What is N-CATT?

• National Technical Assistance Center
• Launched in late 2019
• Operated by Community Transportation Association of America (CTAA)
• Through a cooperative agreement with the Federal Transit Administration (FTA)
The N-CATT Mission

• N-CATT’s mission is to provide small-urban, rural, and tribal transit agencies with practical, replicable resources that help them apply technological solutions and innovations.

• N-CATT is carrying out this mission by analyzing information, communicating it, helping transit systems plan, and encouraging implementation of cost-effective, value-adding technology.
FIND US AT
https://n-catt.org/
Automated Vehicles (AVs) in Transit

Carol Schweiger
President, Schweiger Consulting
N-CATT Webinar
Wednesday, September 16, 2020
What is an automated vehicle?

Technology deployment and safety

Regulations, policies, and legal issues

Public transit automated vehicles

Pilot projects

PRESENTATION OUTLINE
FUTURE OF MOBILITY: WHAT IS MISSING?

ELECTRIC

CONNECTED

SHARED

AUTOMATED
FUTURE OF MOBILITY: WHAT IS MISSING?

- Electric
- Connected
- Accessible
- Equitable
- Shared
- Automated
# Implications for Complete Rural Trip

<table>
<thead>
<tr>
<th>Trip Stage</th>
<th>Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-trip</td>
<td>• If automated reservations, can traveler access reservations?</td>
</tr>
<tr>
<td></td>
<td>• If payment necessary, can traveler pay if un-banked or no credit card?</td>
</tr>
<tr>
<td>Trip origin</td>
<td>• Can AV reach trip origin?</td>
</tr>
<tr>
<td>Between trip origin and location where first mobility service accessed</td>
<td>• Can AV reach stop?</td>
</tr>
<tr>
<td>Where first mobility service accessed</td>
<td>• Is stop accessible?</td>
</tr>
<tr>
<td>Board first mobility service</td>
<td>• If no driver, can traveler board AV?</td>
</tr>
<tr>
<td>On-board access</td>
<td>• If payment on-board, can traveler pay with no assistance?</td>
</tr>
<tr>
<td></td>
<td>• If automated payment, can traveler pay if un-banked or no credit card?</td>
</tr>
<tr>
<td>En-route using first mobility service</td>
<td>• If travel disrupted, how can traveler re-book or change itinerary?</td>
</tr>
<tr>
<td></td>
<td>• If behavior issues on-board, how will it be addressed with no driver?</td>
</tr>
<tr>
<td>Before alighting first mobility service</td>
<td>• If no driver, can traveler move within AV to prepare to alight vehicle?</td>
</tr>
<tr>
<td>Alighting first mobility service</td>
<td>• If no driver, can traveler alight with no assistance?</td>
</tr>
<tr>
<td>Travel between alighting point and transfer point</td>
<td>• Does traveler need directions?</td>
</tr>
<tr>
<td></td>
<td>• Is the path accessible?</td>
</tr>
<tr>
<td>Travel between final mobility service stop and final destination</td>
<td>• Does traveler need directions?</td>
</tr>
<tr>
<td></td>
<td>• Is the path accessible?</td>
</tr>
</tbody>
</table>
VEHICLE AUTOMATION TECHNOLOGIES

• **Automated Vehicles (AVs)** - at least one element of vehicle control (e.g., steering, speed control) occurs without direct driver input

• AVs work by gathering information from suite of **sensors**, which may include:
  – Cameras
  – Radar
  – Light detection and ranging (LiDAR)
  – Ultrasonic
  – Infrared

• **Positioning** systems may include GPS, inertial measurement units, and detailed map data

• AVs may combine these data with other inputs, including **Vehicle-to-Vehicle (V2V)** and **Vehicle-to-Infrastructure (V2I)** inputs
LEVELS OF AUTOMATION ACCORDING TO SAE

## TRANSIT INDUSTRY READINESS FOR AV TECHNOLOGY

### Unions and Labor
- Will workers (primarily bus operators) be eliminated?
- Concern regarding timing of implementation, displacement of workers, and need to be actively involved

### Human drivers/operators versus trusting in AV technology

### Operational benefits
- Can AV transit systems be more reliable than human-driven systems?
- Automation may improve scheduled operations

