
Autonomous Vehicles in Transit

Applications and Policy Planning For Florida's Future



**2018 APA Florida Annual Conference
Ballroom C**

September 13, 2018

Moderator

Gabe Matthews

Transit Planning Research Administrator
Florida Department of Transportation

Panelists

Dennis Smith

Florida State University

Brian Pessaro

Center for Urban Transportation Research

Brad Thoburn

Jacksonville Transportation Authority

Participant Survey



Poll Everywhere

Panelist #1

Dennis Smith
Florida State University



Florida Department of
TRANSPORTATION



Department of Urban
& Regional Planning

Autonomous Vehicle Policy Guide for Public Transportation in Florida MPOs



Florida State University
Florida Planning and Development Lab
Fall 2017 Studio

Purpose

Conduct research and develop guidance for MPOs, transit agencies and local governments to begin to

- Prepare for
- Pilot, and
- Implement

transit applications of EV-AV-CV technologies.

Special Focus

- Develop model policy language for LRTP updates
- Outline costs and considerations for infrastructure and equipment investment
- Develop conceptual urban design guidance to showcase potential solutions for technology integration

Team

Florida Planning and Development Lab

- Dennis Smith
- Jeremy Crute

Graduate Student Capstone Project Members

- Marshall Anderson
- Glennika Gordon
- Christopher Ibarra
- Jenna Osbun
- Ronnie Shelly
- Ryan Wenger

Florida Department of Transportation

- Gabrielle Matthews



Tasks

Task 1 – Literature Review of Transit Applications of AV Technology

Task 2 – Stakeholder Outreach

Task 3 – Assessment of Automated Transit Technology and Applications

Task 4 – MPO Automated Transit Policy and Implementation Guidance

Task 5 – Conceptual Urban Design Guidance

Task 6 – Interim Studio Report

Task 7 – Draft Final Report and PowerPoint Presentation

Task 8 – Final Report and PowerPoint Presentation

Context

- 27 Metropolitan Planning Organizations (MPO's) and Transportation Planning Organizations (TPO's) in the State of Florida.
- MPO's are federally mandated and funded transportation policy-making organizations made up of representatives from local government and governmental transportation authorities.
- Must update Long Range Transportation Plan (LRTP) every 5 years. Planning horizon is 20-30 years.

Context

HB 7027: 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.

This policy is important to MPO's/TPO's because autonomous technology is expected to be adopted in public transportation earlier than other modes of transportation.

Literature Review

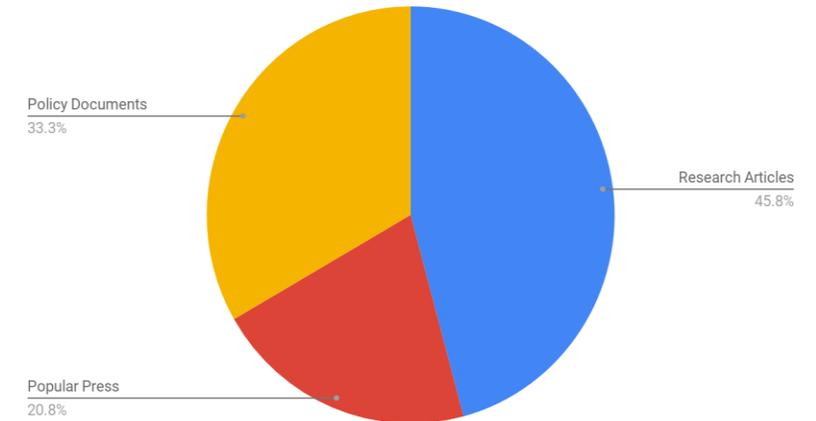
Purpose

- To understand the current state of the technology
- Identify guiding legislation and legal requirements for planning
- Provide a foundation for policy guidance

Methodology

- Conduct a review of popular press articles, governmental reports and academic research
- Summarize key articles
- Develop a comprehensive bibliography
- Sorting articles by topic area
- Develop general conclusions by topic area

Research Resource Distribution



Findings - Literature Review

- Despite various sources and information about autonomous vehicles, there is debate about the timing and extent of implementation.
- AVs, when fully implemented, will be found in many transportation choices, from public transit, to freight, to personal use.
- Human behavior and decision making are the most challenging variables for planners to predict about AVs because human behavior will shape how quickly this technology is adopted.
- Because of all the unknowns in AV technology, every decision maker faces some risk in legislating for it and creating policies surrounding it.

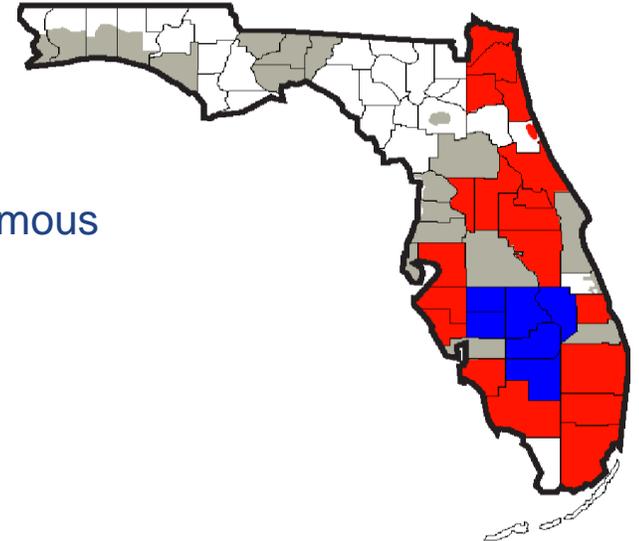
Stakeholder Outreach

Purpose

- To get a perception from each MPO director on the adoption of autonomous vehicles being used as public transportation in their jurisdiction

Methodology

- Survey of MPO Directors
- Review Long Range Transportation Plans
- Contact Cities and Universities
- Contact other state departments of transportation
- Contact public transportation agencies within multiple Florida cities.



Findings - Stakeholder Outreach

- MPO and TPO directors are aware of AV technology, but need guidance on the adoption process.
 - Even with all the unknowns, MPO and TPO directors believe autonomous public transportation will reduce congestion and, most importantly, improve the safety of their communities.
 - Universities throughout Florida that are testing this technology are generally further ahead in the process than the cities in Florida.
 - There is a lot of AV testing happening in the State of Florida, but each location is testing different technologies. This can make it difficult to stay up to date on all the innovations occurring.
 - Most states are behind Florida in terms of AV policy, but some states are at about the same place, such as Nevada and California.
 - There are no current AV public transportation projects in the other 49 states that have been implemented, all projects are still in the testing phase.
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Technology Assessment

Purpose

To identify:

- Autonomous vehicle types (retro-fit, AV shuttles, AV buses), and components
- Urban settings suited for autonomous transit systems (circulators, first mile last mile)
- Dedicated infrastructure necessary for implementation (BRT, office parks, campuses)
- Relative cost of implementation



Sensor



Camera



Lidar

Technology Assessment

Methodology

Conduct an intensive review of

- Peer reviewed articles
- Reports from publications such APA Planning Magazine.
- News articles
- Symposiums
- Meetings
- Conferences

Conduct outreach through calls and emails to

- GM
- Mercedes/Daimler
- Navya
- EZ-Mile
- Parts manufacturers

Findings - Technology Assessment

- Autonomous public transportation would be best utilized to shuttle people between specific origins and destinations at the beginning of the implementation process because this removes some operational variables.
- Dedicated bus lanes will also help with the implementation of autonomous buses and shuttles because they will not have to navigate with traffic. This again reduces the number of variables the technology must account for.
- Numerous vendors exist that retrofit buses to become autonomous, that build autonomous buses and shuttles, and that build autonomous cars.
- There are countless vendors and technologies that exist in the AV world. It is not crucial for MPO and TPO staff to keep up with every single one, but it is important to understand just how wide open the field is currently.

