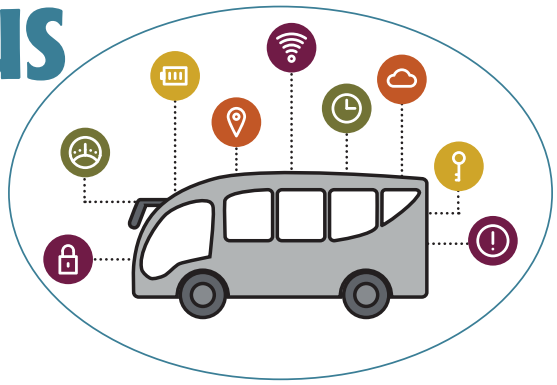
What is an AV Shuttle?

Autonomous vehicle (AV) shuttles are equipped with advanced sensors and computing abilities to perceive and communicate with their surroundings. The shuttles would perform all critical functions (steering, acceleration, and braking) without an operator, while carrying pedestrians along fixed guideways at relatively low speeds.

Autonomous Vehicle Shuttles



What do we know?

AV shuttles are becoming the most heavily researched automotive technology. Yet only a fraction of the future deployable capabilities are available today.

The Challenges

- Public and agency acceptance
- Workforce impact
- Capital investment issues
- Technology availability and maturity
- Demonstrated safety and security

FTA Transit Automation Research

The Benefits

- Increased safety
- Reduced liability
- Decreased maintenance costs
- Increased service availability
- Reduced environmental impacts
- Operation efficiency
- Increased customer satisfaction

The Hurdles

- ADA compliance
- Equity
- Executive Support
- Regulations
- Staffing and skill sets
- Funding
- Internal impediments
- Work rules
- Role-down of liability and risk
- Available technology
- The decision to contract out the AV service or expand internal agency service
- Urban and/or rural areas
- Labor replacement
- Vehicle size
- Customer assistance

General Legislative

- 29 states, including Washington DC, have enacted AV technology legislation
- 10 states have enacted executive orders regarding AV technologies
- National AV legislation passed at www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx

Enacted Legislation

- Most states that have enacted regulation on AVs require vehicles to have a fallback when system fails
- Some states allow that the driver does not have to be present in the vehicle
- Liability is placed on user (not on manufacturer or service provider), even if they are not in the vehicle

Costs

- Based on limited sources, since the technology is new and not widely deployed or piloted
- Combinations of grants and public/private investments
- Champion/partnered local businesses, institutions, municipalities, and DOTs
- January 2016, USDOT committed $4+ billion over the next 10 years

Policies

Federal

- SELF Drive ACT (HR 3388)
- AV START Act (BAG17C69)
- NHTSA federal guidelines—*A Vision for Safety* 2.0 (Sep. 2017) and 3.0 (Oct. 2018)

What should North Carolina do?

- Legislatively — Per HB 469, NC requires an operator to be present in the AV, but the operator is not required to have a driver's license; "Fully AV" is defined as a vehicle with the ability to act safely if the program fails; An adult must be present if a rider is under 12
- Testing — NC is home to one of the proving grounds to test AV technology as per USDOT
- Considerations — Available technology; campus or downtown deployment; rural deployment needs

Recommendations

- Authorized agencies to request an ordinance to operate an AV shuttle on a public road, if one does not exist
- Request permission to operate an AV shuttle on a campus sidewalk, if necessary
- Look to partner with a municipality, a campus, or a business with large campus to pilot a shuttle
- Explore grants for pilot funding (FTA, Bloomberg, USDOT, Challenges, etc.)
- Reach out to multiple vendors to create pilot program
- Research areas that would like a deployment, but don't have the technology; partner with NCDOT
- Implement an in-reach public workshop to discuss concerns and obtain buy-in; coincide with demonstrations

Technology

- Fiber, wireless technology, and integrated apps to function
- Differential GPS, Lidar sensors, cameras, odometry sensors, IMV sensors

Most Popular Shuttles

- Navya ARMA
  - » 15-passenger capacity, 9-hour functional time, 16 mph max speed
  - » Uses GPS, Lidar sensors, cameras, odometry sensors, IMV sensors
  - » $225,000
- Easymile EZ10
  - » 12-passenger capacity, 14-hour functional time, 25 mph max speed
  - » Uses cameras, Lidar sensors, differential GPS
  - » $225,000-$250,000

What is Fallback?

Minimal Risk Condition

- Required of AVs in many states
- The driving system must be able to recognize when it can no longer operate safely
  - » "A minimal risk condition will vary according to the type and extent of a given failure, but may include automatically bringing the vehicle to a safe stop, preferably outside of an active lane of traffic." —NHTSA

State	City	Road Type			# of Passengers	Deployment Type				Max Speed (mph)	Operator	Performance	Brand
		Campus	Public Road/ Fixed Route	Closed Route		Short Term	Testing	Pilot	Development				
North Carolina	Raleigh			●	2				●	15		–	EcoPRT
Texas	Houston	●			–		●			12	●	–	–
	Austin	●			15			●		15		–	EasyMile
	Frisco		●		8			●		–	●	–	Drive.ai
South Carolina	Greenville County		●		–			●		–		1st mile/last mile	Robotic Research
Minnesota	Minneapolis	●			12		●			6		winter weather	EasyMile
	Minneapolis			●	12			●		12	●	–	EasyMile
Florida	Gainesville		●		12	●				25		–	EasyMile
	Tampa	●			15	●				15		–	May Mobility
	Babcock Ranch		●		12			●		8	●		EasyMile
	Jacksonville			●	12			●		18	●		EasyMile
Nevada	Las Vegas			●	15			●		15	●	–	Navya
	Reno	●			–			●		–		–	–
California	San Ramon			●	12					12		1st mile/last mile	EasyMile
Michigan	Ann Arbor	●			15	●				12	●	–	Navya
	Detroit		●		–		●			15		1st mile/last mile	May Mobility
Massachusetts	Cambridge		●		–		●			12		Weather and time of day	Optimus Ride
Nebraska	Lincoln		●		15			●		15		On-demand	Navya

NHTSA's Best Practices for Legislatures

- States should not over-regulate testing or limit testing to manufacturers
- States should manage AV registration clearly and accurately
- States should set up communication with AVs to gather data and improve safety
- States should review existing laws to make sure testing and deployment of AVs isn't impaired

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