### Management and organization structures will probably need modification
- Labor force may shift away from being dominated by operators and mechanics
- Organizational models may need new divisions
Few safety and security concerns among riders or potential riders. Examples:

- Perception of safety positive due to reduction in distracted driving and bad driving behavior
- Less risk of a crash for autonomous buses compared to conventional buses
- Greater sense of traffic safety in driverless shuttle buses compared to conventional buses. However, driverless shuttle buses worse in terms of in-vehicle security, probably due to the lack of a driver

Other safety-related studies investigated or evaluated the impacts of new technologies on safety, such as collision avoidance technology.
Discussion about liability and the lack of a legal framework are critical issues. Need to develop a framework with recommendations to address liability issues.

Key policy areas for public transportation and shared mobility in an era of automation, such as accessibility, equity, inclusivity, safety and public–private integration.
MARKET ASSESSMENT

**Driver Warnings**
Some buses are using sensor-based, non-automated systems that provide warnings to drivers, although these are not particularly common.

**Bus Automation**
Development of automation systems for transit buses has been gradual, and such systems are not yet commercially available.

**Specific Components**
No suppliers offer commercialized product for automating steering or braking in transit buses, although some of the components needed to support those systems exist.

**Small Automated Shuttles**
Most automated shuttles are more widely available for early pilot testing and demonstrations, but they are not currently produced at scale and don’t comply with Federal requirements.

**Most Automated Shuttles**
Shuttles carrying relatively few occupants and operating at low speeds (typically between 10 and 15 miles per hour), which may preclude many transit use cases.
# US TRANSIT AUTOMATION PROJECTS

<table>
<thead>
<tr>
<th>Status</th>
<th>States</th>
<th>Rural?</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planned</td>
<td>AL, CA, CT, FL, GA, IA, IL, MI, MN, NY, NV, OH, TX, VA</td>
<td>Y</td>
<td>• Anniston, AL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Treasure and Yerba Buena Islands, CA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• From Iowa City through rural areas and small towns, IA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Huron Transit Corporation, aka Thumb Area Transit, MI</td>
</tr>
<tr>
<td>In-progress</td>
<td>AZ, CA, CT, FL, IN, MI, NV, OH, RI, SC, TX, UT, WA</td>
<td>Y</td>
<td>• City of Columbus, IN</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• County of Greenville, SC</td>
</tr>
<tr>
<td>Completed</td>
<td>CA, CO, IN, MN, ND, NV, OH, OR, WA</td>
<td>Y</td>
<td>• Yolo County Transit District (YCTD), CA</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• Capital Area Transit, ND</td>
</tr>
</tbody>
</table>
PUTTING AVs IN ACTUAL PUBLIC TRANSIT SERVICE

• **Jacksonville Transportation Authority (JTA) Ultimate Urban Circulator (U²C) Program - Autonomous Avenue Project**
• Future Autonomous Bus Urban Level Operation Systems (FABULOS) Project
• Shared Personalised Automated vEhicles (SPACE) Toolkit
• Hamburg Electric Autonomous Transportation (HEAT) Project
• Connecticut DOT (CTDOT) deployment of three 40-foot battery electric buses with key automation features on CTfastrak bus rapid transit corridor between New Britain and Hartford
Skyway Modernization Program

U²C Program Development

Bay Street Innovation Corridor
Autonomous Avenue
Remaining Skyway Conversion
Neighborhood Extensions

