

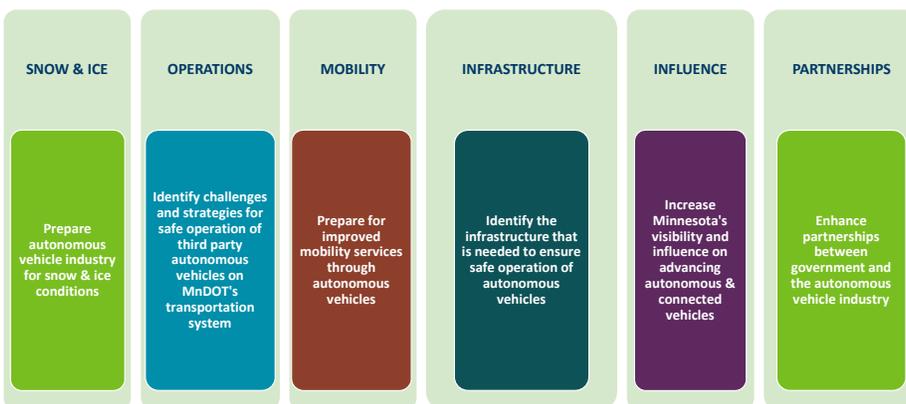


# Minnesota Autonomous Bus Pilot

April 4, 2018



## Project Goals

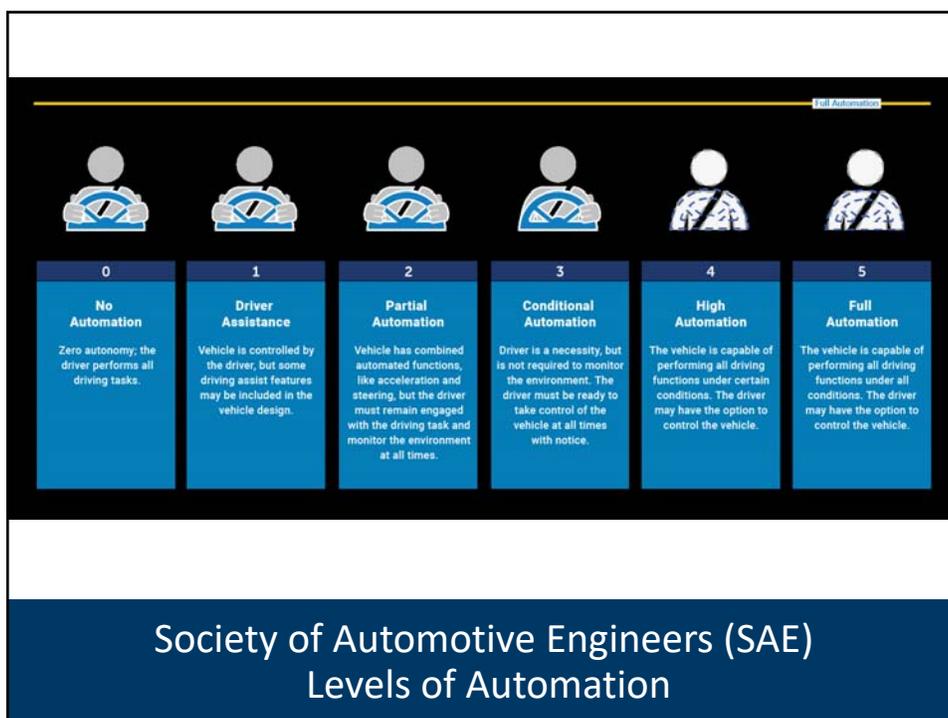


## About the Easy Mile EZ10 Shuttle



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

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## 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

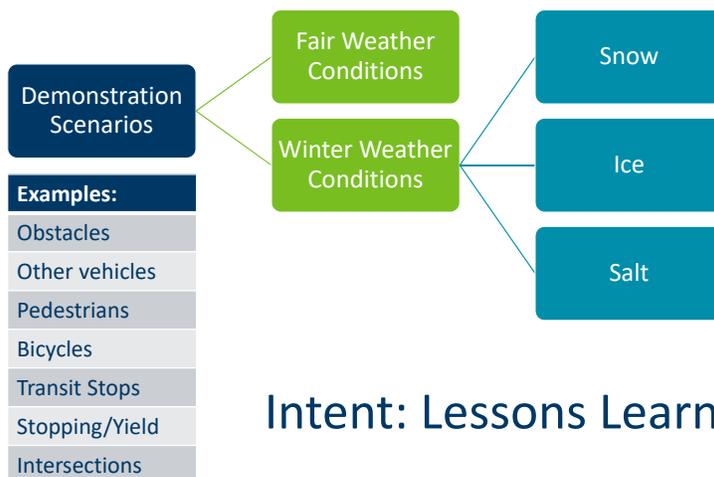
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## Project Phases

