrifying their vehicle model fleets.

That likely will be around the same time that the more advanced CAV systems will emerge for wider use. As a result, the future CAV transportation network will likely rely primarily on electric vehicles and electric power. Use of power from renewable sources, such as through New Jersey's solar and wind energy programs, will further contribute to reducing carbon impacts of the transportation sector.

Mobile Devices—Smart phones and other mobile devices have greatly expanded access to vital transportation information for most people. Mapping apps allow users to quickly find places or plan a trip. Transit agencies are providing real time schedule information via their own apps as well as third-party apps that integrate information about other travel modes. The ability to explore and access multimodal options is part of a growing movement called mobility-as-a-service. Along these lines, an NJTPA pilot project explored developing General Transit Feed Specifications (GTFS) to enable apps to capture the schedules of local transportation providers, such as county shuttle buses—a worthy area for future development.

Smart phones have become the essential tool for accessing ride hailing and on-demand mobility services. Future mobile device technology may allow pedestrians and bicyclists to be detected by and connected to the CAV communications grid to create a safety zone around them as they navigate streets. However, privacy and security are concerns, especially as smart phones are also being used as a source of data for monitoring travel and system conditions, as discussed further below.



Pedestrian signalized crosswalk

Broadband/ Telecommuting—High speed internet allows individuals to get information and data about travel options and resources quickly and reliably. The pandemic has underscored the vital role it plays in remote working and telecommuting. While traditional commuting will rebound after the pandemic, telecommuting will likely be much more common than it was, as many companies continue practices started to keep employees safe. This promises to reduce the volume of cars on the roads, alleviating congestion and improving air quality. But the extent remains uncertain, as does its potential impact on transit agencies due to lost ridership and the effect lost gas tax revenue or reduced mileage-based funding may have on the ability to maintain the transportation network.

For up to 15 percent of U.S. households and 12 percent of New Jersey households, telecommuting —and remote schooling—is not an option because

they lack high speed internet access, creating equity concerns that are now gaining greater recognition and generating calls to action. This digital divide will only grow over the next few years as technology advances, unless high speed connectivity for everyone is addressed.

When 5G networks now being built in some areas become widespread, internet access speeds will be many times that of existing 4G or fiber optic networks. For those that can afford it, 5G will expand opportunities for remote work and collaboration. 5G, along with further advances in communications technologies expected in coming decades, will also greatly expand the reach and capabilities of connected transportation systems. Fast connectivity also makes possible integrating transportation with other systems as part of the Internet of Things, as discussed below.

Smart Cities/Internet of Things—Transportation technologies can be integrated with other internet-connected systems used by and serving the public to create data-driven "smart cities." A smart city pilot project in Columbus, Ohio used more than 3,000 datasets on traffic characteristics, city infrastructure inventory, crash records, weather readings, emergency response times, food services, parking locations, health behaviors and more. The integration and coordination of the various systems facilitates efficient public services. Among the applications are improving transit services to meet changing needs; implementing mobility-as-a-service; deploying resources in response to emergencies or events; and making cost effective budget decisions across city programs and services. Newark and other larger cities in the NJTPA region are exploring these sorts of strategies. However, as interconnected systems proliferate, cities must take steps to make them secure, fail-safe and resilient, with redundancies to allow operations to resume after disruptions.

State/Metropolitan Initiatives

The NJTPA coordinates with its partner agencies in pursuing a variety of ITS programs and projects that are helping improve regional travel and preparing the region for the advent of CAV. In some cases, projects and programs are funded through the NJTPA's Transportation Improvement Program (TIP), as discussed later. A non-profit advocacy group, ITS–NJ, a state chapter of ITS America, provides education, forums and outreach to foster the understanding of ITS applications and technologies. Among the major ITS initiatives coordinated statewide or across the tri-state metropolitan area are:

ITS Architecture—The New Jersey Department of Transportation (NJDOT), NJ TRANSIT, the New Jersey Turnpike Authority and other transportation agencies in New Jersey have cooperated in the development of the state's *ITS Architecture*. The architecture website says the system elements "represent transportation management centers, field equipment (e.g., detectors, CCTV cameras, dynamic message signs, and weather stations), vehicles with ITS equipment (e.g., buses, commuter trains, and snow plows), and traveler equipment (e.g., mobile devices) that satisfy transportation system stakeholder needs."

