MPO Policy and Planning Guidance for Transit Applications of Automated Vehicles

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16. Abstract

Autonomous vehicle technology is on the brink of revolutionizing transportation systems across the country. The State of Florida has mandated that autonomous vehicles be addressed in long range transportation plans. This report provides guidance on how MPOs can integrate current literature and best practices into their transportation plans. Based on these best practices, each jurisdiction will have different strategies to implement these technologies based on their community's context. The MPO and local government plans must also identify timeframes for when these technologies will continue to be tested, and the years into perpetuity, after sufficient testing, when autonomous technology will be increasingly implemented at large scales.

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Executive Summary

Autonomous technology associated with autonomous vehicles (AVs) is a rapidly evolving technology that will have revolutionary effects on transportation systems across Florida. This technology's impacts are required, by state mandate, to be addressed in Long Range Transportation Plans (LRTP) in all communities across the State of Florida.

This document provides guidance to Metropolitan Planning Organizations (MPOs) and Transportation Planning Organizations (TPOs) to effectively address the incorporation of AVs as a mode of transportation in their LRTPs. Instruction is given on how to meet the minimum level of compliance with relevant state statutes. Additionally, further guidance is provided on how MPOs can approach AVs in a way that surpasses the minimum and endeavors to compound on the inherent benefits of AVs and diminishes potential negative externalities of the technology.

This report presents guidance on incorporating policies addressing AVs into the long-range transportation planning processes, and for moving toward piloting and implementing automated transit projects. The strategies are as follows: mobility, connectivity, and access; social equity; safety and security; data and decision making; and economics and fiscal planning.

The report also includes preliminary urban design guidance in three basic development settings: urban, suburban, and rural. The differences in these three areas will impact the design considerations when planning for AVs. Three cases were examined to provide an example of urban design considerations for each context. An important design idea was for the creation of dedicated AV bus lanes. These lanes create a transit line comparable to light-rail, without the need for rail line infrastructure.

As planners, engineers and elected officials prepare for the future of transportation, autonomous vehicles are increasingly expected to change the transportation system. Transitioning this technology through the stages of innovation, manufacturing, testing, and operating on road networks will require policy and coordination.

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Introduction and Literature Review

Introduction

As planners, engineers and elected officials prepare for the future of transportation, electric, autonomous, and connected vehicles are increasingly heralded as the next radical change to the transportation system. Transitioning the current transportation infrastructure to these technologies through the stages of innovation, manufacturing, testing, and operating is going to require policy consideration and coordination. The State of Florida has been an early adopter of legislation and autonomous vehicle (AV) policy and is paving the way for transit agencies and local governments to begin operating these vehicles. Chapter 2016-181 Laws of Florida requires all Metropolitan Planning Organizations (MPO's) and Transportation Planning Organizations (TPO's) to consider AV technology in their Long Range Transportation Plans (LRTP). It is anticipated that public transportation could see an autonomous overhaul in their fleets over the next couple of decades., It is important for MPO's and TPO's to begin coordination and planning with the transit agencies for this new technology.

While the transition to an autonomous fleet will be a slow process, AV's are on the road today and several transit agencies have begun testing piloting AV technology for public transportation. This underscores the need to begin long range transportation planning for regional AV technology by the MPOs and TPOs. Long range plans will need to begin to consider the special needs of AV technology in long range cost estimates and in programing projects.

This report was written in conjunction with the Autonomous Vehicle Policy Guide for Public Transportation in Florida MPO's (Florida Planning and Development Lab, 2018). Information and guidance for implementing complementary technologies such as electric and connected vehicles are also provided; however, the main focus of this report is provide guidance necessary for MPO's and TPO's to fulfill the requirements of Chapter 2016-181 Laws of Florida.

Summary of Literature Review

To inform the guidance provided to the MPOs and TPOs, the Florida Planning and Development Lab (FPDL) conducted a comprehensive literature review of current literature on the history of planning for AV use in Florida, AV transit adoption in the US, AV-related directives to MPO's, existing AV policies and policy guidance documents, and an evaluation of early adopters domestically and internationally. A summary of the key findings of this review are presented here to provide a baseline understanding of key implications of AV technology on public transit. For more information, the complete literature review can be found in the FPDL's corresponding report (FPDL, 2018).

