



# AUSTIN CHAMBER

## WELCOME



# **AECOM**

PROUD MEMBER OF AUSTIN CHAMBER OF COMMERCE SINCE 1979

# Our Presenters

Jay Hietpas, PE (MnDOT)  
Assistant Commissioner - Operations



Susan M. Mulvihill, PE (MnDOT)  
Deputy Commissioner/Chief Engineer



Richard Wolsfeld (AECOM)  
Executive Vice President, North America Transportation



Travis Boone, PE (AECOM)  
Executive Vice President, Central Region Executive



Mark Ryan, AICP (AECOM)  
Vice President







## Automated Vehicles – The Minnesota Approach

Sue Mulvihill – Chief Engineer / Deputy Commissioner  
Jay Hietpas – Assistant Commissioner

1

Minnesota's  
Vision for  
CAV



# Why CAV?





# Why CAV is Important

## Greater Mobility & Equity



## Workforce Impacts



## Traffic Operations



## Economic Development



## Infrastructure



## Health & Environment





# What About Winter Conditions





2

Preparing  
for CAV



 **NewsRoom**

[ABOUT AAA](#) [AUTO](#) [GAS](#) [SAFETY](#) [ADVOCACY](#) [TRAVEL](#) [DISCOUNTS & MORE](#)

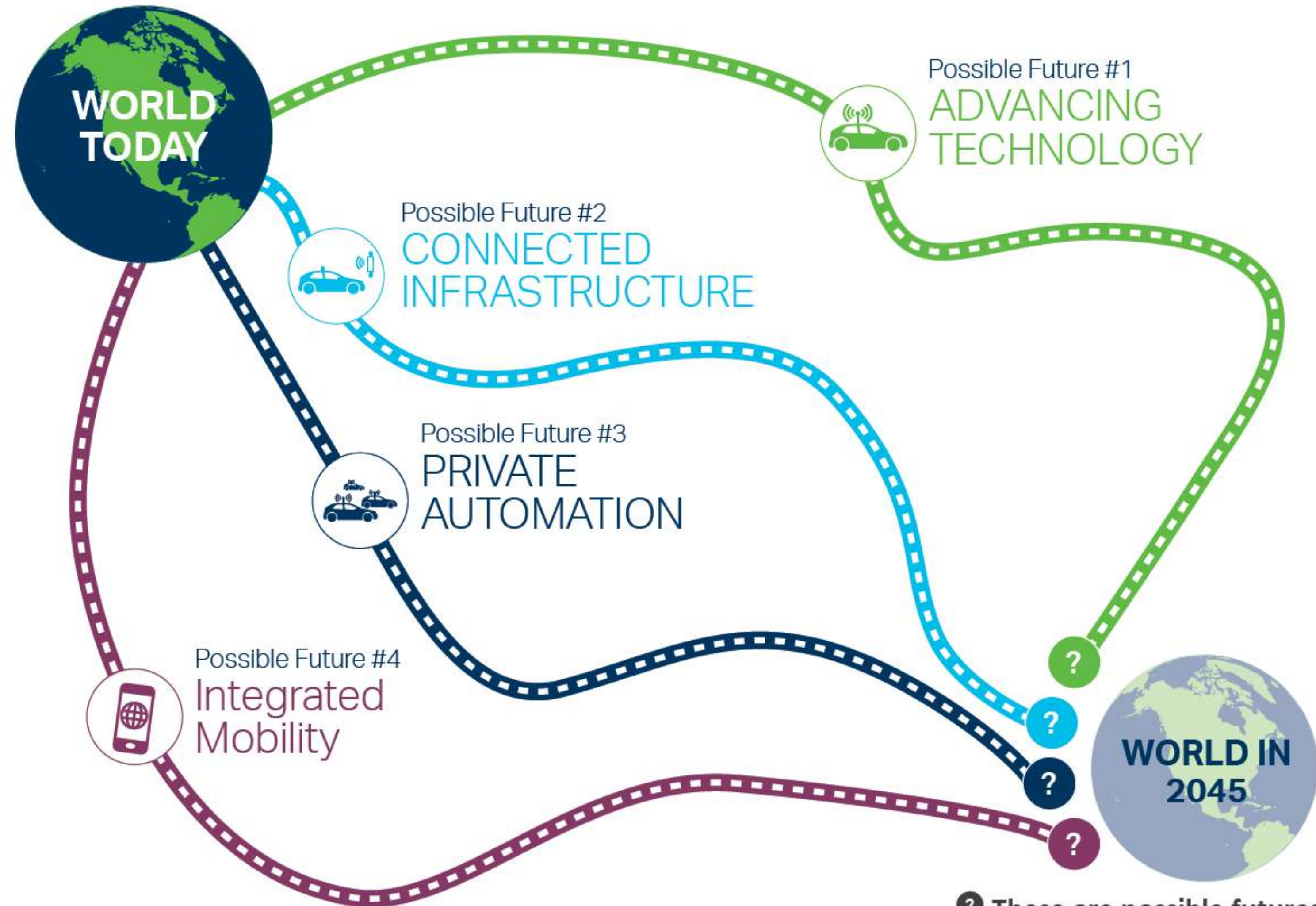
AAA NEWSROOM > AUTO > THREE IN FOUR AMERICANS REMAIN AFRAID OF FULLY SELF-DRIVING VEHICLES