Transportation System Management—NJDOT also maintains the *Transportation Systems Management (TSM) Procedure Manual* to ensure consistency in the design process of various ITS facilities. NJDOT's Bureau of Mobility and Systems Engineering manages the development, implementation, and support for ITS initiatives. The agency also operates two Traffic Operations Centers to manage traffic on state highways.

TRANSCOM—This non-profit organization is supported by transportation agencies in New York, New Jersey and Connecticut to gather and disseminate data on traffic and travel conditions in real-time. The organization maintains an Operations Information Center and provides a continuous data feed to members. Its feed underpins state 511 traveler information systems; it is used by law enforcement to

respond to incidents; by media for compiling radio traffic reports; and by the traveling public to get up-to-date information on travel conditions.

NJ TRANSIT—The agency employs multiple technologies on its bus and rail network, including:

- Mobile applications for ticketing and trip planning.
- Smart bus technology that monitors vehicle condition, counts passengers, reports real-time locations and generates ridership reports. Data from the systems are used to provide real-time bus information to riders.
- The agency is deploying a federally required positive train control system, which, as noted, will automatically control train speeds and movements to improve safety.
- As part of a pilot project initiated with NJTPA support, buses along Route 9 in Monmouth County are equipped with wireless technology for use in signal preemption systems, which switches a red light to green whenever a bus is approaching. Similar projects are planned in other North Jersey locations.

Weather information for freight carriers

Tunnels and Bridges—The Port Authority of New York & New Jersey Agency Operations Center provides around-the-clock staffing by specialists who use camera feeds, travel- time detectors and other equipment to monitor traffic at all its bridge and tunnel facilities and to coordinate with affected facilities and regional partners to manage traffic incidents and congestion. The agency is also investigating future connected vehicle applications, such as platooning of buses traveling the Lincoln Tunnel to increase capacity.

Freight Movement—ITS applications can be found throughout the freight industry, including multiple apps for matching cargo loads between shippers and trucking firms, warehouse management systems, blockchain systems, and technologies at the New York-New Jersey Port. The latter includes the truck appointment system and automated stacks and truck operations at GCT Bayonne, and PortTruckPass, which includes the Port's web-based Terminal Information Portal System (TIPS), for efficiently managing resources when delivering or picking up cargo.

Highway Safety Data—Efforts to improve safety on New Jersey roads depend on gathering and analyzing accurate data on crashes and injuries. The state's system draws reports from police departments and the State Police and archived real time data from road sensors and cell phones. The State Strategic Highway Safety Plan and NJTPA safety programs, as discussed below, draw upon this data and analysis.

Preparing for CAV in North Jersey

MPOs such as the NJTPA have an important role to play in the deployment of transportation technologies. The Association Of Metropolitan Planning Organizations has ***summarized*** this role:

[MPOs are a] critical venue for sharing community values, concerns, and impacts related to transportation and building consensus on policy and vision across their respective regions. As vehicle connectivity and automation is deployed, MPOs will work with their partners to explore visions of the desired future of transportation … MPOs have the opportunity to help weave vehicle connectivity and automation into the transportation system in a way that is context sensitive to the existing urban fabric and community vision and helps meet regional goals and needs.