Policy Guidance

- In order to come up with recommendations for MPO's and TPO's, there must be a set of assumptions of what the future will look like. These assumptions may vary by levels of urbanization (rural, suburban, urban), within each jurisdiction.
- Policy considerations may differ depending on what is most important in each jurisdiction. For example, safety considerations might trump funding or land use considerations.
- Policy language must address the short term, testing “phase” of adoption of AV's while also addressing the long term, implementation “phase” of adoption.

Policy Guidance

The primary areas for consideration of AV policy development include:

- Land Use
- Infrastructure
- Coordination
- Safety
- Funding
- Liability, Licensing and Registration
- Equity and ADA Compliance

Land Use

- MPOs will need to look at ways in which they can **remove on street parking** in urbanized areas so that the parking lane can be used for transit.
- MPOs will need to keep autonomous **personal vehicles** in mind when they plan for public transportation because they have different land use requirements.
- MPOs will need to **re-examine parking requirements** for new developments.

Infrastructure

- Decision makers need to **monitor technological advances** to decide which technology they should employ.
- Decision makers need to **identify intersections and corridors** where **infrastructure improvements** will be **needed** first in order to phase in improvements.
- Some **roads will need retrofits**, including new signage, painted lines, or landscaping.
- **Dedicated bus lanes** will help facilitate autonomous bus networks because they reduce the variables that currently delay implementation (interaction with other AVs and non-AVs).
- In the slightly more distant future, “**smart infrastructure**” will replace current MOT and signage systems

Coordination

- Each MPO should designate a **lead agency or staff person** to facilitate coordination on emerging intergovernmental issues.
- Each MPO should create an **autonomous vehicle stakeholder group**, with varied representation, to make recommendations based on the testing phase.
- Each MPO should establish a **decision making process** that **involves the transit authorities** as well as themselves.
- **Transit agencies** should develop a **sub-committee** focused on AV technology and coordination with other transit authorities.
- A **public outreach/ education campaign** should accompany the **testing phase** of autonomous transit vehicles, as well as a ridership/ public perception study.
- MPOs should seek out **universities and manufacturers** within their jurisdiction for **partnership** opportunities.

Safety

- MPOs should conduct **public meetings** to gauge perception of safety and other issues
- Any transit agency under an MPO should go through a quarterly **safety assessment** on all autonomous public transit components and **meet** all federal, state and local **safety guidelines**.
- MPOs must require transit agencies to certify that all autonomous transit **meet requirements** specific to **crashworthiness** capabilities and post-crash ADS behavior.
- Transit authorities are required to confirm that **during early implementation**, all autonomous transit have bus **operators on board at all times** in case human intervention is needed, until such time as autonomous vehicle technology no longer requires a human operator.
- For current and future implementation, autonomous vehicles must be **designed to interact safely with human users** (non-AV drivers, cyclists, pedestrians).
- Autonomous transit must **employ technology and firewalls to prevent cyber-attacks**, and transit agencies must have an **emergency response plan** in place in the event of such and incident.

Funding

- **Funding** a fleet of **AV** busses **will be expensive**. 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.
- **Retrofitting** of existing busses may prove more cost effective than purchasing new equipment.
- All available **federal** (FHWA, NHTSA, DOE) **and state** (FDOT, FDHS) **grant programs** should be considered in identifying possible funding sources
- **Public Private Partnerships** may be effective in larger scale equipment or infrastructure upgrades
- With 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.

Liability, Licensing, Registration

- **Liability** should be determined by the **nature and extent of the accident** involving the autonomous transit vehicle.
- MPOs must 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.
- Product liability laws need to be updated 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 to an autonomous transit vehicle is a reasonable safety expectation pursuant to amendments to state statute.
- **Registering** vehicles should be done **uniformly throughout the state**, utilizing the Department of Motor Vehicles administrative capacity.
- MPO's should **lease or rent** autonomous transit vehicles.

Equity and ADA Compliance

- MPOs must ensure that autonomous transit vehicles have proper **access for wheelchairs** by being equipped with wheelchair lifts or ramps.
- As we transition to autonomous buses, drivers will become “**operators**”. One of their main tasks will be **assisting those with disabilities** or impairments.
- Navigation in autonomous transit vehicles should **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 **should be advocated for** to be included in autonomous vehicle technology.

Model Policy Language

The following language is an example of policy that can be incorporated into long range transportation plans in order to satisfy the state mandate:

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 will 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 MPO's 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. Coordination between land use planning and transportation planning will be necessary as these changes occur.

Urban Design

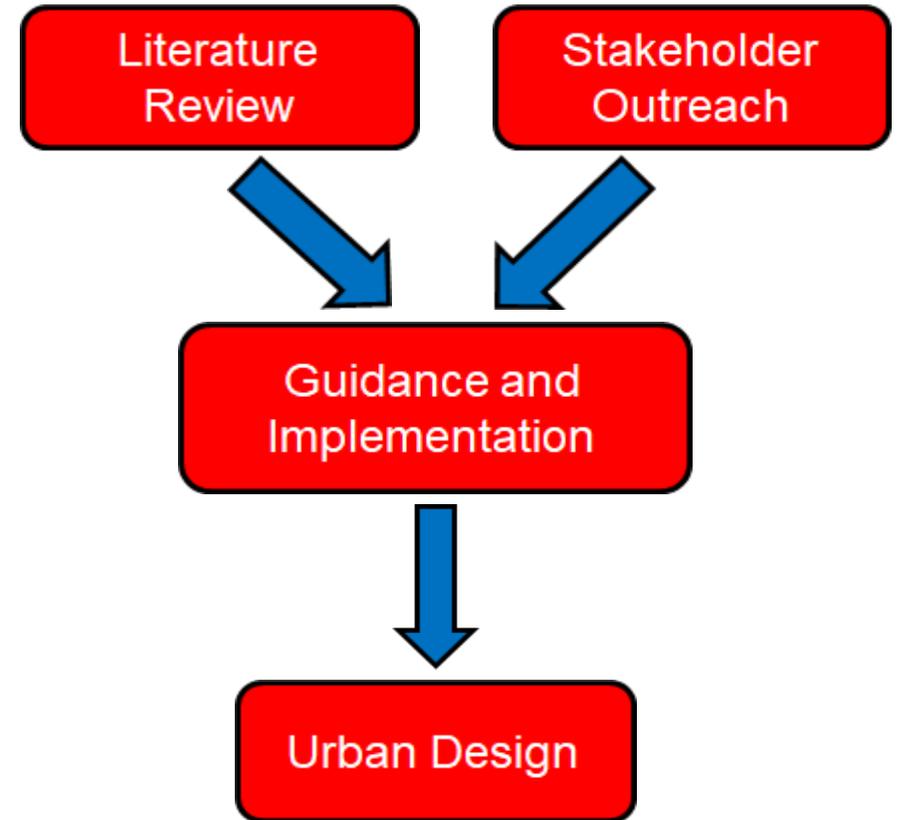
Purpose

- The urban design portion of the project illustrates how the adoption of autonomous vehicles could potentially impact communities in Florida.
- Community types used included:
 - Rural
 - Suburban
 - Urban
- It is likely that the MPOs in Florida will have one or more of these community types within their jurisdictions.
- Although three locations were used to highlight design, the concepts illustrated could be implemented in other community types

Urban Design

Methodology

- The **three sample locations** used were identified **early adopters**
- The designs for the three communities came from the research done in the literature review, the stakeholder outreach, and the guidance and implementation phases of the project
- Additional data for the locations was conducted through **outreach to key informants** in the study area