Three in Four Americans Remain  
Afraid of Fully Self-Driving Vehicles



# CAV - When Will It Come?



**? These are possible futures.**  
Any of these could happen. Or none.



# CAV Executive Report Key Themes



Modernize policy



Equity



Proactive statewide leadership



Public education & outreach



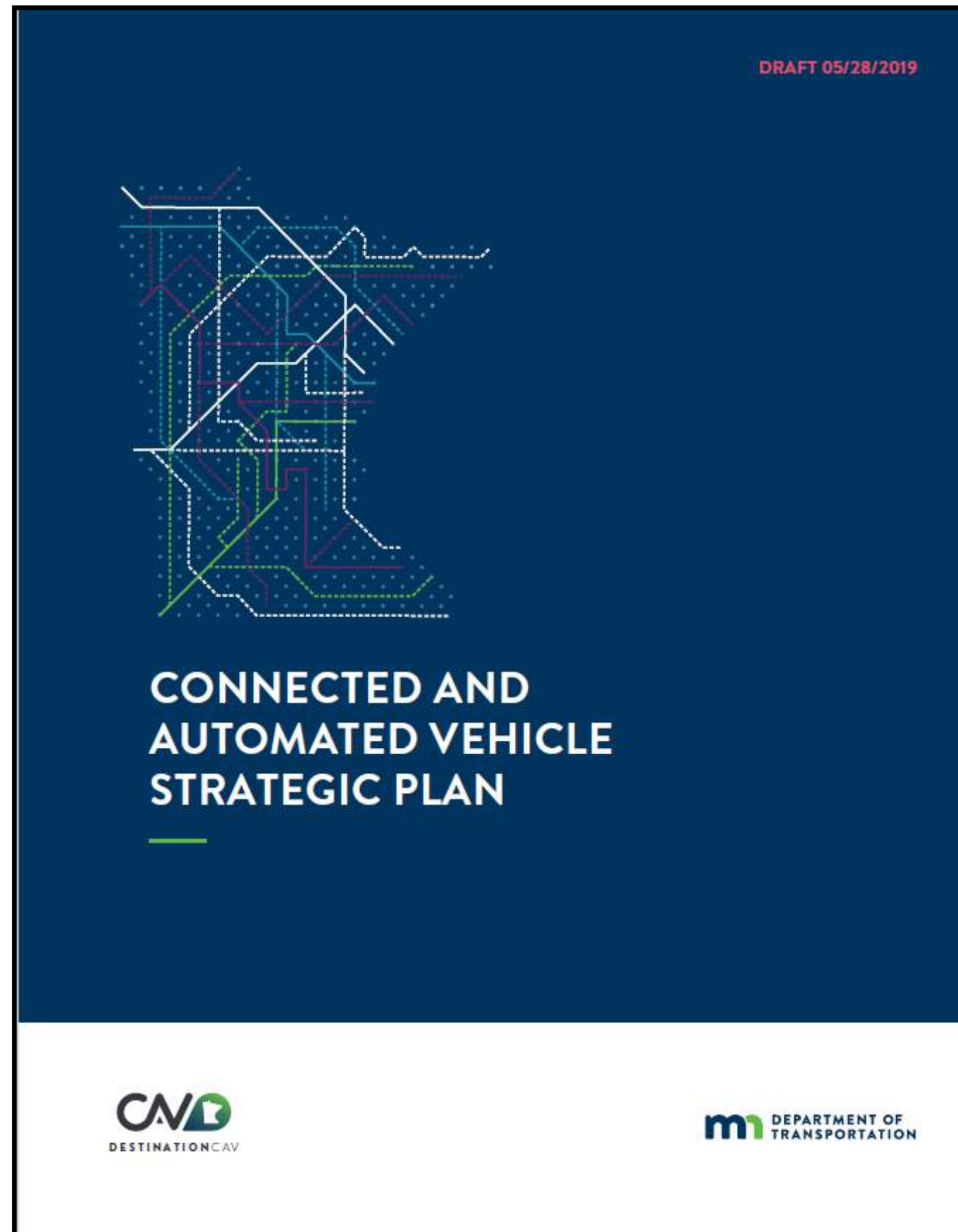
Funding and revenue



Public-private partnerships



# MnDOT CAV Strategic Plan



Capital Investment

Research

Partnerships

Policy and Standards

Operations and Maintenance

Staffing

Multi-Modal

Communications

Long Range Planning



# 3

Engagement,  
Projects &  
Partnerships



# Public Engagement

Super Bowl



Minnesota State Fair





# AV Technical Demonstrations





# Engagement Efforts

VRUs



Transit



Freight



Public



Industry



Employees





# Partnerships





# Minnesota CAV Challenge



THE FUTURE OF MOBILITY  
COMES TO MINNESOTA

Innovative  
procurement

Industry  
Innovation

Ideas Submitted  
Anytime





# Innovation - MN CAV Challenge

30+ Industry  
Meetings

26 Vendors

21 Proposals  
Submitted

9 Proposals  
Accepted

Three Under  
Contract

AECOM / WSB

Micro Systems / Kratos

Ernst and Young

First Transit

University of Minnesota

Iteris

Traffic Control Corporation

WSB

HDR



# Minnesota CAV Selected Contracts



**AECOM**  
wsb

Automated Bus  
Consortium (ABC)

Automated Truck  
Mounted  
Attenuator  
(ATMA)

**KRATOS**  
UNMANNED SYSTEMS DIVISION









# Snow Plow Priority Video







# DESTINATION CAV

THE FUTURE OF MOBILITY  
COMES TO MINNESOTA

Thank you!





# Automated Bus Consortium Program Minnesota Guidestar Update

Accelerating automated  
technology for transit services

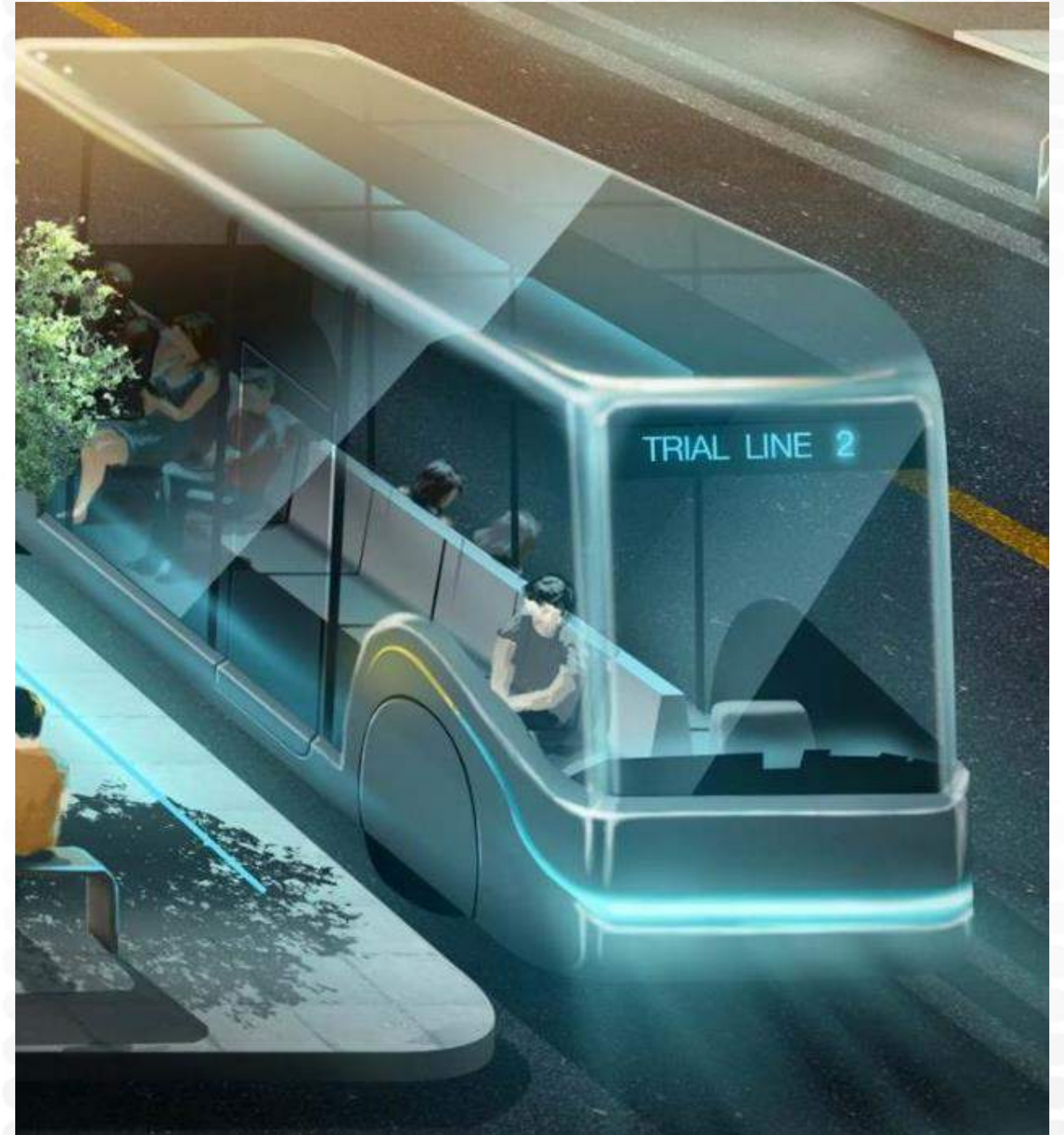
Presented by Dick Wolsfeld, AECOM  
September 16, 2019