The NJTPA has been fulfilling these functions for existing ITS systems through its plans and programs in cooperation with its partner and member agencies. As more advanced systems become available and are implemented, the NJTPA will have to broaden and extend its activities and programs relating to technology, with focus on a variety of new impacts and challenges CAV will present. Among them:

THE NEED FOR SUBSTANTIAL INVESTMENTS

Advancing CAV will require major investments in communications and other infrastructure. According to ITS researchers, the requirements over the next decade include:

- Hardware and software—in particular, traffic signal controllers and related systems—that meet the latest national and industry standards so they will be compatible with future CAV applications.
- Communications infrastructure including equipment and fiber optic or other cabling across the road network and systems for short range V2I and V2X data transfer.
- Upgrading road markings and signing to meet reflectivity and other standards to enable vehicle sensing systems to use them to guide the navigation of automated or semi-automated vehicles and help avoid crashes. The NJTPA has helped subregions comply with reflectivity standards for road markings and signs in the federal Manual on Uniform Traffic Control Devices (MUTCD)
- Upgrading other elements of existing infrastructure as new technologies are likely to have more stringent infrastructure condition requirements.
- Upgrading on-board vehicle systems in the existing vehicle fleet to meet connected vehicle standards.

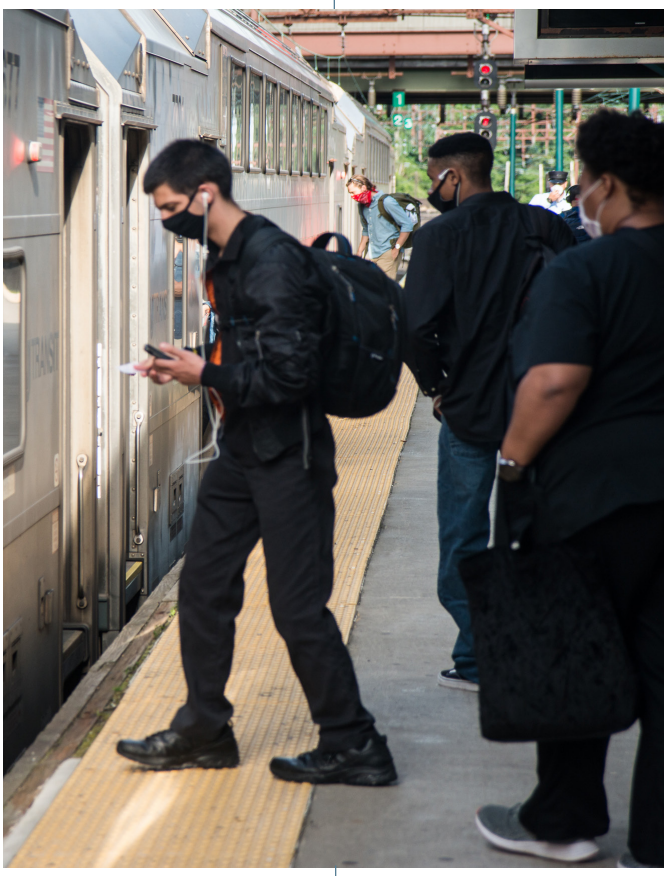
If public and legislative support is gained for making these and other needed investments to advance CAV, they will have to be initiated, funded and overseen by state implementing agencies. To make them possible, states and the federal government must consider structuring fees and cost sharing arrangements with private operators and developers of CAV systems. The investments will have to extend from major highways and corridors down to local roadway and transit systems. They must be accompanied by measures to guard against criminal, terrorist or cyber threats, securing the infrastructure and protecting the

safety of people in vehicles, bicyclists and pedestrians.

The NJTPA's plans and programs can help assess needs and prioritize investments at the local and regional level. Major investments must advance through then NJTPA capital programming process to receive federal funding.

EQUITY AND AFFORDABILITY

Emerging technologies have the potential to improve mobility and safety for all travelers if they are widely shared and accessible. The NJTPA's studies, data analysis, outreach and coordination activities could help support the transition to CAV systems with a focus on equity for diverse North Jersey communities, whose populations vary greatly in mobility needs and income levels. The capacity of local governments to fund needed investments also greatly vary.



