



Minnesota Autonomous Bus Pilot



Project Goals

SNOW & ICE

Prepare autonomous vehicle industry for snow & ice conditions

OPERATIONS

Identify challenges and strategies for safe operation of third party autonomous vehicles on MnDOT's transportation system

MOBILITY

Prepare for improved mobility services through autonomous vehicles

INFRASTRUCTURE

Identify the infrastructure that is needed to ensure safe operation of autonomous vehicles

INFLUENCE

Increase Minnesota's visibility and influence on advancing autonomous & connected vehicles

PARTNERSHIPS

Enhance partnerships between government and the autonomous vehicle industry

Project Timeline

Industry & Regulatory Environment Research
(February 2017)



Project requirements & RFP development



Industry Outreach (April 2017)



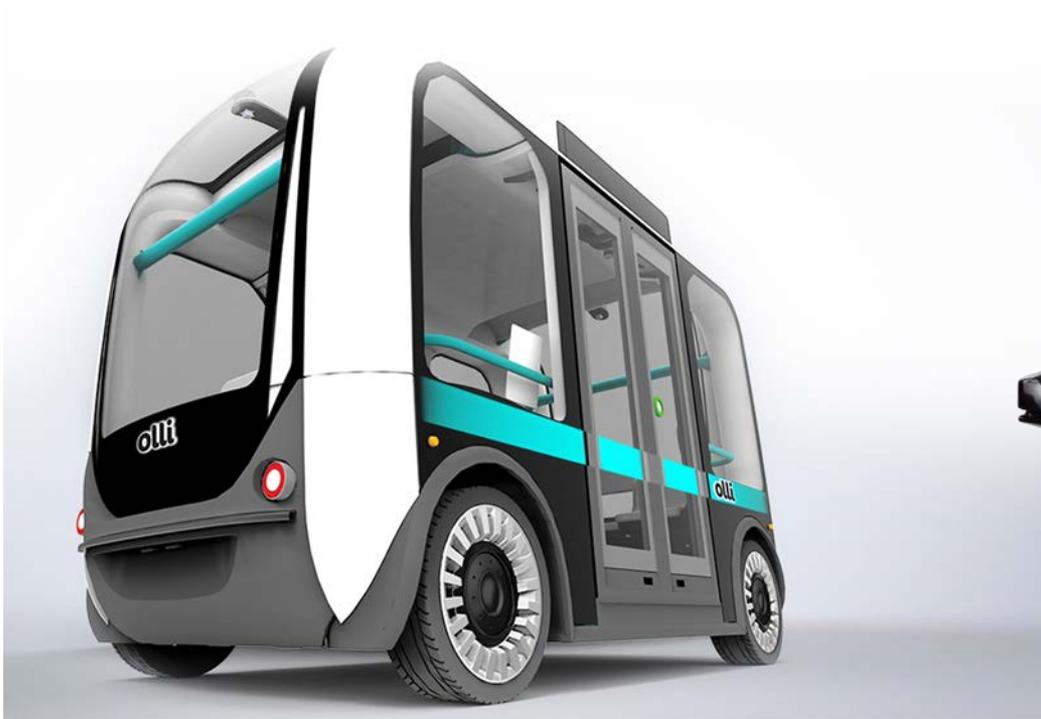
RFP finalized & Advertised



Preferred Vendor Selected/Notice to Proceed
(September 2017)

Vendors Responding to RFP

Local Motors



EasyMile

About the Easy Mile EZ10 Shuttle



Criteria	EasyMile EZ10 Shuttle
Capacity	12
Speed	Avg. 10-15 mph, up to 25 mph
SAE Level of Autonomy (0-5)	4
Obstacle Detection	Laser (LiDAR)
Route Setup	Pre-mapped/pre-programmed
Navigation	GPS/LiDAR
Accessibility	Wheelchair ramp

Levels of Automation: Simplified

- Level 0 – Hands and feet ON
- Level 1 – Hands or feet OFF
- Level 2 – Hands and feet OFF, eyes ON
- Level 3 – Hands, feet, eyes OFF, brain ON
- Level 4 – Hands, feet, eyes, brain OFF
 - Constrained environments
- Level 5 – Hands, feet, eyes, brain OFF
 - Unconstrained

Project Phases

Phase 1

- Testing at MnROAD

Phase 2

- Operation during Super Bowl week
- Open to the public

Phase 3

- Additional tests/demonstrations
- Investigating public & private partnerships for demonstrating in an operational setting



Minnesota's EZ10 AV Shuttle Bus – “Minne”

AV Bus Top Design Speed

- 40 KPH (25 MPH)

Top Testing Speed

- 18 KPH (11 MPH)

Curve Speed

- 14 KPH – 17 KPH
(8.7-10.6 MPH)