History of Autonomous Vehicles

Autonomous vehicles are one of the most significant upcoming advancements in transportation technology. Autonomy in automobiles is not a new concept; the idea of AV's has been around as long as the automobile. For decades now, car manufacturers have been providing vehicles that are less and less reliant on the driver, with technologies such as automatic transmissions, cruise control, and backup cameras. Today, the intelligence and the adaptability of new computer systems make full automation possible.

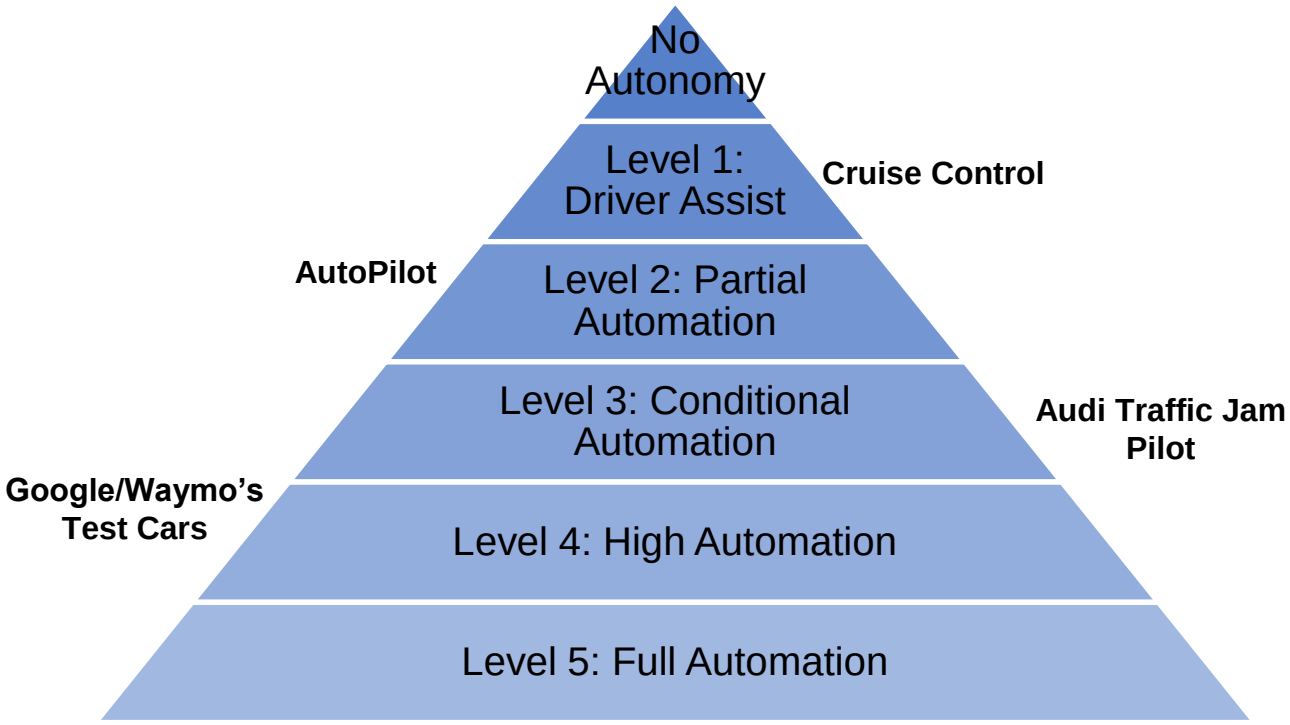
There are many reasons for the push towards autonomy, but the strongest argument is the unreliability and lack of safety present in today's transportation system. "35,092 people died on US roadways in 2015 [and] 94% of crashes are due to human error" (USDOT. 2017). Advanced driver assistance systems such as forward collision warning and automatic braking systems have been found to reduce rear-end crashes by as much as 39 percent (Cicchino 2016). As AV technology progresses toward full automation, the safety benefits are expected to increase.