Equity concerns will arise with the advent of automated vehicles. While they could offer options for those who cannot drive or afford their own vehicles and connect rural and suburban areas to transit stations, trips must be priced affordably. This should be possible given that companies will not have to pay drivers and will realize operating efficiencies compared to taxis and current ride hailing services. The NJTPA can assist in planning and assessing where and how the services can meet local needs and the nature of pricing structures and/or subsidies needed to meet affordability and equity goals. The NJTPA's Long Range Transportation Plan and other plans, such as the Coordinated Human Services Transportation Plan, can set priorities for targeting new services. Transportation Management Associations and NJTPA member agencies can help guide CAV deployment to meet community needs.

PROTECTING SAFETY

Safety is an overarching goal in all the NJTPA's plans and programs. There is concern that private developers and operators of CAV technologies may compromise safety in the pursuit of profit. State and federal agencies will have primary responsibility to ensure that the technologies are fully tested and proven safe. However, community organizations and MPOs can help guide safe operations and business practices. NJTPA programs supporting local planning, such as the Subregional Studies Program, could be reoriented to assist counties and municipalities in planning for CAV technologies. This could include creating standards for safe pick-up and drop-off locations; directing how, when and where AVs operate; seeing that the systems guard the safety of pedestrians and bicyclists in heavily trafficked locations; and other issues related to CAVs.

The transition period when advanced vehicles mix with more conventional vehicles will require special measures to prevent crashes and protect pedestrians. Thus far, AVs have not proven able to fully integrate with conventional traffic, including misidentifying hazards and even being confounded by rain and other weather conditions. Until AV technology advances sufficiently, regulations may be needed to require drivers to give AVs wide berth or yield to them in certain circumstances. In addition, during the transition period:

- Programs likely will be needed to train car purchasers and student drivers on the capabilities of automated features on newer vehicles.
- Laws and insurance policies will have to be modified to address penalties and liabilities for crashes and other incidents involving driver-assist features and AVs.
- Emergency response practices and protocols will have to be established, for instance, ensuring AVs pull over safely when disabled, yield to emergency vehicles, respond to law enforcement directives, etc.

Pedestrians in signalized crosswalk with buses

These and related issues could the subject of NJTPA outreach and education activities.

MEET LAND USE, ENVIRONMENTAL AND SUSTAINABILITY GOALS

Widespread use of AVs could transform regional land use in dramatic ways. In particular, the need for space set aside for parking will decline as residents rely less on personal autos. Many downtowns now devote *50 to 60 percent of their scarce real estate* to vehicles including parking and roads. Communities will have opportunities to reuse the space for new development, parks or other uses. As this prospect comes into view, communities will have to plan for a future with reduced parking, including remaking master plans and circulation plans. NJTPA programs supporting local and subregional planning can assist in this work. In the short term, NJTPA-supported studies can consider future scenarios with growing numbers of AVs on the road.

But AVs also have the potential for harmful impacts on land use and the environment. Their convenience and potentially low cost per trip (depending on how they are operated and regulated) could encourage more travel by auto and discourage use of transit. Traffic congestion could worsen, harming air quality and contributing to climate change. The convenience might also encourage people to seek out homes in sparsely settled areas, setting off a new wave of sprawling development, compounding the impacts the region still faces from the previous waves

of such development—loss of open space, degraded natural resources, pollution, lack of affordable housing, overwhelmed local roads, inadequate water systems and more.

The NJTPA, in cooperation with partners and community organizations, must ensure CAV is implemented in ways that are sustainable, including incentivizing shared rides and supporting, rather than competing with, transit systems. CAV systems can also be shaped to minimize climate change impacts, such as using electric power from renewable sources, and encouraging sustainable land use, among other goals.

DATA ACCESS/SECURITY

As noted, ITS systems are generating a wealth of real-time data that can be used for managing traffic, providing information to the public and feeding analytical models and other planning tools. CAV will vastly increase available data from vehicles, including information on braking, steering and other operations, and from more sophisticated roadway sensors and controllers. Aggregated data must be made freely available to public agencies to assist in the transportation operations, identification of potential hazards, long-term planning and other uses. The NJTPA can contribute to discussions about data needs, use and security.