<table>
<thead>
<tr>
<th></th>
<th>GOLDEN 20 – AV REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Full ADA Compliance</td>
</tr>
<tr>
<td>2.</td>
<td>Buy America/Buy American Compliance</td>
</tr>
<tr>
<td>3.</td>
<td>Cybersecurity</td>
</tr>
<tr>
<td>4.</td>
<td>Remote Route Programming with Low Latency</td>
</tr>
<tr>
<td>5.</td>
<td>National Highway Traffic Safety Administration (NHTSA) Approval to operate on Public Road</td>
</tr>
<tr>
<td>6.</td>
<td>Vehicle to Infrastructure and V2X Capabilities (DSRC &amp; 5G)</td>
</tr>
<tr>
<td>7.</td>
<td>Traverse Slope of ± 12 Degrees w/ Full Passenger load (Sustained Acceleration/Deceleration)</td>
</tr>
<tr>
<td>8.</td>
<td>Operate bi-directionally up to 35 MPH</td>
</tr>
<tr>
<td>9.</td>
<td>≥12 hours of battery life</td>
</tr>
<tr>
<td>10.</td>
<td>Operate at speeds of 15 MPH within ± 1 foot of Stationary Object and Operate at speeds of 15 MPH within ± 3 feet of Moving Object</td>
</tr>
<tr>
<td>11.</td>
<td>May Operate during Inclement Weather (Rain, Fog, Wind, and Extreme Heat)</td>
</tr>
<tr>
<td>12.</td>
<td>Internal Cab – Environment control with Rapid Cool capability &amp; Sustained temperature with Full Passenger Load</td>
</tr>
<tr>
<td>13.</td>
<td>Ability to be towed; Push/Pull and Steer AV Manually or towed via another AV</td>
</tr>
<tr>
<td>14.</td>
<td>Crash Worthy up to 35 MPH</td>
</tr>
<tr>
<td>15.</td>
<td>Ability for Fast Charge/Opportunity Charging</td>
</tr>
<tr>
<td>16.</td>
<td>Ability to regulate passenger capacity</td>
</tr>
<tr>
<td>17.</td>
<td>System for recording/storing video for at least 30 days (Black Box)</td>
</tr>
<tr>
<td>18.</td>
<td>Emergency button to contact Authority/Agency control center</td>
</tr>
<tr>
<td>19.</td>
<td>Remote command &amp; control operations of vehicles with low latency</td>
</tr>
<tr>
<td>20.</td>
<td>Complete Vehicle Monitoring system, including health monitoring</td>
</tr>
</tbody>
</table>
In Gjesdal, there is a 12% incline due to the mountainous terrain.

In Lamia, high temperatures must be successfully managed.

In the Netherlands, the large number of cyclists must be taken into consideration.

In Helsinki, the route passes the second busiest train station in the country.

In Tallinn, the connection to the airport will be improved, leading to challenges with factors such as existing bus traffic.
FUTURE AUTONOMOUS BUS URBAN LEVEL OPERATION SYSTEMS (FABULOS)
The SPACE toolkit consists of everything you need to know about shared automated vehicles (AVs). It can serve cities, operators, the industry and planners by providing a guidance on how to integrate AVs with public transport. 

https://space.uitp.org/toolkit

Chapter 1
Practical scenarios and how to get there

Chapter 2
Integration of automated vehicles in public transport

Chapter 3
Impact assessment
HAMBURG ELECTRIC AUTONOMOUS TRANSPORTATION (HEAT)
HEAT (Cont’d)

• Decentral infrastructure: Sensors and digital communication systems on the road (including high precision maps)
• Permanent supervising control center at HOCHBAHN
• Vehicle:
  o 8 sitting passengers plus wheelchair (or 2 additional seats)
  o 10 m turning radius
  o 2.88 t total weight
  o 4 t gross load weight
  o Equipped with 5 radar and 8 lidar
CTDOT AUTOMATED BUSES
CTDOT AUTOMATED BUSES

• **First automated heavy-duty buses** in revenue service in North America

• Project set to **go live in approximately a year**

• Includes deployment of **three battery-electric 40-foot New Flyer Xcelsior CHARGE™ vehicles**. CTDOT scheduled to take delivery of first vehicle in December 2020.

• Will operate on CTfastrak bus rapid transit (BRT) guideway — **9.4-mile dedicated BRT route** connecting downtown Hartford and downtown New Britain

• New Flyer will **integrate Robotic Research LLC’s proprietary AutoDrive® automated driving technology** into new buses

• Demonstrating SAE **Level 4 automation**
RESOURCES


RESOURCES (CONT’D)


• Timo Woopen, „Addressing Equity, Accessibility, Inclusivity and Acceptance in the Development of new Architectures for Automated Vehicles in UNICARagil,” presentation at Automated Vehicle Symposium 2019, Breakout Session 17, June 16, 2019, Orlando, FL

THANK YOU!