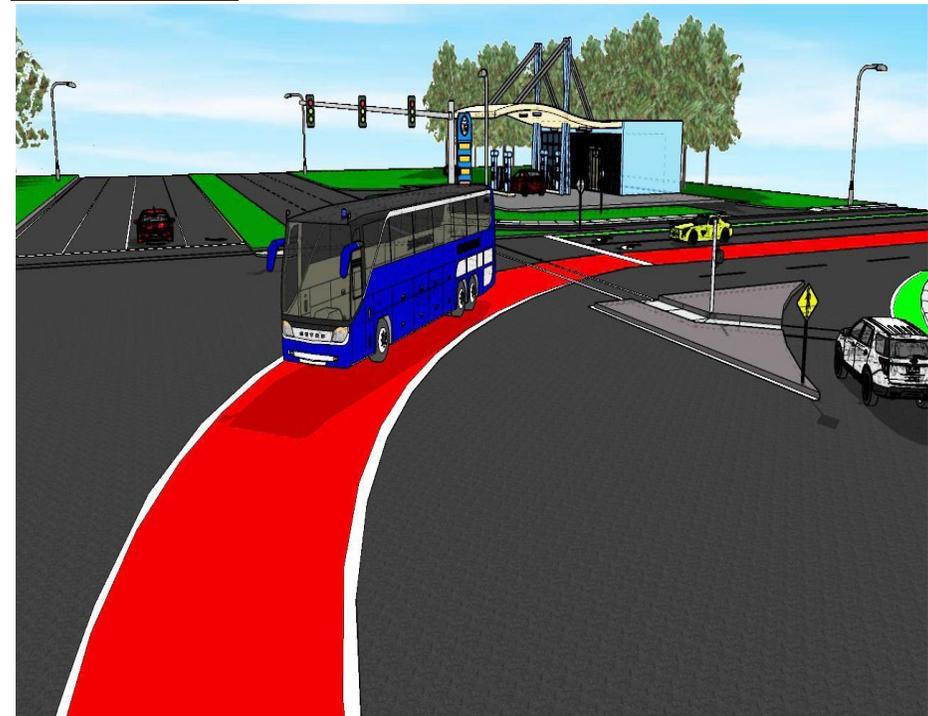
Rural Communities

Anticipated Design for Rural Communities:

Before



After



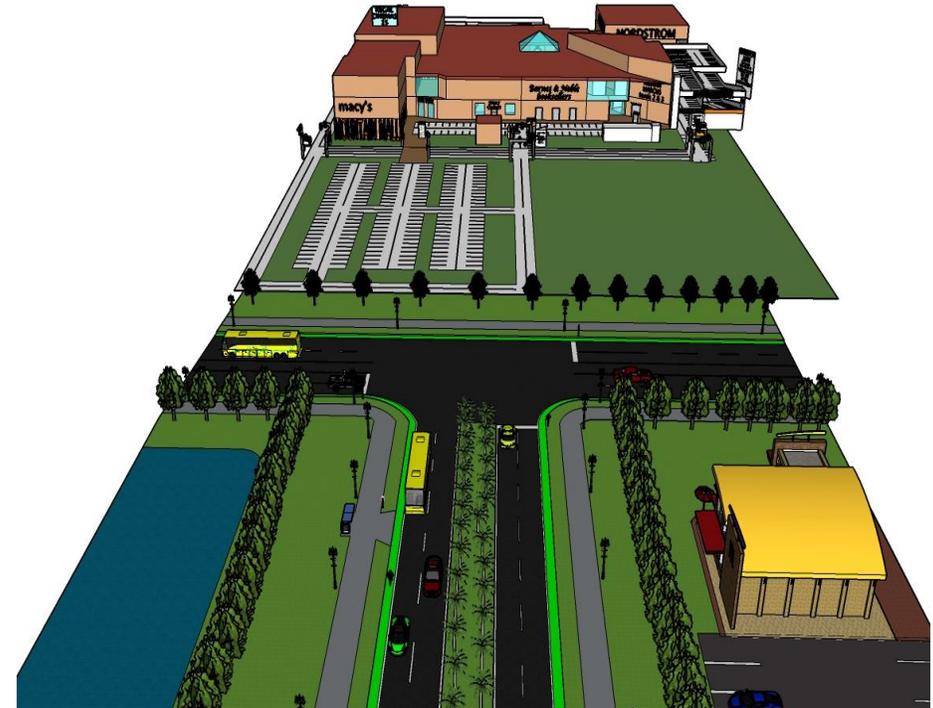
Suburban Communities

Anticipated Design for Suburban Communities:

Before



After



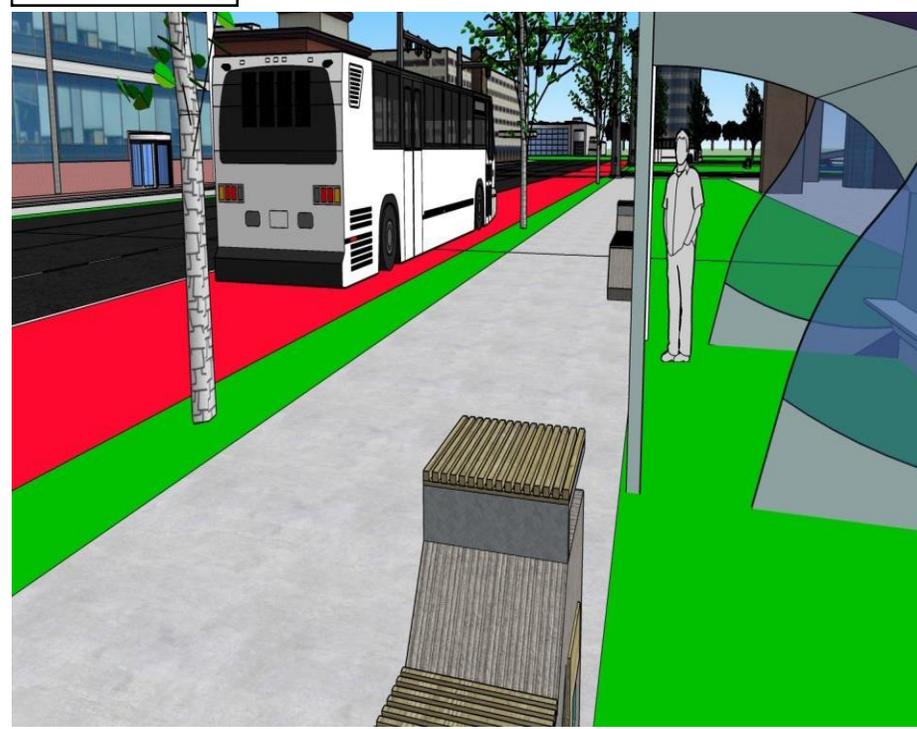
Urban Communities

Anticipated Design for Urban Communities:

Before



After



Urban Design - *Summary*

Urban Communities

- Will most likely 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

Suburban Communities

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

Rural Communities

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

Contact Information

Dennis J. Smith, AICP
Planner-in-Residence
Florida State University
Department of Urban and Regional Planning
113 Collegiate Loop, 346 Bellamy
P.O. Box 3062280
Tallahassee, FL 32306-2280





Florida Department of
TRANSPORTATION



Department of Urban
& Regional Planning

THANK
YOU !



Panelist #2

Brian Pessaro
Center for Urban Transportation Research

Florida Automated Transit and Shared Use Network (ATSUN)

Florida American Planning Association Conference
Sept. 13, 2018

Brian Pessaro, CUTR Transit Research Program



Florida Automated Transit and Shared Use Network (ATSUN)

Florida American Planning Association Conference
Sept. 13, 2018

Brian Pessaro, CUTR Transit Research Program

What is the Florida ATSUN?