- 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

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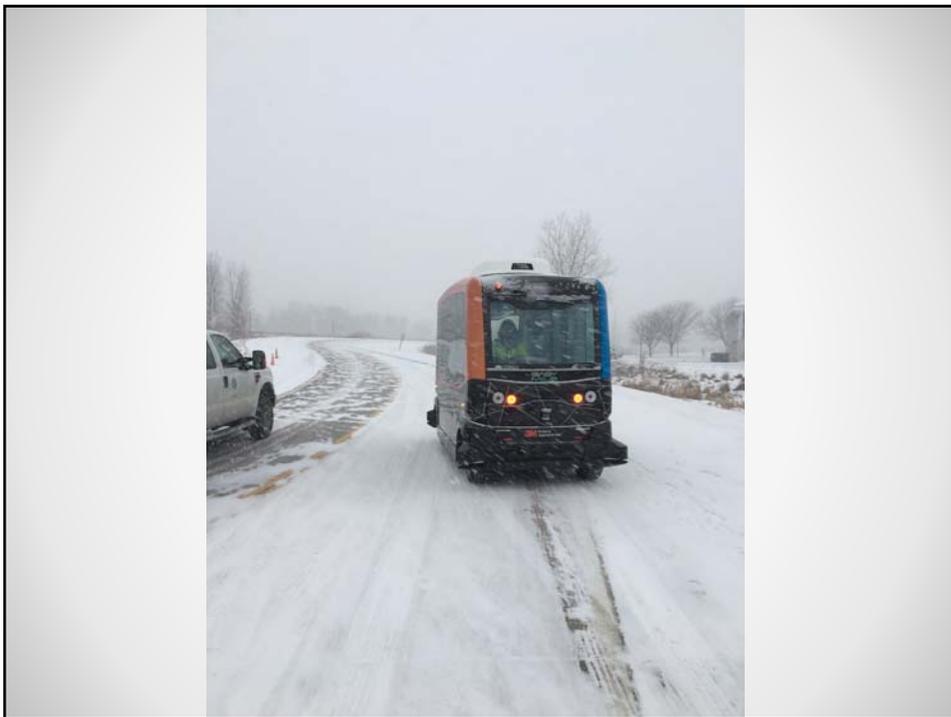
## Demonstration Concepts



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## MnROAD Testing





## Demonstration Observations

- **Conditions:**

- Clear Weather / Bare Pavement
- Uncontrolled Weather
- Controlled Weather



- **Introduced Variables:**

- Shuttle Bus Only
- Obstacles (Work Zone Barrel)
- Other Cars, Pedestrians, Bicycles

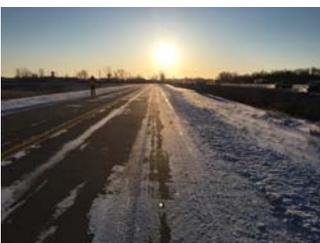


## Test Days

Day	Time of Day	Temps / Sky Conditions	Pavement Conditions
12/5/17	Night	23 / Partly Cloudy	Partial Snow Cover
12/11/17	Morning / Day	Low 30s (Feels 25) / Cloudy	1" Snow on Pavement
12/18/17	Afternoon / Night	36 (Feels 30) / Cloudy	Mostly Bare Pavement
1/2/18	Afternoon / Night	13 (Feels -3) / Light Snow, Cloudy	Compacted Snow / Ice Patches
1/3/18	Afternoon / Night	-3 (Feels -14) / Mostly Clear	Compacted Snow / Ice Patches / Loose Snow
1/4/18	Morning / Day	-4 (Feels -4) / Mostly Cloudy	Pavement Plowed
1/5/18	Morning / Day	-13 (Feels -23) / Sunny	Compacted Snow
1/8/18	Day	22 (Feels 14) / Cloud & Sun	Snow Making
1/9/18	Morning / Day	40 (Feels 33) / Sunny	Road Salt
1/10/18	Afternoon / Night	37 (Feels 30) / Misty Rain & Fog	Bare Pavement
1/11/18	Afternoon / Night	6 (Feels -10) / Wind Gusts 30	Bare / Snow Drifts
1/12/18	Day	-9 (Feels -24) / Sunny	Snow Making