Carol Schweiger
President
Schweiger Consulting LLC
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carol@tech4transit.com
Transit Innovation in Michigan
MDOT Supporting and Encouraging Transit Innovation

- Sharing risk - funding projects
- Providing technical support
- Facilitating partnerships
- Gathering and sharing lessons learned
- Clearing policy and regulatory roadblocks
Recent Projects

- $8 Million Michigan Mobility Challenge
- NAIAS 2020 Mobility Challenge
- Automated Bus Consortium
- Statewide MaaS
- Michigan Connected Corridor
Goal: Use technology to solve mobility gaps for seniors, persons with disabilities and veterans

Launch event: Daylong workshop to bring together transportation providers, technology companies, advocates for target populations

Received over 40 proposals

Thirteen projects selected - awards ranged from $100,000 to $2.1 million
More information

www.Michigan.gov/mobilitychallenge
Purpose
Provide and demonstrate **INNOVATIVE SOLUTIONS** and **CUTTING-EDGE TECHNOLOGIES** that showcase AV technology capabilities

Need
Further solidify NAIAS and Motor City as the **PREEMINENT ENVIRONMENT** for new transportation solutions

Showcase technology that embodies how **AV TECHNOLOGY TRANSFORMS** how we live, work and play
The Challenge

Provide AV services for select media between DTW and Downtown Airpot

TECHNOLOGY
- Minimum Level 3 AV services
- Safety driver/liaison required in vehicle

RIDERS
NAIAS media attendees and VIPs

OPERATIONAL DATES
NAIAS Media/Press Preview

FEATURES
In-vehicle experience
The Challenge

Provide AV services for NAIAS attendees within predefined boundaries

TECHNOLOGY

• SAE Level 3+ AV services
• Safety driver/liaison required in vehicle

RIDERS

Public/NAIAS attendees

FEATURES

In-vehicle experience

OPERATIONAL DATES

Preview and Public Days (2 weeks)

SERVICE OPTIONS

• Multiple providers and vehicles
• Fixed-route (4)
• On demand (1)
PROPOSAL
• Provide an integrated, seamless user experience
• Custom NAIAS 2020 Michigan Mobility Challenge App
• Integrates AV Mobility Solutions with existing mobility options (i.e. transit, Uber, scooters)

FUNCTIONALITY
• Allow users to schedule AV rides
• Displays vehicle location, time to pickup, trip duration, etc.
• Links with NAIAS Application and existing mobility options

Sample MaaS app User Interface for June 2020 NAIAS event
Partnership of 13 state DOTs and transit agencies to develop and test full-size, full-speed, accessible automated buses

www.automatedbusconsortium.com
MDOT is exploring a statewide MaaS project that would enable people anywhere in the state to connect with available transit options in their area. Additional features, such as mobile trip planning, reservations and fare payment, could be added in various regions.
Michigan Connected Corridor
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SIP launched Cavnue to build the future of roads
## Corridor Vision

<table>
<thead>
<tr>
<th>Key Benefit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First-of-its-kind dedicated AV corridor</strong></td>
<td>Transformative project provides infrastructure to accelerate AVs drawing on resources of Detroit and Michigan</td>
</tr>
<tr>
<td><strong>Privately funded</strong></td>
<td>SIP and Cavnue provide upfront capital for infrastructure build-out</td>
</tr>
<tr>
<td><strong>Not competing with rail transit projects for passengers or financial resources</strong></td>
<td>Aligned with regional transit planning to deliver affordable, accessible transit</td>
</tr>
<tr>
<td><strong>Opportunity for innovation with OEMs and technology partners</strong></td>
<td>Leading technology companies and OEMs deliver vehicles, digital, physical, and coordination technology</td>
</tr>
<tr>
<td><strong>Mobility, transit access, and economic development</strong></td>
<td>Broaden access to shared and personal mobility for entire community with priority for fairness and equity, while spurring economic development by connecting to key anchors</td>
</tr>
</tbody>
</table>
Integrated CAV Laneway Creates Mass Mobility with Greater Throughput and Efficiency
Anatomy of a CAV Laneway

The core infrastructure technology stack for a connected AV laneway consists of four broad buckets: physical, digital, coordination, and operational.