# Summary of Concept

- Automated small vehicle shuttle technology is proven
- Appears feasible to transfer AV shuttle technology to full-sized buses
- Vendors need a market to cost-effectively produce these buses
- Concept: Joint procurement of 75-100 buses by 12 agencies





# Goal of Automated Bus Consortium Project

Deploy full-sized, full-speed accessible automated buses:

- In a variety of geographies and applications to advance the industry understanding of the technology
- Leverage the technology to improve safety, reliability, operating efficiency and customer experience



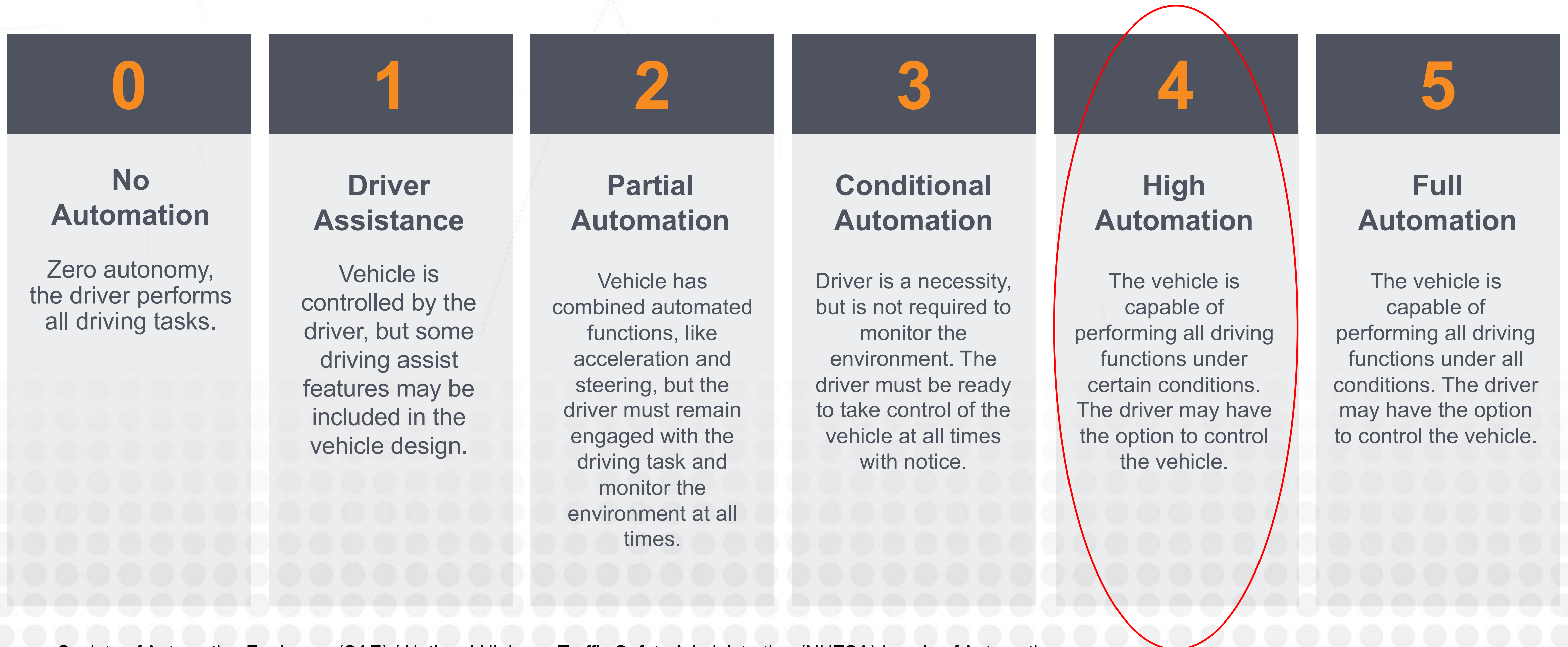
# Consortium Agencies



Connecticut Department of Transportation (CTDOT) | Dallas Area Rapid Transit (DART) | Foothill Transit | Long Beach Transit (LBT) | Los Angeles County Metropolitan Transportation Authority (Metro) | MetroLINK (Moline) | Metropolitan Atlanta Rapid Transit Authority (MARTA) | Metropolitan Transit Authority of Harris County (Houston) | Michigan Department of Transportation (MDOT)/Michigan's mobility initiative, PlanetM | Minnesota Department of Transportation (MnDOT)/Rochester Public Transit | Pinellas Suncoast Transit Authority (PSTA) | Virginia Department of Rail and Public Transportation (DRPT)/Hampton Roads Transit



# Automation Scale





# Roughly 260 Worldwide Demos

## LAS VEGAS

- Automated bus route on Freemont Street
- Public streets: mixed traffic, 8 intersections and 6 traffic lights
- 35,000 riders
- Providers: Navya AV and Keolis Transit (operators)



## MINNESOTA

- Cold weather test
- Performed well on snow and ice
- Providers: Easy Mile and First Transit





