Automated Vehicles in Wisconsin

Research - Testing - Development - Evaluation - Deployment

ITS Wisconsin
Helping You Travel Better

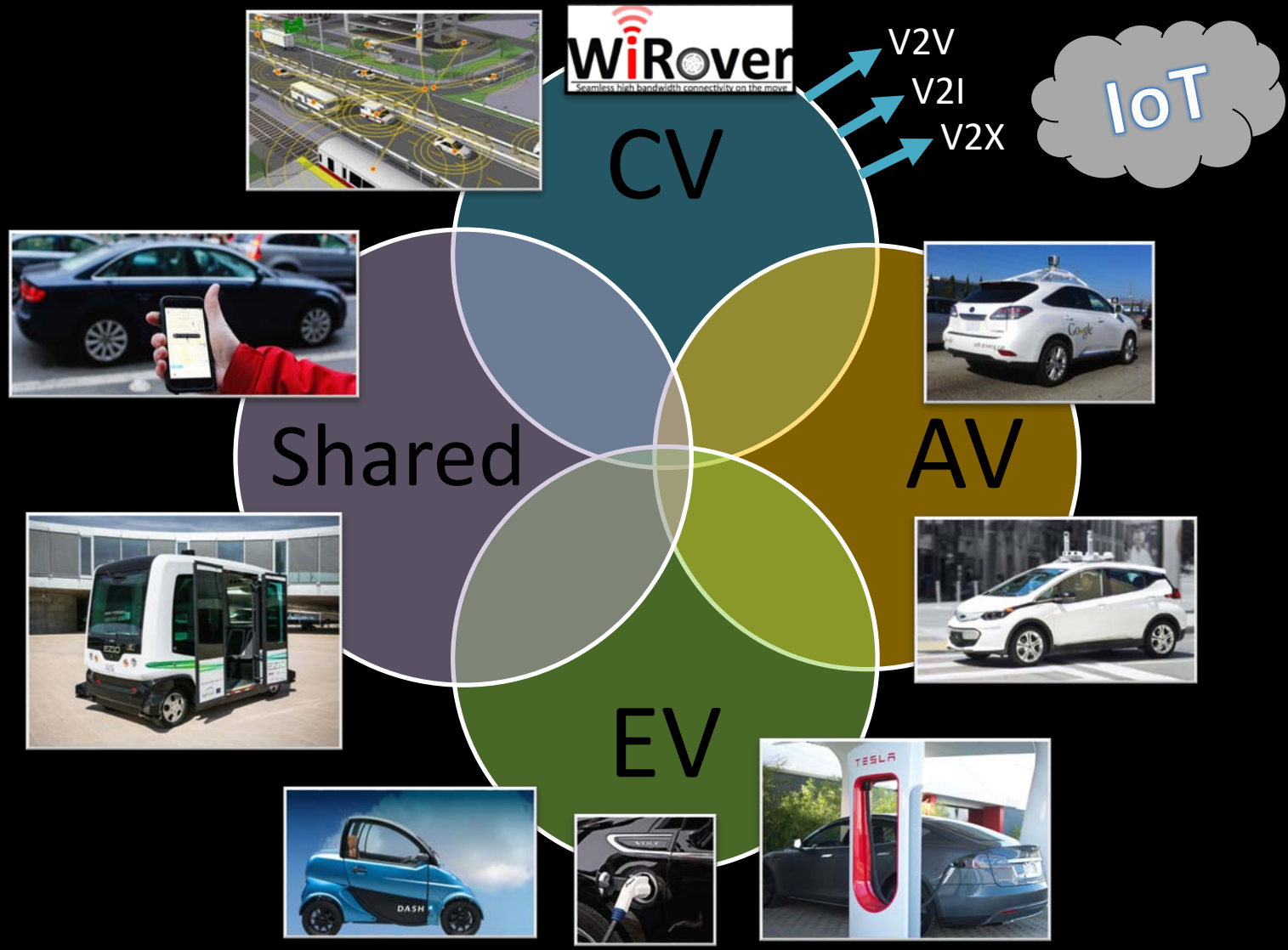
Annual ITS Forum
November 8, 2017

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

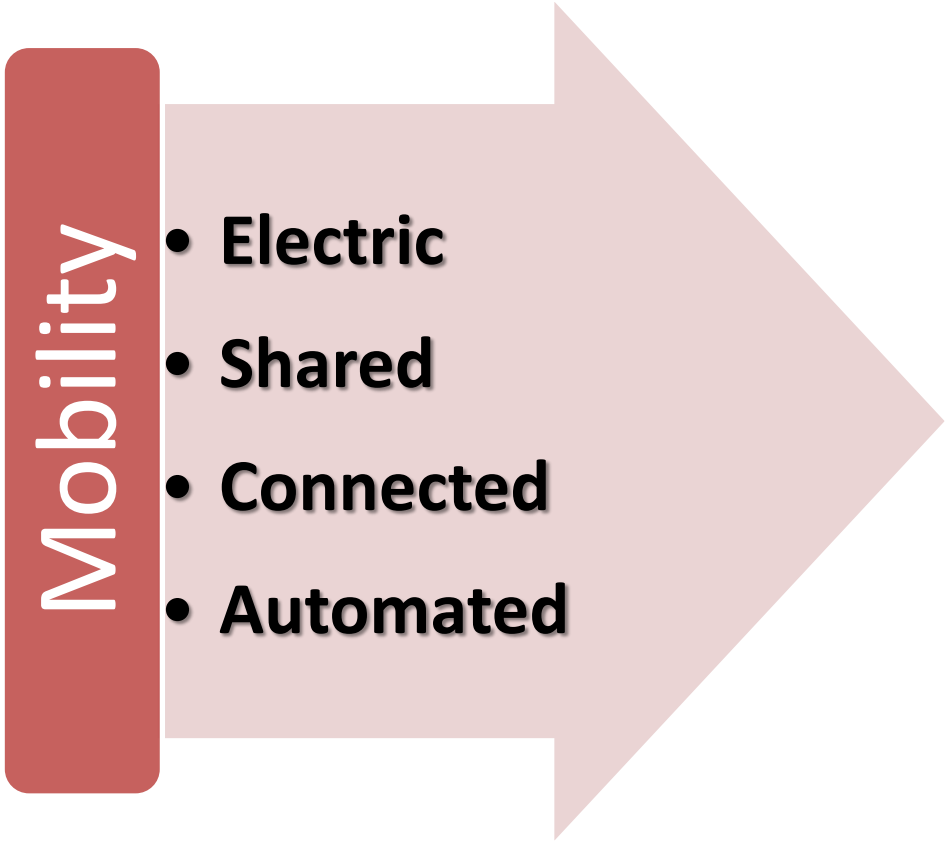
WISCONSIN
AUTOMATED VEHICLE
PROVING GROUNDS

What is an AV?


"Personal
Delivery
Device"

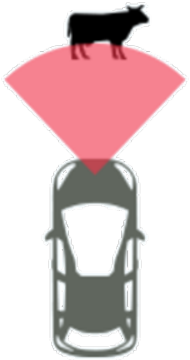

WiRover
Seamless high bandwidth connectivity on the move
V2V
V2I
V2X
IoT
CV
Shared
AV
EV
TESLA
DASH

Trends and Outcomes



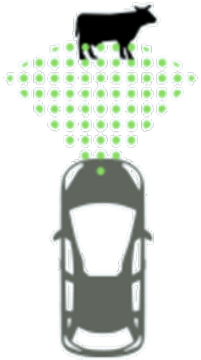
- Safety
- Vehicle Miles Traveled (VMT)
- Sprawl
- Parking
- Energy
- Air Quality
- Public Health
- Equity
- Accessibility

How AVs Operate



CAMERAS

Cameras gather visual information from the road and traffic control and send them to the controller for processing.



LIDAR

LiDAR sensors bounce lasers off of detected objects. LiDAR can detect road lines and assets and differentiate objects.

RADAR

Radar sensors bounce radio waves off detected objects. Radar cannot differentiate objects.