There are numerous benefits to AVs, but there is also uncertainty surrounding the technology. People are all wondering if it is going to work. AVs could transform the 21st century in the same way that mass-produced automobiles transformed the 20th century. Auto travel will become safer and more efficient. People will begin to look at travel in an entirely new way as they can be productive rather than endure the stress of driving. Eventually, mobility will be available to everyone, not just those who have a driver's license (O'Toole, 2014). As will be discussed, these changes will provide opportunities for public and shared transit systems to expand into more widespread use. The problem with this level optimism is that though the technology keeps developing at a rapid pace, the political and legal steps to getting these vehicles on the ground is still unclear. Planners, engineers, and policy-makers will need to prepare for the adoption of AVs to enable a smooth transition through the stages of automation.

Five Levels of Autonomy

According to the National Highway Traffic Safety Administration (NHTSA, 2018), these are the five levels of vehicle automation. With each level, the vehicle progressively takes control of more driving tasks.

Figure1-1: Five Levels of Autonomy



Benefits Specific to Autonomous Transit

There are many ways that AV technology will benefit the way users experience transportation, but there are also a number of concerns about the limitations and implications of autonomous technology. *Beyond Traffic 2045* is a document prepared by the United States Department of Transportation (USDOT, 2017) that lays out the transportation plans and goals for the next 30 years. *Beyond Traffic 2045* lists many potential benefits of adopting AVs:

Land Use

- AV technology has the potential to promote transit-oriented development by increasing the cost of a personal vehicle and decreasing public transportation costs.
- Parking requirements will diminish in urban communities as vehicles will be enabled to park themselves outside of the urban core where land is more valuable.
- Increasing driving efficiency and safety may reduce the space needed to automobile travel, allowing for the creation of bike and pedestrian infrastructure.

Equity

- Long term improvements to cost and efficiency of public transit will make it more accessible to low income passengers.
- People that previously were unable to drive now have access to personal mobility

Infrastructure

- Lanes dedicated to AV buses will create a light rail system without the need for a track.

In addition, AV technology may improve the cost-effectiveness of public transit by significantly reducing operational and labor costs. Reducing accident and liability costs may also improve the efficiency of transit service. AVs may also help to improve service by providing innovative first- and last-mile solutions either through a fleet of shared AVs or through low-capacity autonomous shuttles that provide access to the fixed-route system. In short, AVs may provide significant opportunities to expand transit service.

Problems Specific to Autonomous Transit

For all of the good that autonomous vehicles may provide, there are a number of issues and concerns that need to be addressed before they can seamlessly become a part of society. These concerns are as follows:

Land Use

- AVs have the potential to exacerbate urban sprawl by increasing the time passengers are comfortable commuting.
- Focus on autonomous vehicle-oriented design may take focus away from pedestrian-oriented design.

Equity

- A major reduction in the transportation workforce is possible if AVs reduce the need for bus drivers.
- Benefits may be received by higher income populations before low income populations.

Infrastructure

- High capital costs for purchasing will occur before MPOs could see saving from lower operational costs.

Liability & Licensing

- There will be a period of uncertainty until there are sufficient court cases litigating how liability will be determined.

Existing State Regulations

Below is a list of enabling legislation, allowing for testing and operating of autonomous vehicles on public roads in Florida and mandating that Long Range Transportation Plans mention AV technology.

Table 1-1- Florida Legislation Pertaining to Autonomous Vehicles

Bill	Year	Statute	Reference	Purpose
House Bill 1207	2012	FLA. STAT. § 316.003 (2012) FLA. STAT. § 316.85 (2012) FLA. STAT. § 319.145 (2012)	http://laws.flrules.org/2012/111	Authorizes AV Testing
House Bill 599	2012	FLA. STAT. § 319.145 (2012)	http://laws.flrules.org/2012/174	Authorizes AV Testing
House Bill 7027	2016	FLA. STAT. § 339.64 (2016) FLA. STAT. § 316.85 (2016) FLA. STAT. § 316.85 (2016) FLA. STAT. § 334.044 (2016) FLA. STAT. § 319.145 (2016)	http://laws.flrules.org/2016/181	Opens AV to public roads removes 'testing' language
House Bill 7061	2016	FLA. STAT. § 316.0896 (2016)	http://laws.flrules.org/2016/239	Enables platooning (use with buses)
House Resolution 3388 AVs	2017	N/A	https://www.congress.gov/bill/115th-congress/house-bill/3388/text	Self-Drive Act* – Provides a federal safety framework for testing AVs
Senate Bill 1885	2017	N/A	https://www.congress.gov/bill/115th-congress/senate-bill/1885/text	AV Start Act (in progress)* – Similar to the Self-Drive Act