- FDOT-sponsored, CUTR-facilitated network of Florida transportation professionals interested in topic of transit automation and shared use services
- ATSUN is a new network – launched Spring 2018
- ATSUN's goal is to be a clearinghouse for information on automated transit and shared use services in the state of Florida and nationwide

Core Areas

Research



Evaluation



Technical Assistance



Initial Activities

Develop Advisory Panel



- Seeking 8 individuals
- Diverse background
- Help guide direction of the network activities (e.g. research)

Initial Activities

Survey Florida Transit Agencies

- What is the status of transit automation and shared use services in Florida?



Florida Industry Transit Automation Survey

- Sent to all 31 fixed route transit operators in Florida
- 14 surveys completed
- Most survey respondents were “not considering automation at this time”
- Most are “watching the industry” for development

Survey Results

- Interest in automated solutions related to
 - First mile/Last mile
 - Parking
 - Braking
 - Precision docking
 - Lane keeping
 - Pedestrian avoidance

Survey Results

- Only a few systems are operating or considering automated transit services in the near future



RTS Gainesville testing driverless shuttle
(Source: YouTube)



JACKSONVILLE
TRANSPORTATION
AUTHORITY



Survey Results

- Topical webinars and sample RFPs for automated services were the Top Two requests for technical assistance
- Half of the respondents would like to have a one-stop website of information, and have face-to-face technical assistance as needed

Survey Results

- More research needed in the following areas of transit automation:
 - Policy
 - Human Factors
 - Capital and Operating Costs, Cost Effectiveness
 - Safety
 - Guidelines and Standards
 - ADA services

FTA Strategic Transit Automation Research Plan

- Published in Jan. 2018
- Outlines FTA research agenda for next 5 years
- 5 waves of demonstration projects
- Calls for “Strategic Partnerships”



Transit Automation Demonstration Projects

- Smooth Acceleration and Deceleration
- Automatic Emergency Braking and Pedestrian Collision Avoidance
- Curb Avoidance
- Precision Docking
- Narrow Lane/Shoulder Operations
- Platooning

- Circulator Bus Service
- Feeder Bus Service

- Precision Movement for Fueling, Service Bays, and Bus Wash
- Automated Parking and Recall

- Automated First/Last-mile
- Automated ADA Paratransit
- On-Demand Shared Ride

- Automated Bus Rapid Transit

Transit Bus Advanced Driver Assistance System (ADAS)

Automated Shuttle

Maintenance, Yard, Parking Operations

Mobility-on-Demand (MOD) Service

Automated Bus Rapid Transit

Strategic Partnerships

- FTA will partner with organizations that are currently conducting automated vehicle research
- Purpose is to leverage research and investments being made by other agencies and disseminate their findings to the broader transit community
- CUTR selected by FTA to help identify strategic partners, provide technical assistance, and maintain reports of partner demo activities

Contact Information



Dennis Hinebaugh
Director, Transit Research Program
(813) 974-9833
hinebaugh@cutr.usf.edu



Brian Pessaro
Senior Research Associate
(813) 974-5113
pessaro@cutr.usf.edu

Thank You!



Panelist #3

Brad Thoburn
Jacksonville Transit Authority



U²C Program

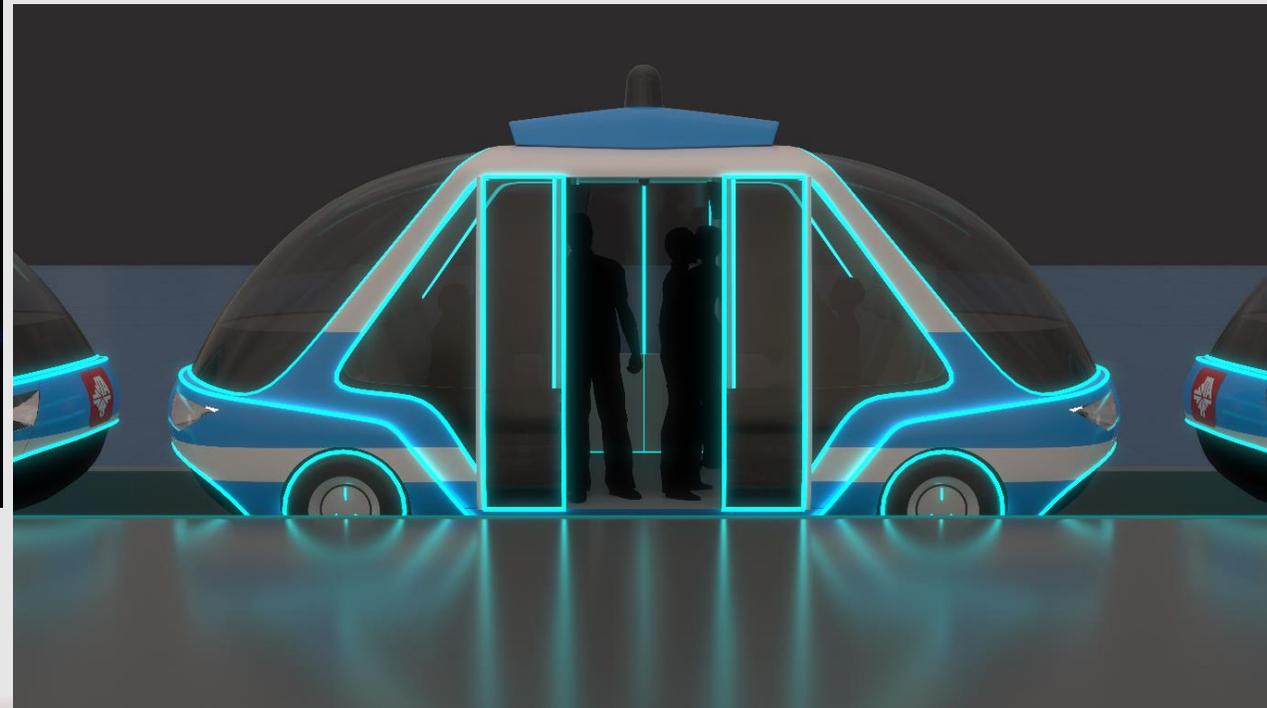
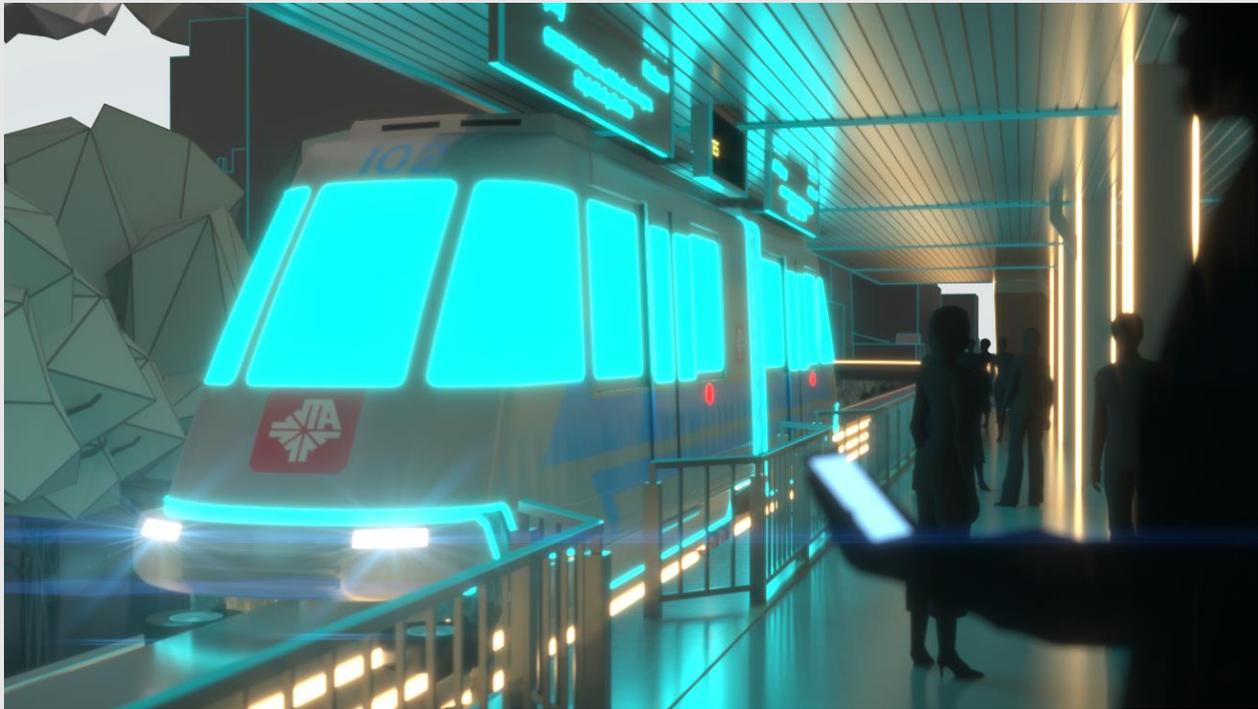
APA Florida – Annual Conference