# MN AV Bus Pilot Summary







**Bus Performed Well in Ice**



# Snow Cloud





# Interaction with Pedestrians

**More conservative with higher speeds**

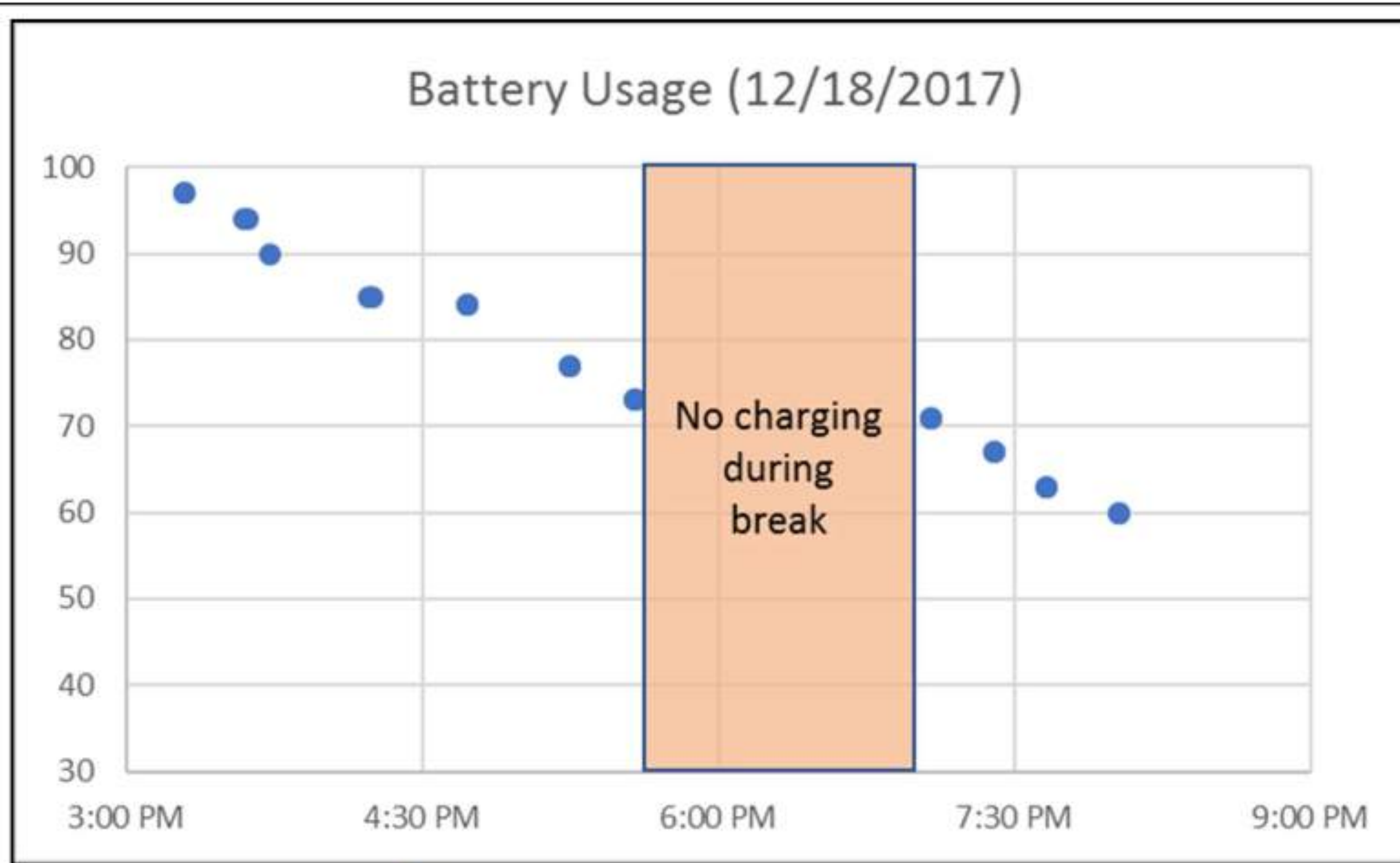


**Front Stop Distance = 5.3 – 6.6 Ft. (Bumper to Shins)**

**Side of Bus = 1.6 – 1.8 Ft. (off Wheel Path)**



# Battery Usage Chart Sample



Dec. 18<sup>th</sup>, 2017 Battery Charge Readings  
Start Temp.: 36° F ; Wind: S 7 mph



# MN AV Bus Public Tours

Event	Attended
Media Day / MnROAD Tours	238
Super Bowl Demos	1,346
Day at State Capitol	216
Rochester Demos	267
TOTALS	2,067





# MN AV Bus Pilot - Summary of Key Findings

- The vehicle operated well in snow, ice and slush covered roads.
- Blowing snow = a big challenge
- Public wants more experiences to learn about AV



<http://www.dot.state.mn.us/automated/bus/finalreport.pdf>



# Scotland to Test First Autonomous Full-sized Bus Fleet in Passenger Service – 11/26/18

- Service to begin in 2020 with 5 – 42 passengers, 38 foot ADL buses between Fife and Edinburgh
- Level 4 Automation: Driver on-board during operation
- In 2019 the bus will be used in autonomous mode only within the depot environment, to carry out:
  - Parking
  - Moving to fuel station
  - Bus washing





# Volvo Announces AV and AE Bus – 3/5/19

- The prototype buses are based on the Volvo 7900 electric model
- Each bus is 12 meters (39 feet) and can carry roughly 80 passengers
- The first bus will operate on the campus of Nanyang Technological University
- Volvo hopes to operate the second bus out of a depot managed by SMRT, Singapore's public transit operator





# New Flyer Launches Program Focused on Self-driven Buses – 5/08/19



- St. CLOUD — New Flyer of America Inc. announced the launch of a **program aimed at possibly creating self-driven buses**
- In a news release, New Flyer and New Flyer Industries Canada announced the launch of their Autonomous Technology Program, which includes development and deployment of technology for advanced driver-assistance systems and automated vehicles
- The largest bus manufacturer in North America said the program will have a guiding principle focused on public safety and will adhere to the Society of Automotive Engineers' definition and recommended practice for levels of driving automation
- New Flyer will actively participate in development of SAE related recommended practices and standards



# Conclusions: Accelerating Automated Transit

- Significant investment is being made in automation
- Industry “appears able” to produce an automated bus in the 2021 – 2022 timeframe
- The technology needs a market
- Labor partnerships are important
- FTA has an interest in automated bus deployment
- Federal, state, and local regulatory framework needs to be refined







# Proposed Program to Advance Full-Sized Automated Bus

Overview of Automated Bus Consortium Program



# One Program to Gain Extensive Experience



## Variety of Geographies

- Cold Weather
- Desert
- Hot and Humid
- Rainy



## Variety of Applications

- Bus Rapid Transit
- Shuttle Service
- Arterial Rapid Transit
- Express Service
- Fixed-Route Service
- Point-to-Point
- Maintenance Depot



## Variety of Vehicle Options

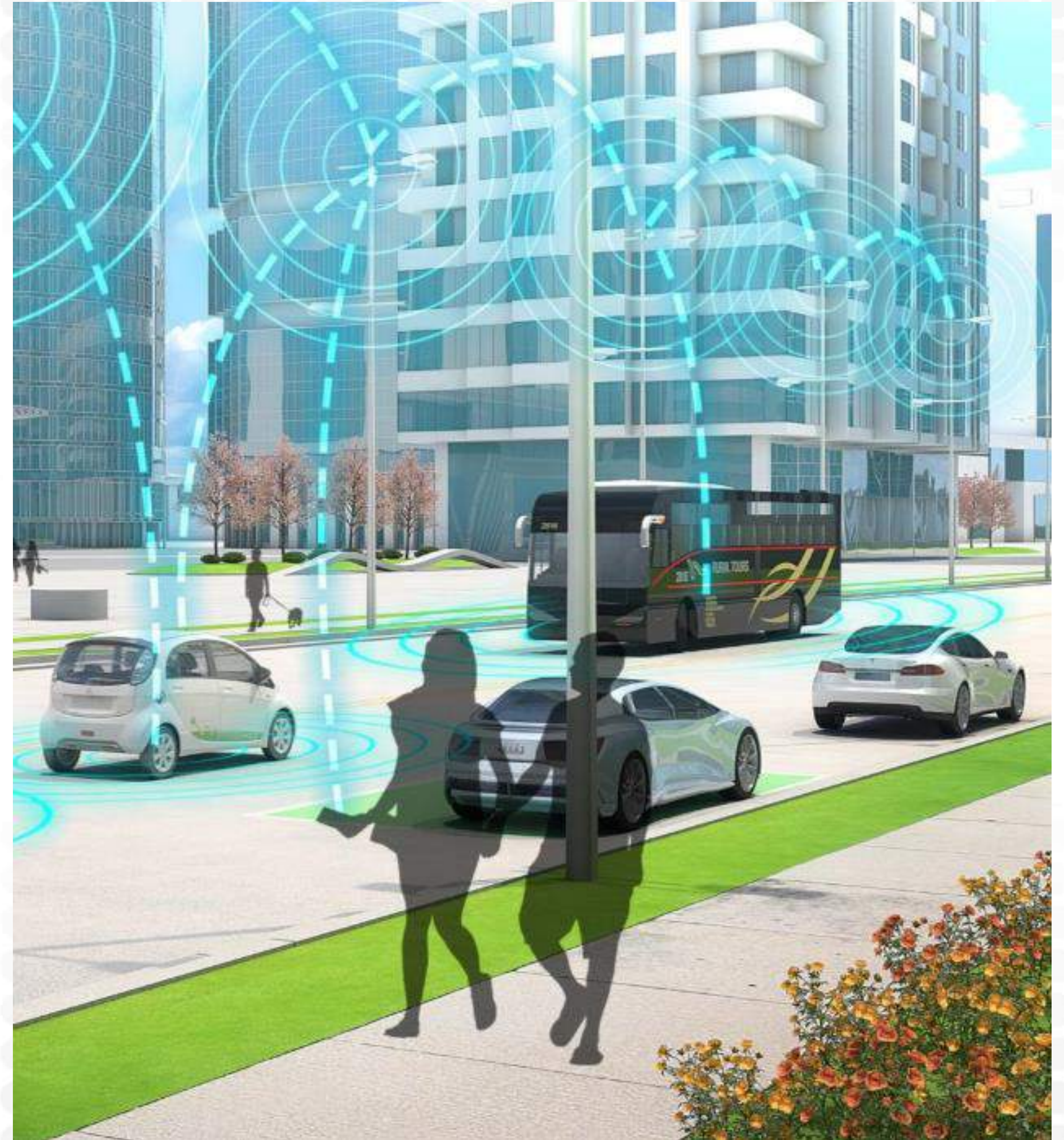
- New Vehicles
- Retrofit Existing Vehicles
- **Electric Vehicles**
- CNG Vehicles
- Diesel Vehicles