*Differences between the Self Drive Act and the AV Start Act will need to be resolved before they can be enacted (Rouse et al., 2018)

Key Findings from Literature Review

1. AVs are expected to improve the safety and efficiency of public transit service.
2. There is much debate about when fully autonomous vehicles will be adopted and how widely they will be adopted.
3. AVs, when implemented, will penetrate every aspect of the transportation system, from public transit, to freight, to personal vehicles.
4. AVs may enhance opportunities for transit-oriented development in some areas while exacerbating urban sprawl in others.
5. AV technology is expected to provide opportunities for first-and last mile transit applications

Summary of Stakeholder Outreach

In order to effectively engage a wide range of stakeholders, the FPDL team interviewed three types of stakeholder outreach groups for a diversity of perspectives pertaining to policies, advisory committees, and implementation strategies being used. The groups were: MPO's, cities and universities in Florida, and other state Departments of Transportation around the country.

MPO Survey Group:

- MPO/TPO directors are aware of the upcoming technology of autonomous vehicles.
- MPO/TPO directors need more guidance on the adoption process from the aspects of: technology, travel demand patterns, plausible scenarios, and a timeline for available technologies.
- MPO/TPO directors believe that autonomous vehicles will impact the community through: reliability, mobility, safety, and congestion reduction.

Cities and Universities in Florida:

- Know there is technology approaching, they do not know how to handle it.
- Every location is in a different phase in the autonomous vehicle adoption.
- The universities are further in the adoption phase then the cities are.
- Every location has different needs for what they need to move toward AV adoption

Other States:

- States do recognize the potential benefits that AV-CV can have on the transportation infrastructure.
- There have been Committees and Alliances put together to start the discussion. regarding AV-CV and implementation of the technology.
- Very little policy has been written yet regarding AV-CV
- States are monitoring other states and introductions of new technology.

Long Range Transportation Plans:

- There is a range in the level to which MPO's address AVs in their LRTPs
- A few MPO's address AVs in depth in their LRTPs
- Most LRTPs have little to no mention of AV

It was found that MPO's are aware of the upcoming technology, but they need additional assistance on how to adopt this technology in their area. The FPDL recognizes the varying levels of staffing capacity, competing priorities, and that attention to autonomous vehicles will vary based on the size of the MPO. It should also be noted that the survey results are skewed towards larger the MPO's that are more likely to have the capacity to address AVs immediately.

Policy Considerations

Introduction

This chapter provides a detailed discussion of guidance for policy recommendations for implementing transit applications of autonomous vehicle technology. The purpose of these recommendations is to aid MPOs as they update their Long Range Transportation Plans. The goal is to incorporate language and policy that advocates for the efficient adoption of autonomous vehicles into the public transportation network.

This chapter organizes the FPDL's findings into five different goal areas:

- Goal Area 1: Mobility, Connectivity, Access
- Goal Area 2: Social and Environmental Equity
- Goal Area 3: Safety and Security
- Goal Area 4: Data and Decision Making
- Goal Area 5: Economics and Fiscal Planning

LRTPs contain a series of goals, policies, and performance measures. This report does not address performance measures as these may vary between each MPO and their metrics should be established by each MPO through a deliberative process. This summary highlights recommended goals and policies that an MPO may consider including in their LRTP update.