ADDRESS COMMUNITY NEEDS

It will be essential that communities have opportunities for input on where and how technologies are deployed. But even with careful planning and oversight, new technologies will have unforeseen impacts over time as they change travel behaviors and reshape the economy. This will require ongoing monitoring and responses.

NJTPA forums, including regular committee and Board meetings, collaboration with subregions and dialog with the public, can assist in addressing ongoing issues and taking advantage of opportunities such as reduced parking requirements. In addition, broader regional coordination can be accomplished through Together North Jersey, a consortium of agencies and organizations promoting regional sustainability, in which the NJTPA plays a leadership role along with Rutgers University's Voorhees Transportation Center. In addition, every four years, the NJTPA is required to update its Long Range Transportation Plan, providing an opportunity to take stock of progress and problems involving technologies and setting long term goals and policies for their use and deployment.

NJTPA Technology-Related Programs and Planning

The NJTPA conducts programs and activities that support the application of ITS and other technologies to address regional and subregional mobility needs. The technology applications, including analytical tools used to assess conditions and trends as part of planning studies, will help lay the foundation for eventual application of CAV systems at the local level. This could help bring the benefits of CAV technology to county and municipal roads, which handle most of the region's traffic.

CAPITAL INVESTMENTS

ITS systems are typically integrated into other transportation projects. In many cases, federal funding is applied to these projects through the NJTPA capital programming process and their inclusion in the TIP. The FY 2020-2023 TIP includes $329 million for 14 projects that incorporate ITS. Additional funding is allocated to NJ TRANSIT ITS initiatives and various programs by NJDOT that provide on-going monitoring and ITS upgrades. Example TIP projects include:

- **Route 46 Project:** A series of ITS facility improvement projects ($16.60 million in 2021-2022) including dynamic message signs, camera surveillance systems, travel time sensors, and traffic signal systems.
- **Route 78 Project:** ITS strategies implemented in the corridor in Hunterdon County ($2 million in 2020) to alleviate congestion and reduce crashes.
- **NJ TRANSIT Programs:** Investing $364 million in 2020 on a micro-grid power system; $181 million in 2020-2023 in signals and communications/electric traction systems; and $45 million in 2020-2023 on technology improvements focusing on passenger communication and fare collection systems.
- **NJDOT ITS Programs:** Includes $50 million in 2020-2023 to upgrade most of the existing traffic signals on NJDOT highways to coordinated, real time response signals; a Mobility and Systems Engineering Program investing $46 million in ITS; and $74 million for the Statewide Traffic Operations and Support Program.

As technologies advance, the NJTPA may consider modifications to its scoring criteria to give greater weight to ITS and CAV projects that can help fulfill regional goals. The funding implications of future technologies will be estimated and addressed in the financial element of Plan 2050.

LOCAL PROGRAMS

The NJTPA uses a variety of plans and programs to support technology investments at the local level, among them:

Local Capital Project Delivery Program—This program allows NJTPA subregions to take the lead in preparing projects to address priority local needs for eventual federal funding through the TIP. Concept development studies, the initial stage of this process, typically examine potential ITS applications.

Various technologies are used to study alternatives and in project design. A recent study of Bridge S-31 in Monmouth County used 3-D modeling, drawing on Light Detection and Ranging (LIDAR) and US Geological Survey data to create visualizations of how various bridge options would look and function. Similar visualizations have been created for potential roundabout projects in the region. A recent study of a 1,700-foot-long, 40-foot high retaining wall along Manhattan Avenue in Jersey City used drones to inspect inaccessible portions of the wall. Also employed are sophisticated camera and motion detection systems available from third-party vendors to count traffic and log vehicle movements.