September 2018



Ultimate Urban Circulator (U²C)

A PLAN TO MODERNIZE THE SKYWAY



Context

- » 2.5 mile, bi-directional system
- » 8 Stations
- » Elevated guidebeam
- » 6-8 minute headways
- » 5000 trips on average weekday
- » 6 am to 9 pm weekdays and special events
- » Vehicles past midlife
- » Structure and vehicles have remaining useful life



Context

» Role as Downtown circulator

» Benefits:

- Speed
- Reliability
- Capacity
- Connectivity with bus system

» Challenges:

- Vehicle obsolescence
- Doesn't reach major existing and planned development
- Frequency
- Cost effectiveness (high cost per revenue mile)

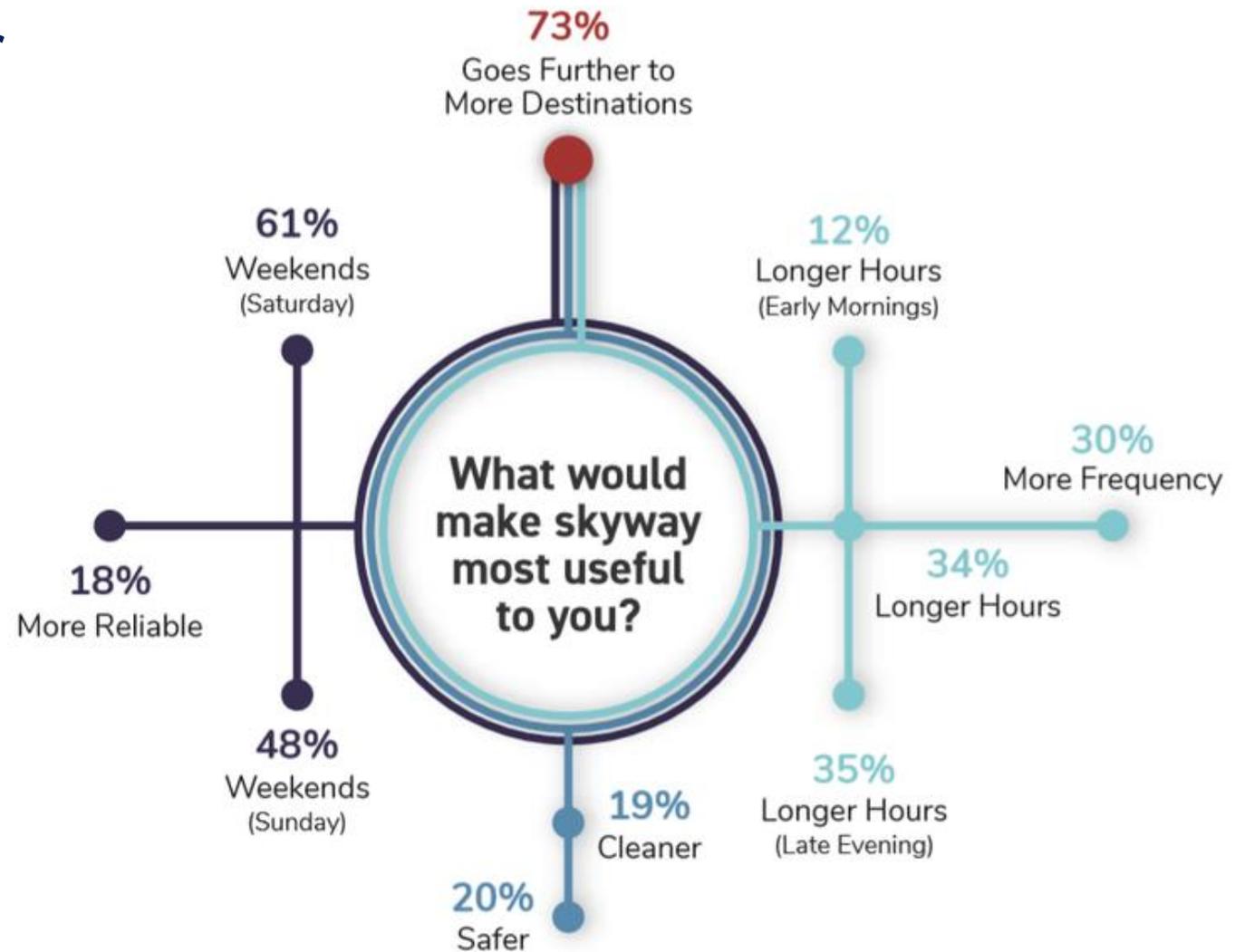


U²C System Plan Development

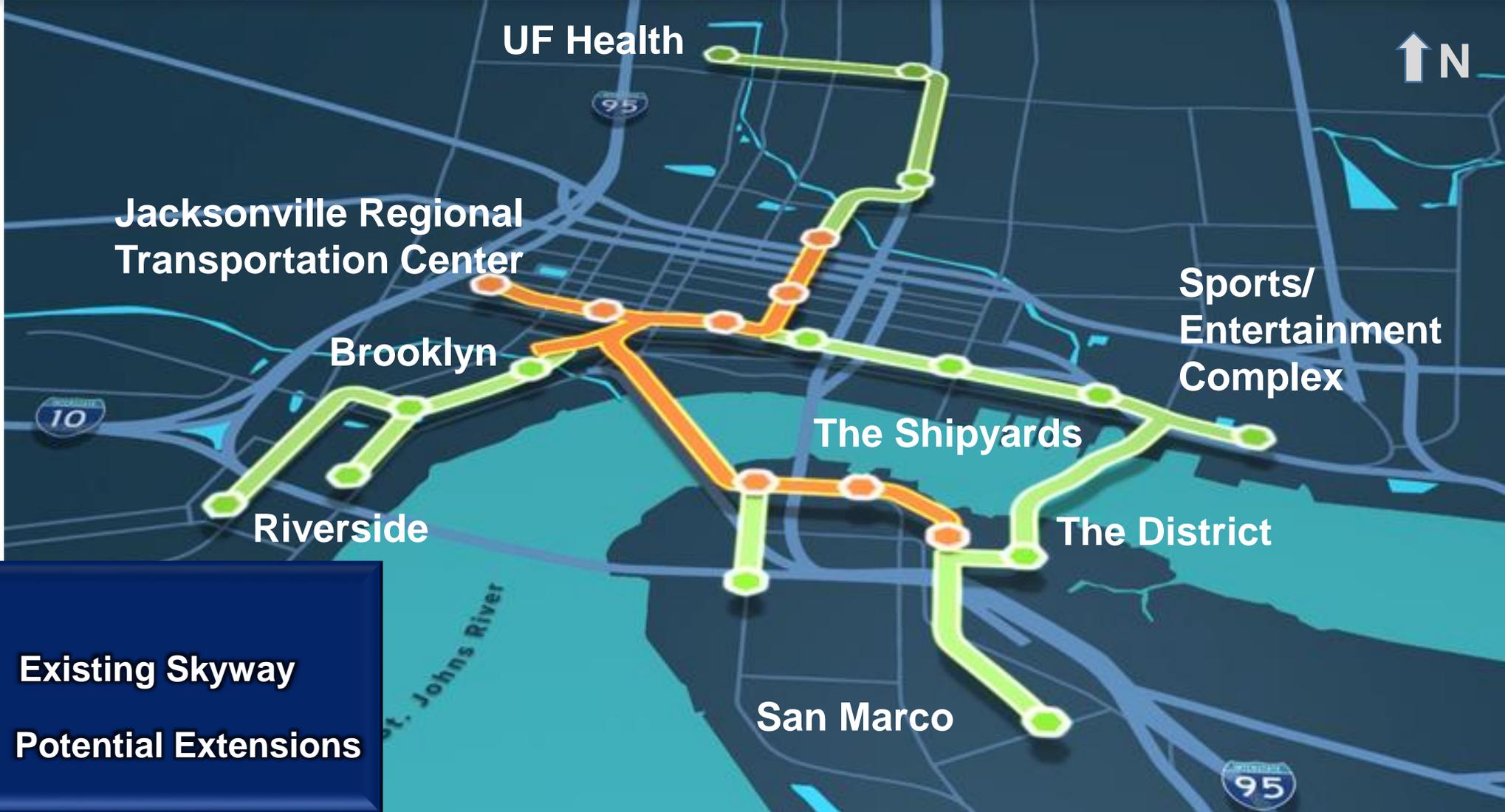