1. **Physical Infrastructure**
   - Well-maintained roadways
   - Separation barriers to ensure efficiency and safety
   - Enhanced, machine-readable markings, digital signage and signalling
   - Enhanced maintenance to maximize pavement life, including levels of prediction and automation

2. **Digital Infrastructure**
   - Ubiquitous, highly reliable connectivity
   - High-definition (HD) maps
   - High accuracy ground-based GPS
   - Road sensors for traffic, weather, road conditions

3. **Coordination Infrastructure**
   - System to manage vehicle coordination and interoperability
   - Ability for transportation authorities to set policy goals to maximize mobility and accessibility, and track their impact

4. **Operational Infrastructure**
   - Modified or purpose-designed connected autonomous buses or shared mobility vehicles to greatly enhance the performance and passenger experience
   - Smart curbs, chargers and other supporting infrastructure
Integrated Infrastructure Technology Framework for CAV Corridors

The infrastructure technology stack serves as part of a broader transit and mobility ecosystem.

1. **Physical Infrastructure (Cont’d)**
   - Adaptive traffic signals with intersection priority, particularly for transit and emergency services
   - Intersection designs optimized for pedestrian safety

2. **Public Transit**
   - Buses operating autonomously on loops
   - Frequent stops using smart curbs and/or bus stops (see #5)

3. **Smart Curbs / Stops**
   - Smart curbs at milestones able to identify available time/space reservations
   - Consoles at smart curb locations for mobility functions
   - Dynamic, digital signage

4. **Ride Sharing**
   - Passenger app integration with superior booking and boarding experience

5. **Support**
   - High speed EV chargers
   - High speed wireless or tether vehicle data download
   - Maintenance and cleaning

6. **Compatible CAVs**
   - Vehicles with certified AV / ADAS systems
   - Ability to share information with other vehicles and infrastructure for navigation and safety
Dedicated Laneway Can be “Future Proofed” and Evolve to Meet Transit-Oriented Goals

TRANSITION TO CAV LANEWAY

Today

Tomorrow:
Connected Transit Lane
Begin with connected buses & shared vehicles meeting transit goals.

Future:
Integrated Connected AV lane
<table>
<thead>
<tr>
<th>OTHER INNOVATIVE PROJECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FY20 Low/No Emissions Program Grant</strong></td>
</tr>
<tr>
<td><strong>Overview:</strong> MDOT received a $6.4 million grant to purchase electric buses and build charging infrastructure for six transit agencies around the state</td>
</tr>
<tr>
<td><strong>Partners:</strong> MDOT, Benzie Transportation Authority, Clare County Transit Corporation, Capital Area Transportation Authority, Delta Area Transit Authority, Huron Transit Corporation, Macatawa Area Express, CALSTART</td>
</tr>
<tr>
<td><strong>WSP Technology Partnership</strong></td>
</tr>
<tr>
<td><strong>Overview:</strong> Recommend new technology for a rural and an urban system; evaluate effectiveness</td>
</tr>
<tr>
<td><strong>Pilots:</strong> Bay Area Transportation Authority (BATA; Traverse City) – Vehicle Crash Avoidance; Suburban Mobility Authority for Regional Transportation (SMART; southeast Michigan) – Transit-Pedestrian Detection System</td>
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<tr>
<td><strong>Comprehensive Healthcare Access with Rural Transit Solutions (CHARTS)</strong></td>
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<td><strong>Overview:</strong> MDOT and BATA will develop and demonstrate a mobility-on-demand service to meet NEMT needs of rural residents in conjunction with a larger sandbox demonstration of on-demand microtransit in Traverse City.</td>
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<td><strong>Funding:</strong> Recipient of FTA Integrated Mobility Innovation Demonstration Program grant</td>
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Lessons learned

- Allow enough time to fully develop partnerships and projects
- Select meaningful metrics
- Monitor milestones
- Constant evaluation - change course if needed
- Public outreach/marketing
Questions?