Local Safety/High Risk Rural Roads Programs—These programs allocate federal funding on a competitive basis to subregions to address safety hazards. To document the need for projects, the NJTPA and the subregions draw on a variety of data sources, including the camera systems noted above and NJDOT assessments of regional roads. One assessment involves a specially equipped NJDOT vehicle that can map and measure curves as it travels, indicating needs for upgraded signing, high friction pavement and other safety features.

Various technologies are incorporated into Local Safety projects. A project on Main Street in Metuchen included pedestrian countdown signals, a pedestrian flashing beacon and an over-height vehicle detector system at the railroad overpass. A road safety audit conducted as part of a project in Carlstadt resulted in the installation of a high-intensity activated crosswalk signal, or HAWK Beacon.

As noted previously, the NJTPA has also supported subregions in purchasing equipment and creating management systems to meet federal reflectivity standards for signs and road markings, which will be important for CAV applications.

Congestion Mitigation and Air Quality (CMAQ) Program—This program supports implementing adaptive and optimized traffic signals. These systems use sensors to gather real time data about traffic and adjust traffic signals, often along a corridor, to smooth traffic flow. Ocean County's Route 549 and 631 optimization project reduced travel time by 11 minutes while reducing accidents and air pollutants. Another project was completed on McCarter Highway (Route 21) in the City of Newark and others are planned.

PLANNING

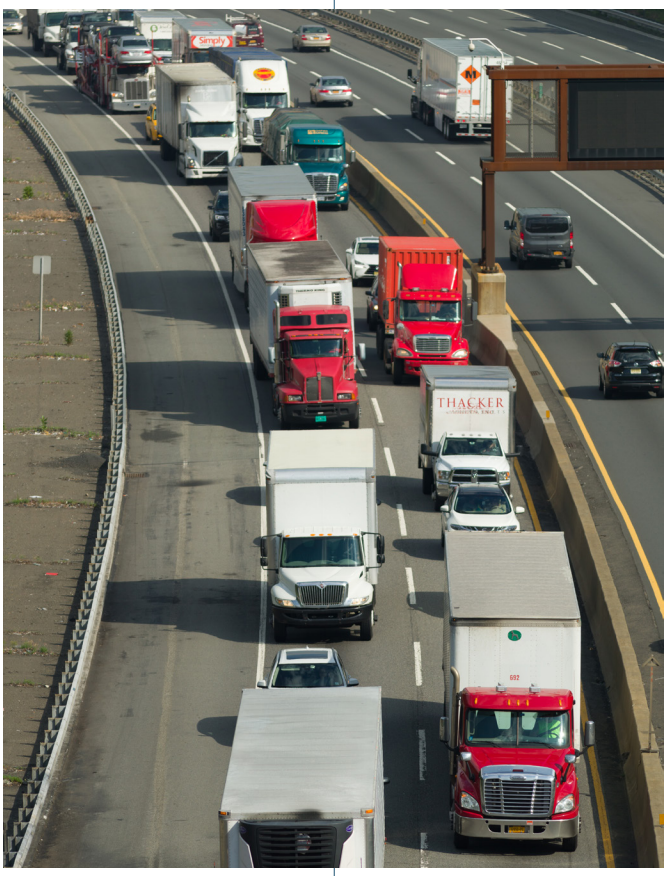
The following planning activities and programs address and use transportation technologies:

Regional Studies—Several NJTPA-led studies of regional issues have included addressing technology applications and challenges. Among these efforts:

- **Transportation Demand Management and Mobility Plan**—This study now underway examines measures to support alternatives to single occupant

vehicle travel, including mobility-as-a-service, microtransit, micromobility devices, telecommuting, and other technologies.

- **Coordinated Human Services Transportation Plan**—Addresses the use of demand-responsive transit services to augment transit systems for providing essential services to seniors, people with disabilities and others. The plan and future updates can provide guidance for using emerging CAV technologies for special needs populations.
- **Congestion Management Process (CMP)**—The CMP assesses locations throughout the region to identify strategies to improve accessibility and mobility. The latest CMP update is considering the impacts and opportunities presented by new technologies and on how transportation can most equitably serve the region's diverse communities.