» Community and stakeholder input

- More frequent
- More places
- More often (Longer Hours)

» Existing and planned development



U²C System Plan Development



LEGEND



Existing Skyway

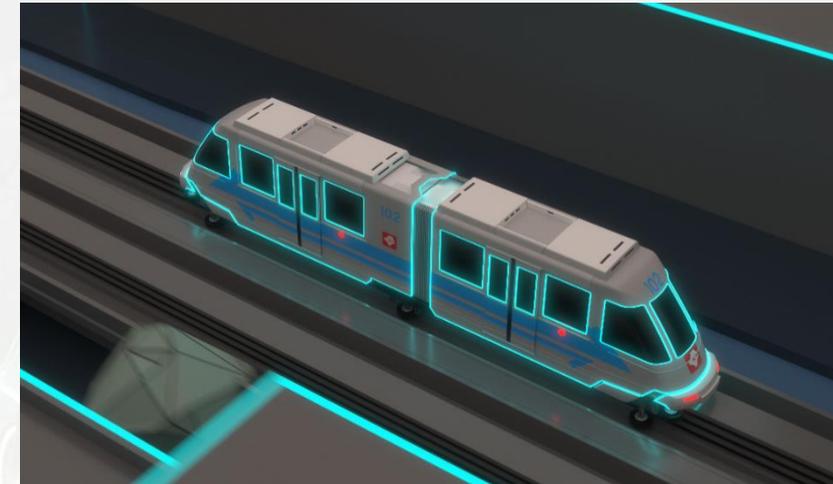


Potential Extensions



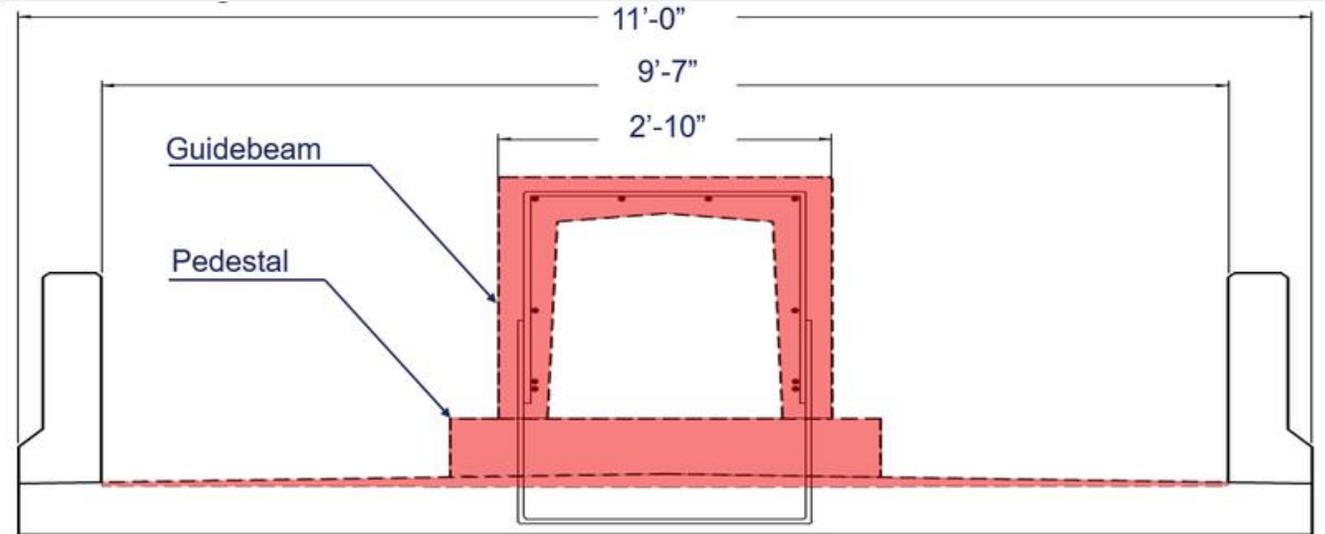
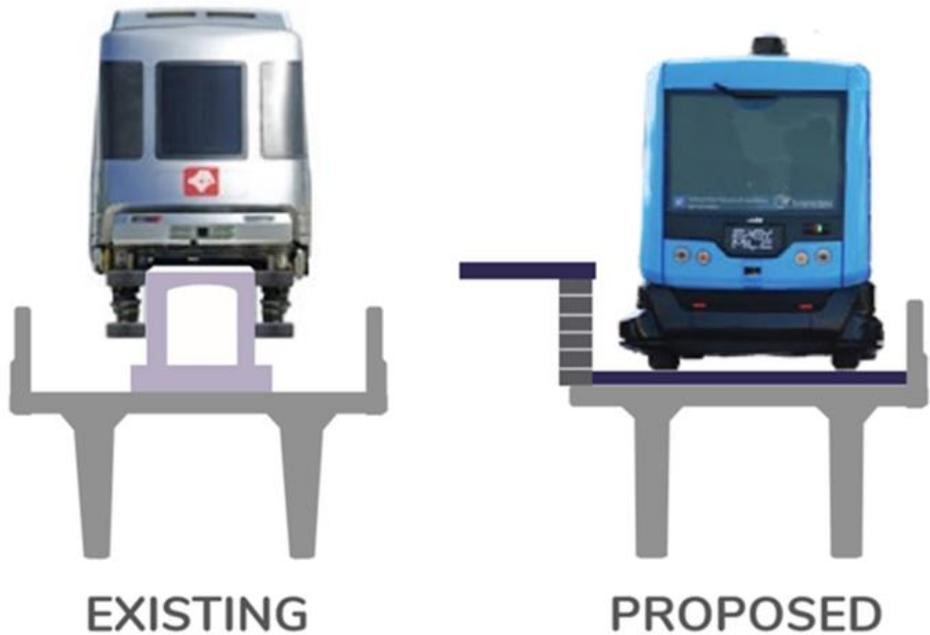
Modernizing the Skyway with AV Technology

- » Uses existing elevated structure
 - Maintains high level of reliability in urban core
 - Ideal platform to deploy AV technology
- » Flexibility
 - High frequency or high capacity
 - Elevated or at-grade
- » Feasibility of extensions
- » Cost effectiveness
 - Stations, guideway, vehicles and O&M less costly than current system
- » Opportunity for future expansion and innovation