# Potential Risks

- Passenger acceptance/security
- Labor opposition
- Technology companies' ability to deliver
- Liability insurance – not enough experience with automated buses for underwriting risk
- Research and development program costs
- Cybersecurity
- Other

Risk register is being developed





# Potential Value of the Consortium



**Accelerate  
Technology  
Development and  
Deployment**



**Reduce Planning  
and Procurement  
Costs**



**Stimulate  
Technology  
Demand**



**Shared Lessons  
Learned**



Website – [automatedbusconsortium.com](http://automatedbusconsortium.com)



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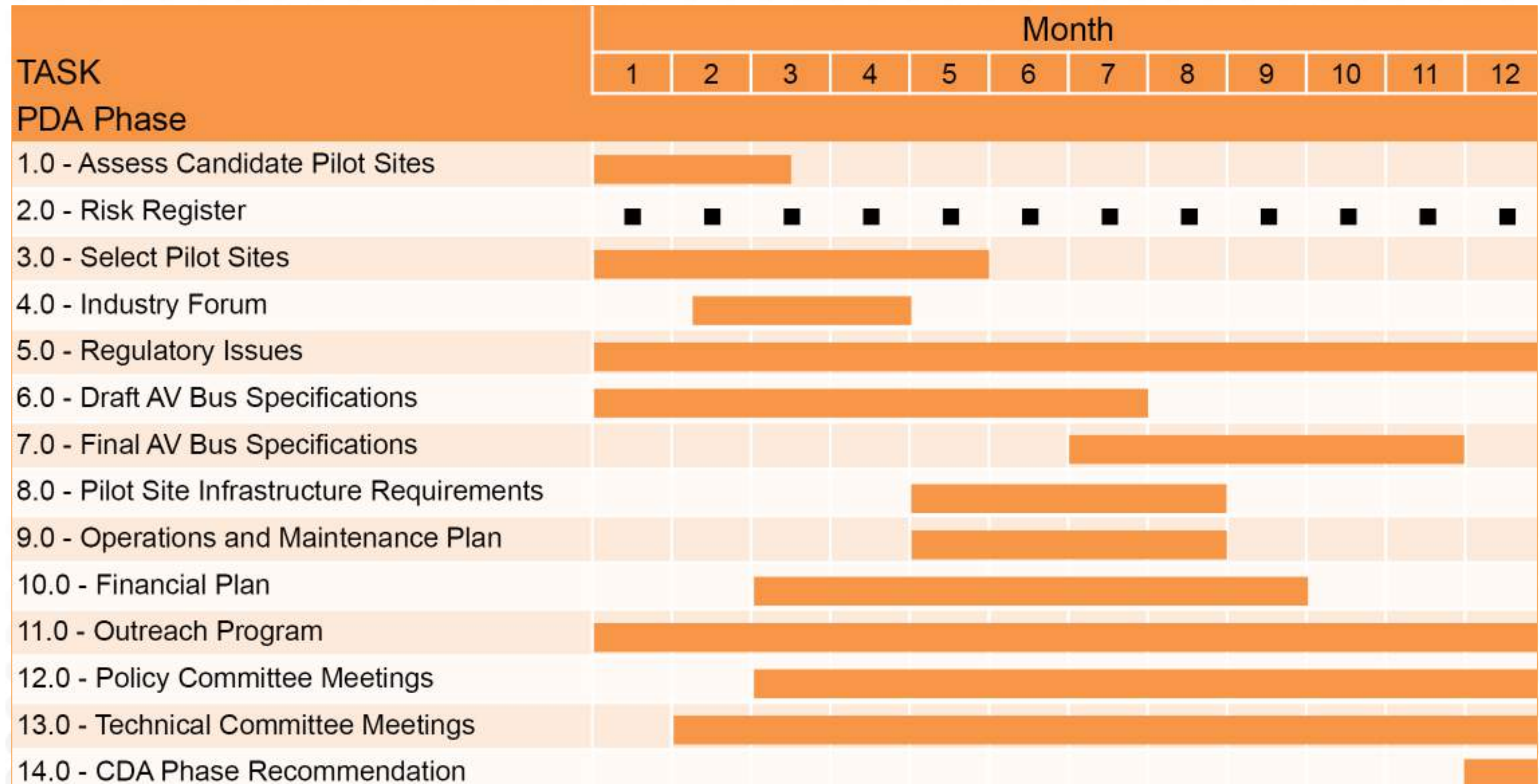
### About the Automated Bus Consortium

With rapid advancement of driverless technologies and the urgent need to improve mobility options while safely and effectively mitigating congestion in cities across the United States, the Consortium's collaborative effort to leverage its combined resources and launch its pilot deployment program of full-sized buses is groundbreaking. Using cost-efficient and standardized methodologies and assessment, the Consortium will lead the nation's effort to test and evaluate driverless bus technology.



# Automated Bus Consortium Program – Phase 1

## Project Schedule: 12 Months – 4.01.19 – 3.31.20





# Phased Approach from Feasibility to Implementation

1

## Preliminary Development Agreement

- Service Visioning/Pilot Projects
- National & Local Outreach
- Vehicle and Infrastructure Technology
- Financial Planning
- Regulations
- Implementation Strategy
- Go/No-Go

GO/NO-GO

2

## Comprehensive Development Agreement

- Procurement of Buses
- Infrastructure Design
- Technology Testing
- Deployment/Construction
- Evaluation
- Next Steps