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## Uncontrolled Testing Conditions

 <p><b>Bare Pavement</b></p>	 <p><b>Light Misty Rain / Edge of Snow</b></p>
 <p><b>Mostly Bare Pavement</b></p>	 <p><b>Compacted Snow / Icy Spots</b></p>

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## Uncontrolled Testing Conditions

 <p><b>Trace - 1 Inch Fresh Snow Cover</b></p>	 <p><b>Loose Snow</b></p>
 <p><b>Low Visibility</b></p>	 <p><b>Blowing / Drifting Snow</b></p>

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## Controlled Testing Conditions



Ice for Wheel Path



Ice Across Lane



Ice at Start / Stop



Ice near Intersection

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## Controlled Testing Conditions



Road Salt



Snow Making



Made Snow Trace – 6 Inches



Made 3 – 4 Inches of Slush

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## Interaction with Bicycles



## Interaction with Other Cars



## Snow Making



## Snow Making Machine



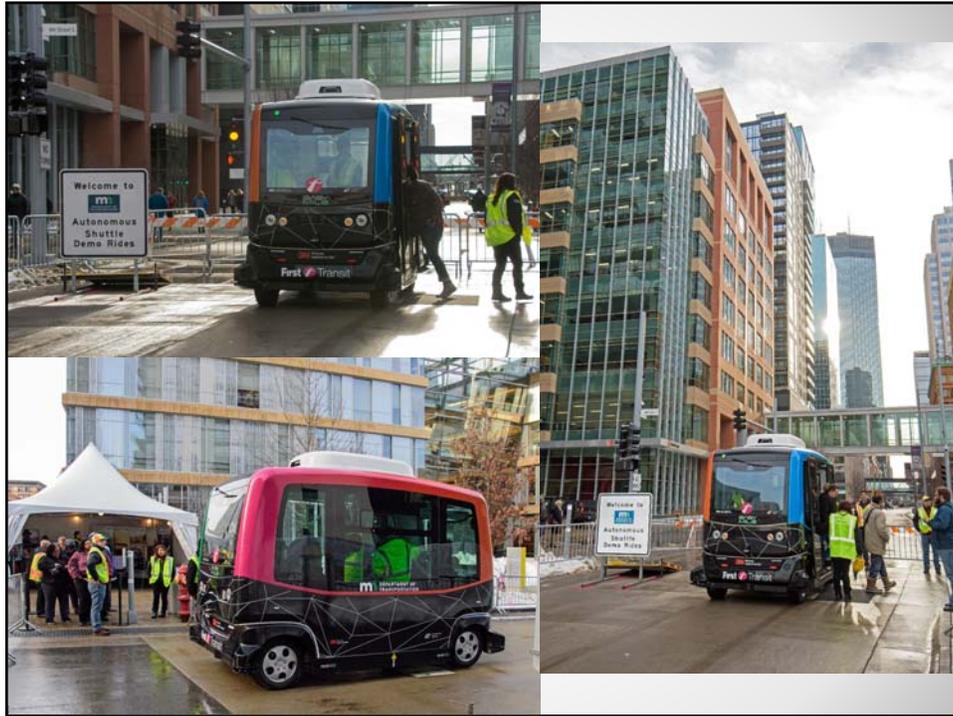
**Snow: Trace to 6 Inches**  
**Slush: Up to 3 Inches**  
**Coverage = 500+ Feet**





Super Bowl Demonstration – Downtown Minneapolis





## 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!**

## State Capitol Demonstration

March 7, 2018



## Next Steps - Summary Report

- Project team is currently working on a draft summary report
- Available by June 30, 2018
- Will cover:
  - Industry research
  - Outreach process
  - Contracting process
  - Stakeholder & Public Demos
  - Testing procedures and observations



Thank you!

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