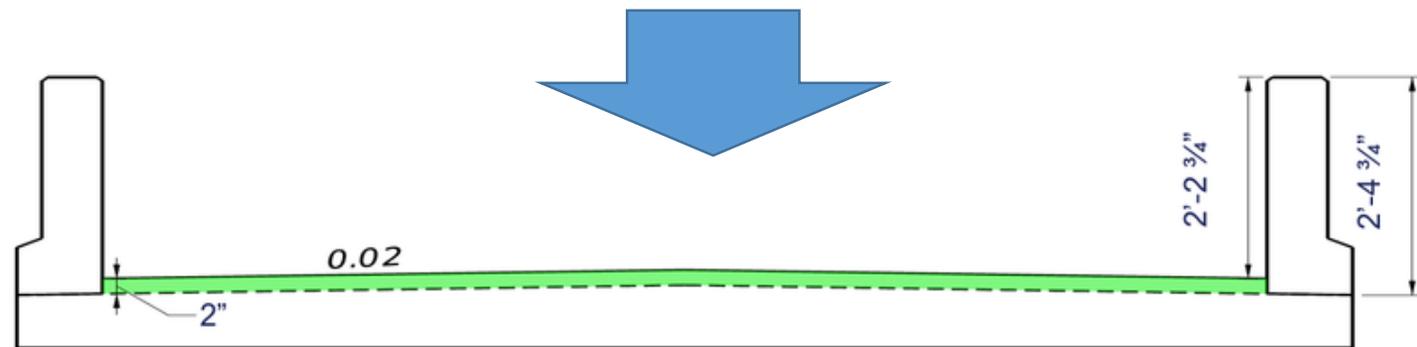


Infrastructure Conversion

- » Remove guidebeam
- » Add smooth running surface



Typical Section of Guidebeam Removal



Typical Roadway Section with Normal Crown

Infrastructure Conversion

» Elevated to at-grade transition

- 6% Grade
- 500-600 feet long
- Urban setting





U²C Visualization

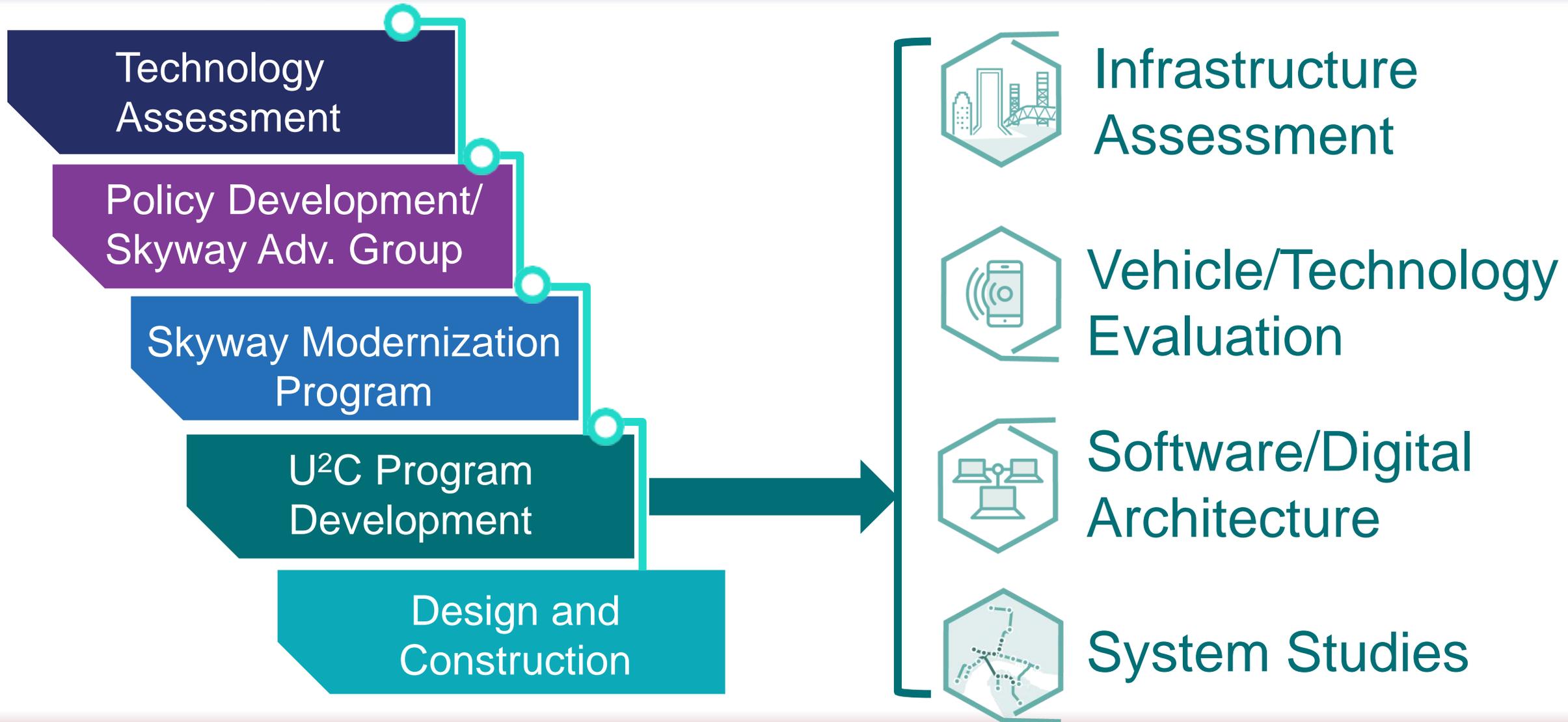




U²C Program Current Activities



U²C Program Development



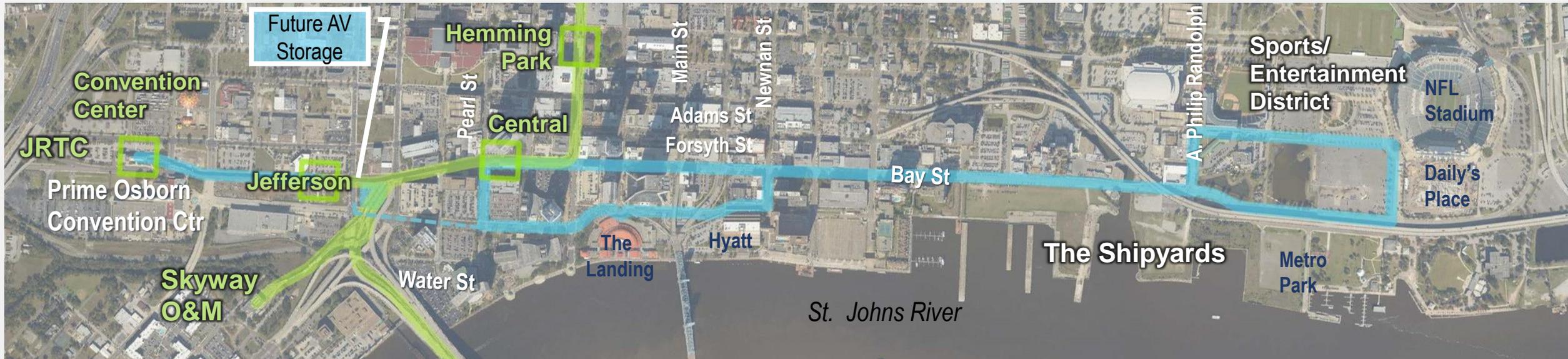
Test and Learn

- » Can test various vehicles and explore application in pilots
- » Develop organizational capacity/workforce development
- » Develop vehicles specifications for U²C
- » Provide exposure and gain public acceptance of technology
- » Public tours are available (u2cjax.com)



Bay Street Autonomous Innovation Corridor

- ✦ Partnership with JTA, City of Jacksonville, Jacksonville Chamber of Commerce, North Florida TPO



- ✦ Creating 3 miles of elevated and at-grade service along Bay Street from the Jacksonville Regional Transportation Center (JRTC) east to the Sports Complex near TIAA Bank Field





U²C Program AV Planning Considerations



NEW PARADIGM

- » Maximize value of investment through technology
- » Expedite project development
- » Public Private Partnerships
- » Scenario planning
- » Nimble and responsive funding
- » Innovative funding and partnerships
- » Scalable solutions

THE CLOCKSPEED DILEMMA

Various industries move at different paces creating the Clockspeed Dilemma.