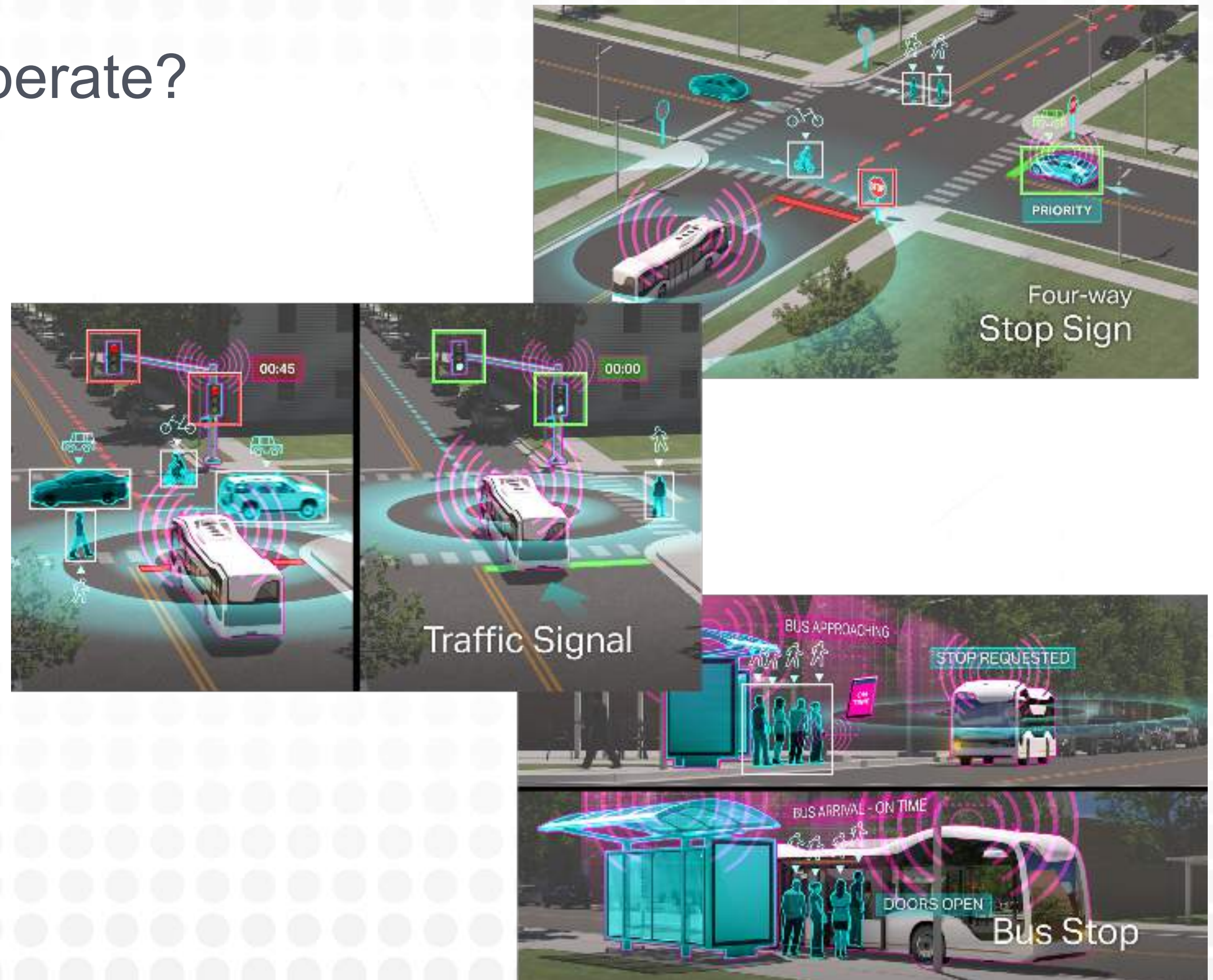
# Automated Technology Overview



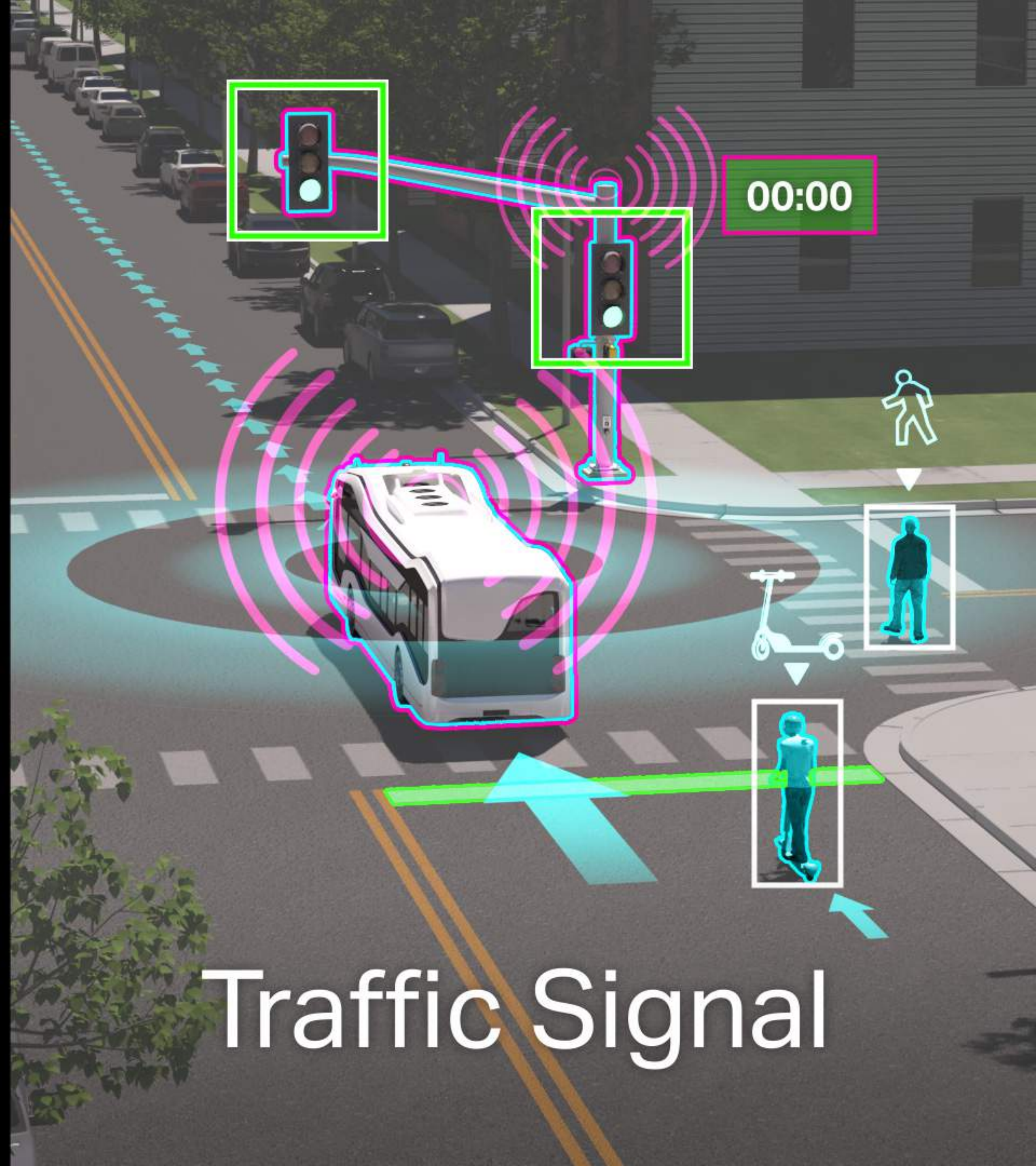
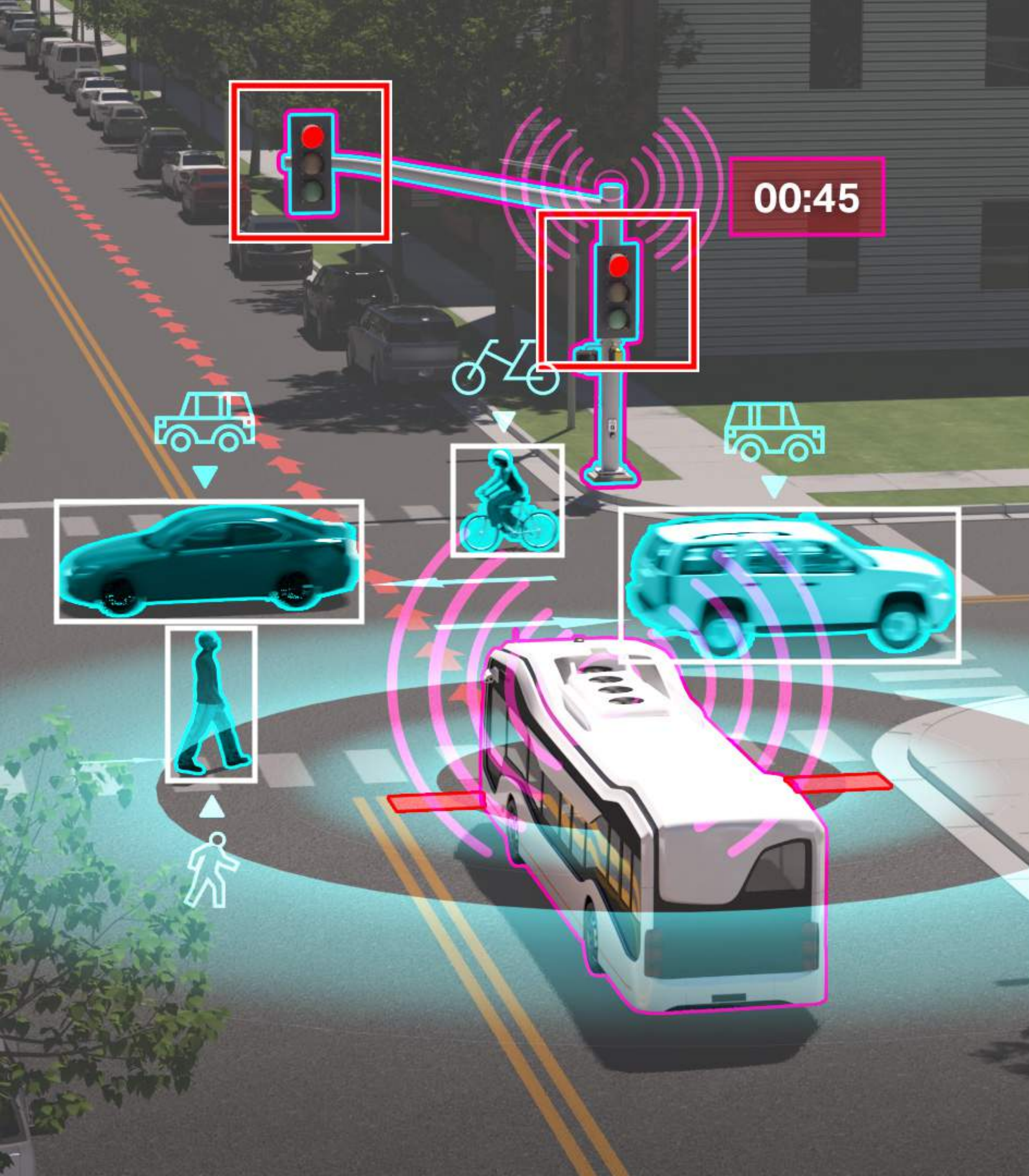
# Automated Bus Operational Design Domain (ODD)