Subregional Transportation Program—NJTPA-member subregions receive funding each year for a core set of transportation planning activities. Many subregions use this funding for technology to assess needs and conditions on their networks, including using camera-based traffic counting systems and Geographic Information Systems (GIS) software. Some subregions have created computer models to simulate the local transportation network.

Transportation Management Associations—New Jersey's eight Transportation Management Associations, administered by the NJTPA, work with employers and governments to promote transit use, provide travel alternatives, assist individuals with ridesharing, and other activities. The shuttle buses, car services for seniors and people with disabilities, guaranteed-ride-home and other programs they operate will likely serve as models for future automated vehicle services. They can help plan public-private partnerships for technology-based mobility services.

Subregional Studies Program—This competitive program provides subregions with two-year grants to develop recommendations for transportation improvements in keeping with regional priorities. Examples of studies involving ITS include:

- **Hudson County: *John F. Kennedy Boulevard Corridor Study***—A traffic video camera was installed to capture vehicle, bike and pedestrian movements and analyze potential user conflicts during a 48-hour period. This was used to demine "near miss" cases and get a better sense of safety issues.
- **Monmouth County: *Moving Mindfully Study***—During this truck travel study, the consultant used GPS and cellphone data purchased from a private

data company to determine where trucks were traveling to and from.

- **Jersey City: *Parking Plan*—**This plan recommended adopting technology-enabled smart parking solutions, such as automated license plate readers. The technology would allow the City to change the amount of time and cost for different parking areas based on the land use, time of day and different days of the week.

***Local Planning Assistance*—**The Planning for Emerging Centers Program provides technical assistance for municipalities to create more sustainable, transit-supportive and walkable communities. As part of these efforts, municipalities often consider various technology applications. The Borough of Keyport is developing a Complete Streets Design and Implementation Plan that will set street design standards and an updated Compete Streets Policy and Ordinance. As new technologies emerge, this program can include helping towns guide their deployment and address their impacts.

***NJIT Partnership*—**In collaboration with the School of Computer Science at NJIT, the NJTPA works on research projects to support its planning efforts. Past projects included virtual reality modeling of distracted driving and roundabout construction, creating a sidewalk inventory from aerial imagery, and advanced text analytics for a planning database.

DATA TOOLS AND ANALYSIS

Much of NJTPA's planning work uses computer systems to analyze and map transportation data. Among these data-related activities are:

***Data Repository/GIS*—**The NJTPA is a central repository for publicly available data, including geospatial data. The NJTPA data portal allows data to be shared with subregions, partner agencies and the public. It includes datasets on demographics, the economy, transportation, and equity, among other areas. The NJTPA offers GIS training and support to subregions.

***Modeling and Forecasting*—**The NJTPA's transportation demand model was developed with NJDOT and NJ TRANSIT and can explore the multi-modal transportation issues facing northern New Jersey. Its estimation of travel patterns and characteristics is now calibrated in part using archived real time data.

The model is used for the NJTPA's air quality conformity analysis and developing demographic and other forecasts to support regional planning. It has been used to explore future scenarios. New exploratory modeling tools are being adapted for the NJTPA to use to investigate technology impacts on levels of traffic, ridership on public transit, walking and biking, lengths of trips and measures of regional accessibility.

***Performance Measures*—**Under federal law, MPOs are required to conduct performance-based planning and programming by tracking performance measures, setting data-driven targets for the measures, and selecting projects to help meet those targets. This performance-based planning draws upon archived real time data and requires creating analysis tools and software focusing on a wide range of transportation system features. Transportation technology advances have the potential to dramatically impact system performance tracked by the measures.

PUBLIC OUTREACH AND EDUCATION

As discussed previously, MPOs can serve as forums for discussion and cooperative decision-making involving the deployment of CAV. In this role, the NJTPA can pursue partnerships with organizations, agencies, companies, universities and others that share

goals for effective use of technology in the public interest. Among the opportunities.