The robust U²C vision, paired with the accelerated pace of new technology, positions JTA to be at the forefront of assessing organizational and implementation clockspeed to integrate innovation and technology into transportation service delivery.

OLD PARADIGM

Time Intensive
Capital Intensive
Constrained by Critical Path
Lagging Behind Innovation
Technology as an Afterthought
Rigid to the Location

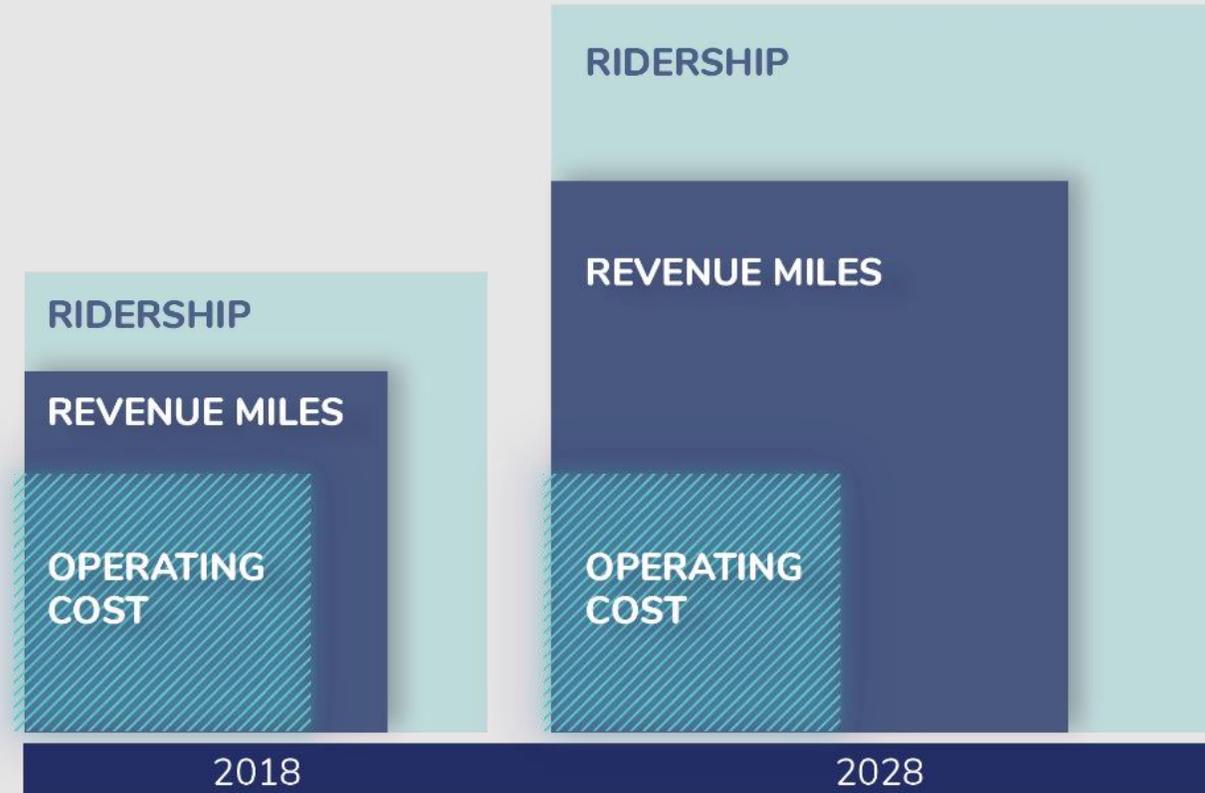
NEW PARADIGM

Speed to Market
Economic Impact
Agile Implementation
Flexible and Customizable
Technology Focused
Optimize Existing Infrastructure



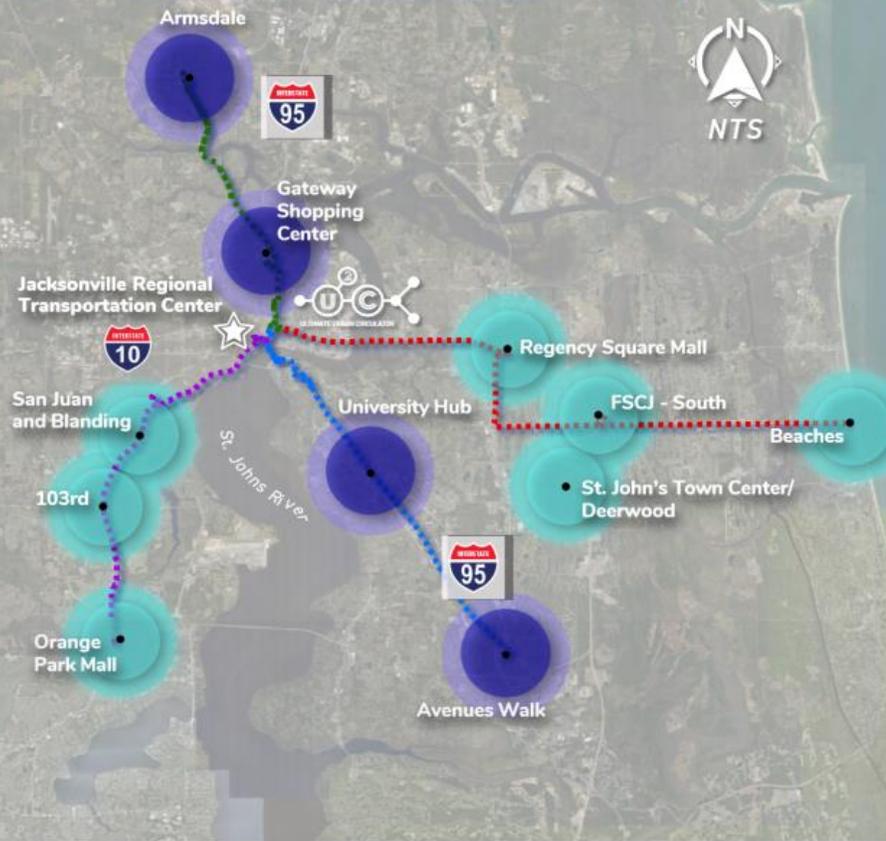
AV TECHNOLOGY POTENTIAL

- » Reduce Cost Per Revenue Hour
- » Enhance service and accessibility
- » Increase flexibility and frequency
- » First and last mile connectivity
- » Innovative revenue opportunities
- » Financially sustainable transit



AV AND SHARED MOBILITY VISION

REGIONAL CONNECTIONS/MOBILITY HUB



LEGEND



Phase I

Phase II

First Coast Flyer
North Corridor

First Coast Flyer
East Corridor

First Coast Flyer
Southeast Corridor

First Coast Flyer
Southwest Corridor

- » Premium Service on High Frequency Corridors
- » Alternative service delivery
 - First and Last Mile
 - Neighborhood circulator
 - Feeder network
- » Integrate shared mobility services



POSITIONING THE WORKFORCE



PLANNING CONSIDERATIONS



- » Land use impacts
- » TOD feasibility
- » Travel demand and congestion
- » Shared mobility adoption
- » Emissions
- » Infrastructure needs
- » Parking requirements



THANK YOU

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