In what environment does the bus operate?

- Urban roadways and traffic
- Global route and path planning
- Bus stops
- Stop sign intersections
- Signalized traffic intersections
- Bike lanes
- Pedestrian crossings

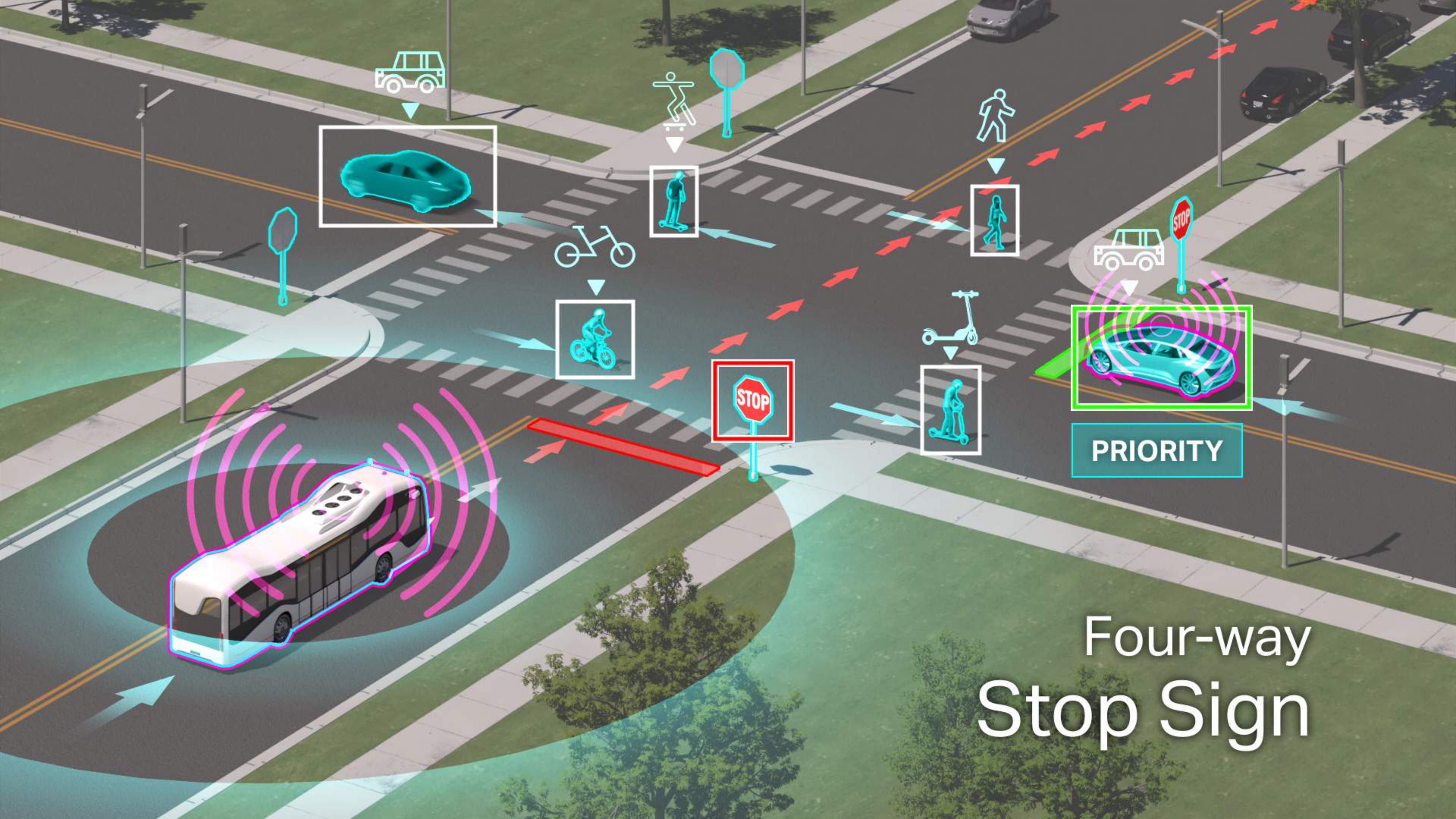






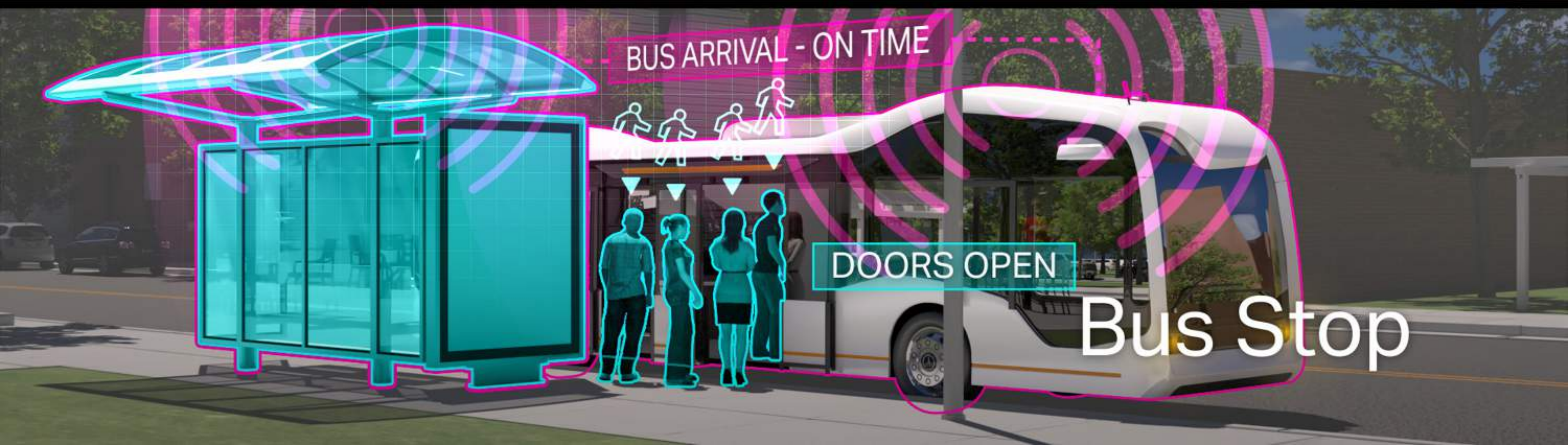
Traffic Signal





Four-way  
Stop Sign









# Development of Candidate Pilot Projects

Overview of Automated Bus Consortium Program



# Route Evaluation Criteria

## ROADWAY CHARACTERISTICS

- % of bus route in exclusive lane
- Curb cuts/mile
- Public cross streets/mile
- Traffic signals/mile
- Stop signs/mile
- Speed limit
- Average traffic level of service
- Average daily traffic (ADT)
- On-street parking along the bus route
- Construction scheduled in next 2-3 years
- Pedestrian/bicycle/scooter presence
- Roadway grades are within -5% to +5%
- Multi-jurisdictional routes – signal interoperability

## BUS ROUTE CHARACTERISTICS

- Bus stops with pull outs (merge required)
- Number of left-turns on the bus route