Mobility, Connectivity, and Access

Setting the Context

Transportation is about moving people and goods from origin to destination in a comprehensive manner by offering a range of mobility choices. The adoption of autonomous vehicle technology is expected to have transformative implications for land use patterns. AVs could exacerbate urban sprawl, by enabling people to work, read, sleep, while they commute. AVs may make people more willing to live further away from urban centers. However, by increasing the cost of owning a vehicle and decreasing operating costs of transit and ride-hailing services (Uber / Lyft), AVs may promote re-urbanization as people move to areas where automated transit and ride-sharing are more accessible. The adoption of AVs could also promote transit-oriented development (TOD) as residents move closer to where they work, due to the improved access to transportation. More than likely, both of these scenarios will happen simultaneously among different segments of the population, but the time to start planning for AVs long range impacts related to land use is now.

It is difficult to make recommendations for infrastructure improvements given the unknown variables of AV technology, their expense, and the planning timeframe. These infrastructure decisions must consider local factors and what is feasible in a given locale. Therefore, the following recommendations are painted with a broad brush so that each MPO in Florida can better prepare for implementation of autonomous public transportation systems. These recommendations are based on scholarly research and on the experiences of early adopters of autonomous buses.

Goal Area 1: Promote Mobility, Connectivity, and Access
Recommended Policies
Consider autonomous personal vehicles when planning for public transportation because they have different land use requirements.
Monitor technological advances to decide which technologies should be employed.
Consider reducing parking requirements for new developments.
Identify intersections and corridors where infrastructure improvements will be needed first to phase in improvements.
Identify roads that will need retrofits, including new signage, painted lines, or landscaping.
Identify potential locations for AV drop-off areas for public and private vehicles.
Create dedicated bus lanes to help facilitate autonomous bus networks.
Remove on-street parking in urbanized areas so that the parking lane can be used for transit.
"Smart infrastructure" could replace current MOT and signage systems.

Social Equity

Setting the Context

With the implementation of AVs it is important to address issues of equity. Autonomous transit systems must be fully in compliance of Section 508 of the Rehabilitation Act, allowing everyone equal access. Seating should be able to accommodate riders with wheelchairs. This means implementing solutions that work for every driver and creating wayfinding and passenger seating that work for everyone. Autonomous vehicles will provide access for all individuals and follow the American Disabilities Act. The Act mandating this consideration is included below.

> *Section 508 of the Rehabilitation Act of 1973, as amended (29 U.S.C. §794d) (ii) individuals with disabilities who are members of the public seeking information or services from a Federal department or agency to have access to and use of information and data that is comparable to the access to and use of the information and data by such members of the public who are not individuals with disabilities*

Goal Area 2: Increase Social Equity
Recommended Policies
Ensure that autonomous transit vehicles have proper access for wheelchairs by being equipped with wheelchair lifts or ramps.
The transition to autonomous buses will cause drivers to become "operators". One of their tasks could be assisting those with disabilities.
Identify intersections and corridors where infrastructure improvements could be needed to provide equitable access to transit service
Some roads could need retrofits, including new signage, painted lines, or landscaping.
Navigation in autonomous transit vehicles could include braille and voice-activated options for those with hearing and sight issues, and simplified controls and directions for developmentally disabled riders**.**
Simultaneous advances in matching learning and artificial intelligence could be advocated for to be included in autonomous transit vehicles.

Safety and Security

Setting the Context

Safety and security will be one of many concerns regarding the adoption of autonomous vehicle technologies into daily lives. Autonomous vehicles have the potential to reduce injuries and fatalities related to automobiles in the United States. The introduction of autonomous vehicles into the mainstream public can have many benefits regarding safety; including improved mobility for people that are impaired temporarily or disabled persons such as those who are blind, deaf, elderly, or physically impaired. In short, AVs could restore personal mobility to those who are unable to drive.

The following Florida statute (FLA. STAT. § 316.85) provides the following language related to licensure in autonomous vehicles.

> *(1) A person who possesses a valid driver license may operate an autonomous vehicle in autonomous mode.*
>
> *(2) For purposes of this chapter, unless the context otherwise requires, a person shall be deemed to be the operator of an autonomous vehicle operating in autonomous mode when the person causes the vehicle's autonomous technology to engage, regardless of whether the person is physically present in the vehicle while the vehicle is operating in autonomous mode.*

As a driver or operator of an autonomous bus, it should be necessary to possess a commercial driver's license. This would not preclude current bus drivers, as they would already have this license. The state mandate would be met and would ensure that in the event that a human must intervene, they are trained to safely handle the vehicle.