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Autonomous Shuttle Demonstration Program

9/16/2020

Jacob Labutka
Project Planner
Pinellas Suncoast Transit Authority (PSTA)
St. Petersburg, Florida
PSTA – Pinellas County

Population of 970,637
Median age of 48
24 municipalities – 22 served by PSTA
Health, manufacturing, and financial services
Significant tourism industry
44 bus routes
12+ million trips annually
PSTA Transportation Innovation

• PSTA is incorporating transportation technologies that are:
  – Autonomous ✔
  – Connected ✔
  – Electric ✔
  – Shared ✔
• PSTA is a nationally recognized leader in innovation
AV Demonstration Purpose & Area Deployments

- Introduce AV technology to service area
- Educate community on driverless shuttles
- Economic development
- Inform future deployments of AV technology
About Beep & NAVYA shuttle

Beep, an autonomous shuttle service provider based out Orlando, will operate two NAVYA shuttles at the direction of PSTA.

**Drive System**
- Motor: Electric
- Operating speed: up to 15 mph

**Energy**
- Operating time: up to 7 hours
- Charge duration up to 90%: 3-4 hours

**Sensors**
- Light Detection & Ranging (LiDAR): 8
- Cameras: 2
- Dedicated GPS Base
- Safety sensors designed to avoid collision
Operational Details – St. Petersburg Demo

- 2 shuttles will be used with 1 attendant for customer safety and feedback per shuttle
- Shuttles serve destinations such as a hotel, art museum, restaurants, and a recently opened Pier District
- Service connects to transit services such as a seasonal ferry and local bus routes
- Fare-free service
- Project is funded through a FDOT Commuter Assistance Program (CAP) grant with matching funds from PSTA and in-kind contributions from the City
- Route has been approved by the National Highway Traffic Safety Administration (NHTSA)
COVID-19 Precautions

- Increased cleaning and sanitizing of vehicles
- Maximum vehicle capacity reduced from 10 to 6 and designated seating arrangements
- Requiring face masks for attendants and riders
- In compliance with CDC guidelines and City requirements
Steps Prior to NHTSA Application

1. Identify AV Shuttle Owner/Operator
2. Identify Road for deployment
   a. Low speed
   b. High visibility/Concentration of destinations within walkable area
   c. Few traffic controls
   d. Short distance
   e. On-road space for stop docking
   f. Adequate space for shuttle turning radius
3. Complete Preliminary Corridor 3D Mapping
4. Determine Operations Plan (e.g. span of service, frequency, stop locations)
5. Determine Number of Shuttles required to operate the service
6. Identify Possible Secure Storage Locations for Shuttles with access to electricity
7. Identify Secure Rooftop for GNSS (Global Navigation Satellite System) Installation
8. Operator submits NHTSA waiver
Steps Following NHTSA Approval

1. Finalization of stop locations and improvements to stops:
   a. ADA accessibility
   b. Sidewalk connections
   c. Signage
2. Landscape adaptation to operate with LiDAR (Light Detection and Ranging)
3. Install 240V chargers in storage facility
4. Freight shuttles to project location
5. Conduct training with EMS on shuttle specs and operations
6. Hire and train shuttle ambassadors
7. Shuttle testing without passengers
8. Public launch
Future

- Data collected through demonstration program will inform future deployments of autonomous vehicles
- PSTA is a member of the Automated Bus Consortium
- Potential future use cases:
  - Bus yard operations
  - Bus on shoulders
  - Bus Rapid Transit
  - Downtown circulation
Planning for a Future, Accessible, Automated Transit System (ATS)

Matthew Lesh, AV Mobility Strategist
driverlesslesh@gmail.com
What does our automated future look like?
So, what’s my point?