- Number of buses to provide service (3 minimum)
- Bus service headways (Peak and off-peak)
- Existing average bus passengers/day
- Current bus service or planned by 2021
- Bus connections / transfers required
- Right-side boarding
- ADA accessibility

## EXTERNAL CHARACTERISTICS

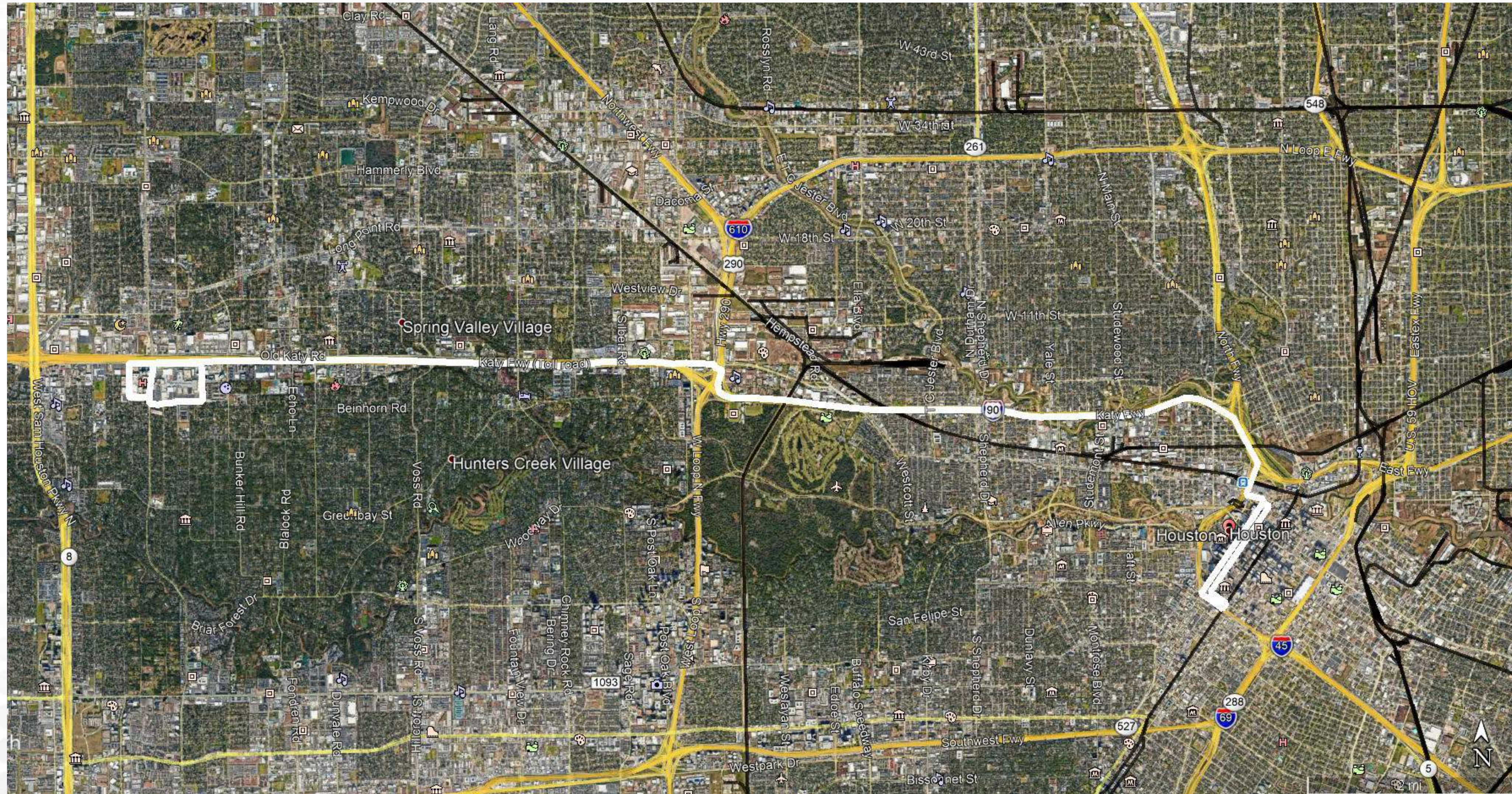
- Adjacent land owner/community support
- Infrastructure costs or availability
- Supporting institutional partner(s)



This is an aerial map from Google Earth showing a city area. A green line highlights a specific route. The route begins in the upper left quadrant, near the intersection of Central Ave and W Mockingbird Ln. It proceeds south along Central Ave, then turns east along Herb Keller Way, and finally turns south along Inwood Rd. The map shows a dense urban area with many streets and buildings. A scale bar at the bottom right indicates 4000 ft. The Google Earth logo is visible in the bottom left corner.



# Houston Metro - 160: Memorial City Express





THANK YOU

Please join us for lunch

5<sup>th</sup> floor AECOM