Goal Area 3: Develop Safety and Security
Recommended Policies
Conduct public meetings to gauge perception of safety and other issues.
Ensure transit agencies under an MPO conduct a quarterly safety assessment on all autonomous public transit components and meet all federal, state and local safety guidelines.
Ensure transit agencies under an MPO certify that all autonomous transit vehicles meet requirements specific to crashworthiness capabilities and post-crash ADS behavior.
Confirm that during early implementation, all autonomous transit has bus operators on board at all times in case human intervention is needed.
Ensure all AVs and operators meet the standards established in **Rule** Chapter 14-90, Florida Administrative Code.
Develop a Public Transportation Agency Safety Plan (PTASP) to satisfy the FTA's PTASP Final Rule.
Autonomous vehicles must be designed to interact safely with human users (non-AV drivers, cyclists, pedestrians).
Employ technology and firewalls to prevent cyber-attacks, and transit agencies must have an emergency response plan in place in the event of such an incident.
Liability should be determined by the nature and extent of the accident involving the autonomous transit vehicle.
Ensure that there is a way to prove human error in the event of an incident (manufacturer proves not at fault). An example of this is surveillance cameras on transit.
Update product liability laws to accommodate the introduction of autonomous transit vehicles onto the roadways while assigning liability for accidents to the party at fault.
The requirement of a Class B commercial driver license to operate an autonomous transit vehicle is a reasonable safety expectation pursuant to state statute.
Registering vehicles should be done uniformly throughout the state, utilizing the Department of Motor Vehicles administrative capacity.
Lease or rent autonomous transit vehicles from available technology vendors.
Test AVs from several technology vendors prior to implementation
Conduct AV pilot projects to test the viability of autonomous transit routes prior to widespread implementation

Data and Decision Making

Setting the Context

Based on the literature review, the need for effective coordination at all levels to ensure successful implementation of autonomous vehicles into local transit systems is apparent. Existing legislation encourages innovation and implementation but to fully realize AVs' potential benefits and ensure the safety of vehicle users and pedestrians, intergovernmental coordination and consistency is a necessity.

Goal Area 4: Effectively Manage Data and Decision Making
Recommended Policies
Designate a lead agency or position to facilitate coordination on emerging intergovernmental issues.
Create an autonomous vehicle stakeholder group, with varied representation, to make recommendations based on the testing phase.
Establish a decision-making process that involves the transit authorities and the MPOs/TPOs.
Transit agencies could develop a sub-committee focused on AV technology and coordination with other transit authorities and MPOs.
A public outreach/ education campaign could accompany the testing phase of autonomous transit vehicles, as well as a ridership/ public perception study.
Seek out universities and manufacturers within their jurisdiction for partnership opportunities.

Economics and Fiscal Planning

Setting the Context

There will be many costs associated with the transition to AVs for public transportation. This includes infrastructure, equipment, and operations. Funding a fleet of AV busses will be particularly expensive. However, the transition to AVs will not happen all at once. It is anticipated that as individual busses are retired, they will be replaced by AVs. There will be a period of time when a fleet consists of both non-AV and AV busses. In addition, there are a variety of agencies that may provide necessary funding as well as considerations of creative solutions to maximize limited funds. MPO's should coordinate funding sources with FDOT.

The cost of AV technology is expected to decrease over time. Until then, transit agencies and MPOs/TPO's have several different options that could help reduce the capital costs. Many AV shuttle vendors will rent or lease vehicles to circumvent high purchasing costs and to provide additional technical support. Other companies offer AV technology packages to retrofit existing buses instead of purchasing a new vehicle. In addition, even though AVs may have high capital costs, they may lower costs long-term by reducing labor and operational costs. As discussed, previously, this will need to be balanced by equity concerns, but it may help prevent AV technology from putting additional pressure on transit agencies' already constrained budgets.