Variable Speed Settings

- 1 MPS = 2.237 MPH
- 2 MPS = 4.474 MPH
- 3 MPS = 6.711 MPH
- 4 MPS = 8.948 MPH
- 5 MPS = 11.185 MPH

MnROAD Testing / Tours
Bus Mileage = > 200 Miles



Uncontrolled Testing Conditions



Bare Pavement



Light Misty Rain / Edge of Snow



Mostly Bare Pavement



Compacted Snow / Icy Spots

Uncontrolled Testing Conditions



Trace - 1 Inch Fresh Snow Cover



Loose Snow



Low Visibility



Blowing / Drifting Snow

Controlled Testing Conditions



Ice for Wheel Path



Ice Across Lane



Ice at Start / Stop



Ice near Intersection

Controlled Testing Conditions



Road Salt



Snow Making



Made Snow Trace – 6 Inches



Made 3 – 4 Inches of Slush

Findings – Bare Pavement / Clear Weather



- Performed Well
- Solid Localization
- Able to Navigate Stops, Starts, Turns, Curves, Intersections
- Good Cars, Peds, Bikes & Obstructions Interaction
- Some Emergency Stops / Slowdowns

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)

Findings – Compacted, Loose & Blowing Snow



- Compacted Snow – Slippage and Localization Issues (Greater with Higher or Variable Speeds)
- Loose & Blowing Snow – Became Obstructions
- Plowed Road - Reduced Blowing Snow but Increased Slippage
- Cold Temps & Compacted Snow Increased Slippage

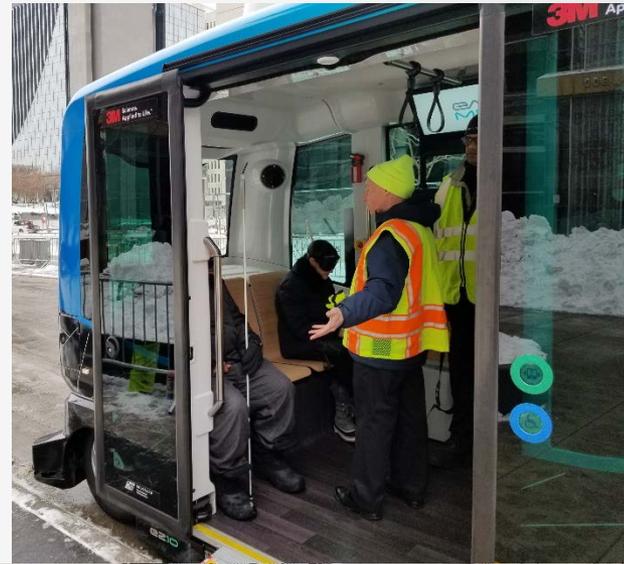


Snow Accumulation in Sensor Housing

Downtown Minneapolis - Nicollet Mall Demo



National Federation of the Blind – Minnesota Chapter visit





3M Science. Applied to Life.™

3M Science. Applied to Life.™

REACH YOURS™

max. 350 kg

e210

COLORADO
Department of Transportation

BRAYO

Nicollet Mall Demo – Ridership numbers

- Day 1 (Friday): 303
- Day 2 (Saturday): 465
- Day 3 (Sunday): 511

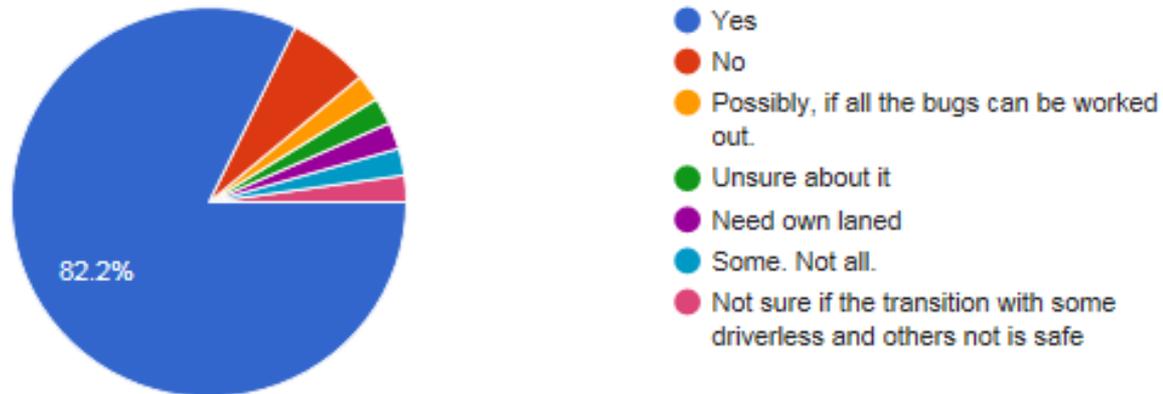


- TOTAL riders for the 3 day demo: **1279!**

Downtown Minneapolis- Public Demonstrations

Are you looking forward to having driverless vehicles operate on all roadways in the future?

45 responses



3M Headquarters: Feb. 20-22



State Capitol Demonstration

March 7, 2018



Next Steps

- Partnering with Stakeholders around the state to demonstrate the technology in different use cases
- Seek out continued opportunities with AV/CV industry



Questions & Answers

Thank You!