Meetings/Forums—Committee and Board meetings provide opportunities for elected officials, agency representatives and the public to explore regional issues. Past speakers have presented on automated and electric vehicles. The NJTPA also hosts periodic symposia and forums on technology-related topics, including an annual Tech Tools for Planning Expo.

Education/Outreach—The NJTPA can support the transition to new technologies which, as noted, may require drivers to learn about sharing the road with automated or connected vehicles and communities to explore accommodating AVs and changing land use The *Street Smart NJ* pedestrian safety campaign may serve as a model for this outreach.

Together North Jersey—This consortium could serve as an important technology forum, with a diverse membership representing many regional interests. Its four task forces meet regularly, and it offers technical assistance to municipalities, non-profits and community groups.

RECOMMENDATIONS

Emerging transportation technologies will have wide ranging impacts on the labor force, housing, real estate, and other areas. As it undertakes planning activities related to technology, the NJTPA must be prepared to work with its partners and other organizations in the state on these broader impacts. Recommendations related to NJTPA's plans and programs are as follows:

Continue and Expand ITS Investments—Support continued ITS investments, including traffic signal upgrades along corridors, in keeping with current initiatives and programs.

Promote High Speed Internet Access—Support efforts for broad access to high speed internet including 5G networks for all communities, on an equitable basis, particularly for remote work/education purposes.

Expand Transportation Information—Encourage and support transportation information provided directly to individuals through mobile device applications. The NJTPA should coordinate with subregions and local agencies to improve GTFS feeds and other measures.

Invest in Hardware, Software and Infrastructure Improvements—This includes upgrading signal controllers to be adaptable to future uses and technology

standards and meeting MUTCD standards for sign reflectivity, lane markings, etc.

Prioritize Safety and Privacy— The technologies that improve safety should receive priority, including systems to reduce bicycle and pedestrian crashes. Careful regulation of communications strategies is needed to ensure privacy and prevent tampering.

Make Data Accessible—Aggregated data must be made freely available to public agencies to assist in the operation of the transportation system and for planning purposes. The NJTPA can contribute to discussions about data needs and use.

Model Technology Impacts—The NJTPA and its partner agencies should use modeling to explore scenarios for future AVs to guide state, regional and local policies.

Encourage Shared Rides and Support Transit—Coordinate with subregional, state and federal partners to ensure CAV incentivizes shared rides and serves as feeders to transit stations and hubs.

Prepare for Opportunities—Planning activities should contemplate possible long-term changes in land use and mobility stemming from increased use of ridesharing and automated vehicles, such as repurposing parking areas, especially for active transportation modes (walking and biking).

Provide Public Education and Training—Support efforts to inform and educate drivers—particularly young people—about using and interacting with new automated systems.

Pursue Partnerships—Engage in shared programs and activities with other agencies and organizations to leverage skills, budgets, and reach broader audiences regarding technology issues.

Ensure Equitable Access—The public and private sectors should ensure affordable options are available to all people to use AVs and other new technologies.

Address Mobility Gaps and Promote Social Benefits—Technologies must be applied to address gaps in mobility, provide job access for low-income workers, and help those without personal autos, people with disabilities and the elderly.

Support Improved and Expanded Transit—Technologies should be applied to make existing bus and rail systems operate more efficiently and better serve the region's communities.

Generate Funding to Support Investment—Regulations for deployment of technologies must incorporate fee mechanisms, such as cross-subsidy programs, to generate public funding to ensure the upkeep and social benefits of technologies.

Support Sustainability and Reduce Climate Impacts—CAV systems should use clean energy, promote efficient use of roads/rails and sustainable land uses to protect the environment and reduce climate impacts.

Ensure Public Input—The public must have meaningful opportunities to provide input on how and where technologies are deployed and to respond to changing conditions and impacts.