Goal Area 5: Integrate Autonomous Vehicles into Economics and Fiscal Planning
Recommended Policies
Replace traditional buses with AV buses at the end of their useful life.
Consider retrofitting existing busses with AV capabilities instead of purchasing new vehicles.
Identify funding sources from federal (FHWA, NHTSA, DOE) and state (FDOT, FDHS) grant programs.
Public Private Partnerships may be effective in larger scale equipment or infrastructure upgrades.
Due to falling gas tax revenues, alternative funding sources, such as congestion pricing, VMT pricing and capacity pricing, as well as curb management and parking revenues, should be explored.

Checklist of Preliminary Concerns for Decision Makers

Based on the recommendations provided in the previous section, the following checklist provides steps MPOs and transit agencies can take to move towards implementing automated transit.

Short Term

- ☐ Update LRTPs to address the emergence of AV technology
- ☐ Consider establishing an AV testing bed
- ☐ Choose the type of transit to be deployed
- ☐ Decide the level of automation that should be tested
- ☐ Secure funding
- ☐ Select a vendor
- ☐ Decide whether to buy or lease vehicles
- ☐ Conduct public participation initiative to establish buy-in and educate the public
- ☐ Set up a system of payment
- ☐ Ensure that state and federal safety regulations are met
- ☐ Designate an agency to license vehicles and establish this procedure

Long Term

- ☐ Update infrastructure
- ☐ Make sure that all vehicles/ stations/ operators/ etc. are ADA compliant
- ☐ Have a workforce development plan for loss of bus driver jobs
- ☐ Designate a lead agency/ stakeholder group to handle questions and decisions that arise
- ☐ Develop an emergency action plan for potential cyber security breaches
- ☐ Incentivize development around the AV service area

Model Policy Language

According to Chapter 2016-181 Laws of Florida Long Range Transportation Plans must, at a minimum:

> *Make the most efficient use of existing transportation facilities to relieve vehicular congestion, improve safety, and maximize the mobility of people and goods. Such efforts must include, but are not limited to, consideration of infrastructure and technological improvements necessary to accommodate advances in vehicle technology, such as autonomous technology and other developments.*

While each of the previous sections included recommended policies formatted in language appropriate for inclusion into a Long Range Transportation Plan, the following language is an example of overarching policy that can be incorporated into Long Range Transportation Plans in order to satisfy the state mandate. It addresses autonomous vehicle technology and its potential impacts on transportation systems within Florida jurisdictions.

> *As autonomous vehicle technology continues to advance, it is anticipated that changes in land use and transportation will require regulatory preparation and policy reevaluation. Public transit infrastructure may require changes to accommodate autonomous vehicles. Infrastructure improvements could include: fixed guideways, clear signage, well maintained roadways, curb adjustments (for ADA considerations), etc. These changes will improve the safety and efficiency of autonomous vehicles. Safety standards will need to be established and monitored related to personal and vehicle safety and cyber-security. Coordination between transit agencies and MPOs/TPOs is essential for efficient adoption. Autonomous transit will allow for increased transit ridership leading to a reduction in parking demand and higher density in urban centers.*

Key Findings & Recommendations

1. Policy language must address the short term, testing “phase” of adoption of AVs while also addressing the long term, implementation “phase” of adoption.
2. Autonomous public transportation could be utilized to shuttle people between origin and destination at the beginning of the implementation process because this takes away some variables the vehicle would have to contend with, such as traffic.
3. Reduced demand for parking may provide opportunities to retrofit on-street parking into dedicated bus lanes.
4. Numerous vendors lease and sell autonomous buses and shuttles. Several others retrofit traditional buses to become autonomous
5. AVs offer a chance to redesign public transit vehicles and infrastructure to better accommodate all users including those with disabilities.
6. Intergovernmental coordination will be an essential part of the smooth and efficient adoption of AVs.
7. It is imperative for MPO/TPO staff to keep up with the rapidly evolving capabilities of AV technology.