“Utilize the tool of automation to enhance society, not just cars!”
Background

- 10 years at FTA - USDOT
  - Mobility / TOD
  - Transit Access
  - Connected Vehicle / ITS
  - Automation Program Plan
- Consultant at Noblis
  - ATTRI Program
  - Smart City Challenge
- Local Motors
- Independent AV Strategist

Morgantown PRT - 2011
Uppsala, Sweden 2012
Washington, DC 2016
Milton Keynes, UK 2018
Discussion

- Review of documented needs
- Low-Speed Automated Vehicles (LSAVs)
- Government programs leading the way
- What a future system might look like
- Tools for planning
- Universal Design Principles
- Lessons learned & advice moving forward

Source: Federal Transit Administration
Documented Needs: Disability & Aging

- 1 in 5 people in the U.S. has a disability (more than 57 million people)
- 25.5 million Americans have travel-limiting disabilities;
- More than 6 million have difficulty getting the transportation they need for jobs, medical appointments, and daily living
- 3.6 million Americans with travel-limiting disabilities do not leave their homes
- The number of U.S. residents aged 65+ is projected to increase to 72 million by 2030
- Nearly 16 million people aged 65+ live in communities where public transportation is poor or nonexistent

Sources: U.S. Department of Transportation, Federal Highway Administration, 2017 & National Household Travel Survey & National Aging & Disability Transportation Center
Addressing Needs: Promise vs. Reality

- One promise of AV development is the opportunity to incorporate those populations that don’t or can’t drive into the transportation system.
- Accessible vehicles would begin to address the great mobility needs of disabled populations, but the form factor has not changed much.
- Paratransit operations continue to grow in expense for communities across the country and globe.
- Most OEMs have treated developing vehicles for disabled communities as an afterthought.

Source: Lyft
Low-Speed Automated Vehicles (LSAVs)
FTA’s Strategic Automation Research (STAR) Program outlines a national direction for transit automation.

Source: Federal Transit Administration
U.S. DOT BUILD Grant

“This grant will support the county's reimagining mobility project. It’s an investment in cutting edge, multimodal transportation.”

-Secy. Elaine Chao, USDOT, November 2019

Orange County, FL received a $20 million federal grant to expand its autonomous shuttle system at Lake Nona through the Better Utilizing Investments to Leverage Development (BUILD) program of USDOT.
Orange County, FL BUILD Project Specifics

- 1st BUILD grant in Central Florida
- Create new and/or modify existing infrastructure
- 22+ miles of AV path to support a 50+ shuttle network
- Dedicated AV stops
- AV storage facility for maintenance and charging stations

Photo courtesy of Beep
Success to Deployment - Engage Early & Often

Beep engages with external stakeholders before, during, and after a deployment to ensure the safe planning, deployment, and operation of the autonomous shuttle.
FTA Accelerating Innovative Mobility (AIM)

- $600k Kansas City Area Transportation Authority (KCATA) for MAX BRT
- Test and develop advanced driver assistance systems (ADAS)
  - ADA-compliant level boarding
  - Reduction of dwell time
  - Object detection
  - Crash Avoidance
  - Breaking assistance

Robotic Research’s technology will help operators overcome ADA-compliant gaps between platforms, which will improve accessibility, reduce dwell time and ensure a better transportation experience.
Critically important to the Houston plan is regional access to urban core districts by a high capacity transit system. The system will strategically include ATS circulator systems to provide vital first and last mile connections.
What might the future look like?
Podaris has its roots in PRT system design, providing high-level tools for accurate, parametric drawing of automated transit systems.

Its multi-modal nature allows you to explore the relationship between a variety of transport modes and conduct early stage feasibility studies in a fraction of the time, at a fraction of the cost.
Built for real-time collaboration

Podaris empowers interdisciplinary teams to explore concepts together, in real-time, on a shared web-based platform. It engenders dialogue, promotes transparency and reduces feedback loops from months to milliseconds.
Principles of Universal Design

- Body Fit - accommodate a wide range
- Comfort - keep demands within limits
- Awareness - ensure information is easily understood
- Understanding - operation is clear and intuitive
- Wellness - contribute to health promotion
- Social Integration - treat all groups with respect
- Personalization - present opportunities for choice
- Cultural Appropriateness - respect cultural values

The IDEA Center produces knowledge and innovative tools to increase equity in design for underrepresented groups.
Reflections for Future Automated Mobility

• Find or be a local champion
• Plan with Universal Design Principles – Accessibility in mind
• Pedestrian Environment Supports Multimodal Mobility
• Understand Battery Capacity & Duty Cycles
• Encourage IoT, Connected Vehicle, & ADAS for greater safety
• Leverage Purpose-Built Vehicle
• Build Inclusive Strong Teams
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