Conceptual Urban Design Guidance

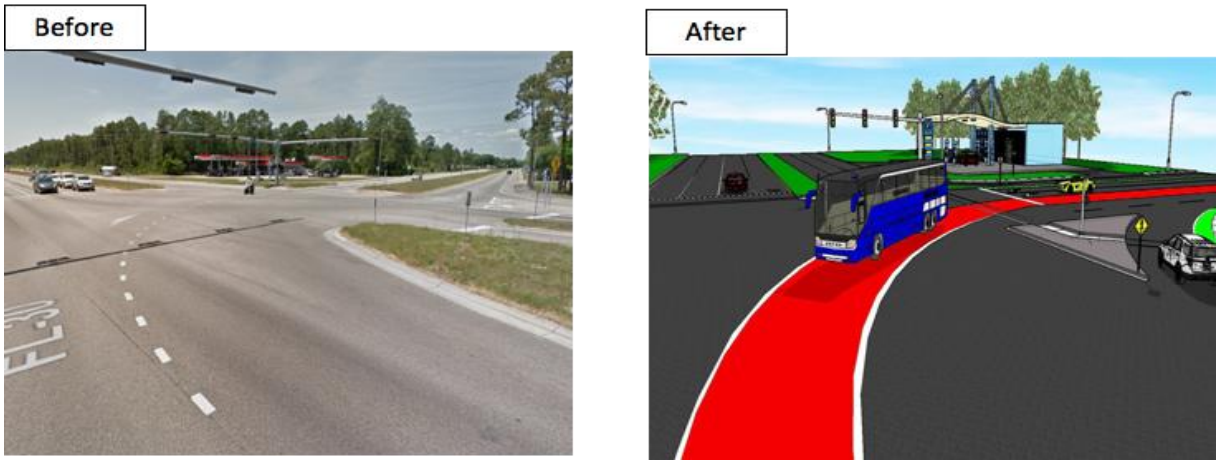
Introduction

The urban design chapter of this report analyzes how the adoption of autonomous vehicles could impact communities in Florida. Florida communities will be looked at in three different settings: rural, suburban, and urban. Every MPO or TPO in Florida has areas representative of each of these settings within their jurisdictions, so it will be important to consider how changes to the transportation network will inevitably impact each context. In order to explain these differences, the FPDL provided a brief explanation of how public transportation currently operates in each setting and then how an autonomous system could change that network. The team then examined three cities that served as examples for each setting. For the rural setting, the team used the State Highway 30A Mobility Project (30A) in Seaside to describe an autonomous shuttle from remote parking lots into more urban areas. For the suburban setting, the team used the Sawgrass Mills Mall proposed autonomous circulator to help illustrate how an autonomous bus could operate in a typical Florida suburb. Lastly, the FPDL researched the Ultimate Urban Circulator in Jacksonville to understand innovations that could be applied in a downtown, urban setting.

The three focus sites that the FPDL looked at are considered early adopters of AV technology. Early applications of new technology often look very different from how the technology is ultimately adopted. As such, the following examples do not necessarily represent normative examples that every other community will need to follow exactly. Every community will need to implement AV technology in a way that fits their local context. The early adopters presented here simply provide examples and ideas that other communities can learn from as they move toward implementation.

Rural Public Transportation

Figure 3-1: Depiction Before and After Autonomous Bus Implementation in Rural Areas



- May be the **last to incorporate** autonomous vehicles into the public daily use
- A **designated** autonomous vehicle **lane along the centerline** may reduce conflicts
- Can be used to **transport people from rural areas to suburban or urban areas**
- Likely to rely **on a bus rather than a shuttle** because of lower trip frequency

Suburban Public Transportation

Figure 3-2: Depiction Before and After Autonomous Bus Implementation in Suburban Areas

- Autonomous vehicle must be **able to integrate with traffic**
- A **designated lane is not necessary**
- Most initial utility in providing a "**last mile**" solution

Urban Public Transportation

Figure 3-3: Depiction Before and After Autonomous Bus Implementation in Urban Areas

- Likely to be **the first** to adopt autonomous vehicles for public transportation
- A **designated lane** will reduce modal conflicts
- **Removal of on-street parking** for the designated lane boarding / alighting may be required

Key Findings & Recommendations

1. In rural areas, an autonomous shuttle between satellite parking lots and the main transportation system could effectively move people around the system.
2. In suburban areas, autonomous shuttles may need to operate between large population centers (such as a mall, hospital, college) in order to be efficient and effective.
3. In downtown, urban settings, an autonomous system should look to move large numbers of people in order to relieve congestion and improve safety.

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