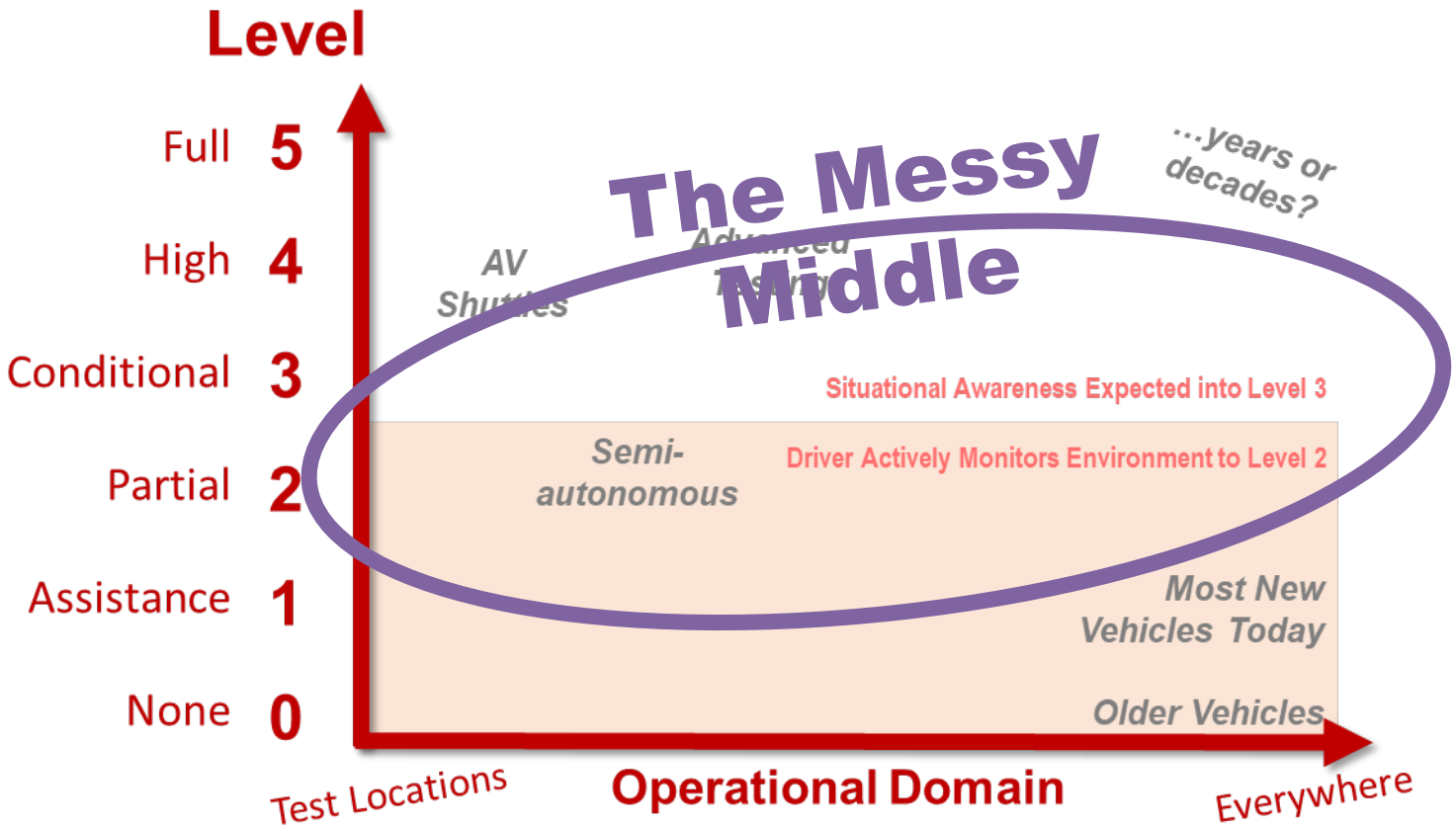
GPS UNIT

The GPS unit identifies the precise position of the vehicle and aids in navigation.

SAE Levels of Automation

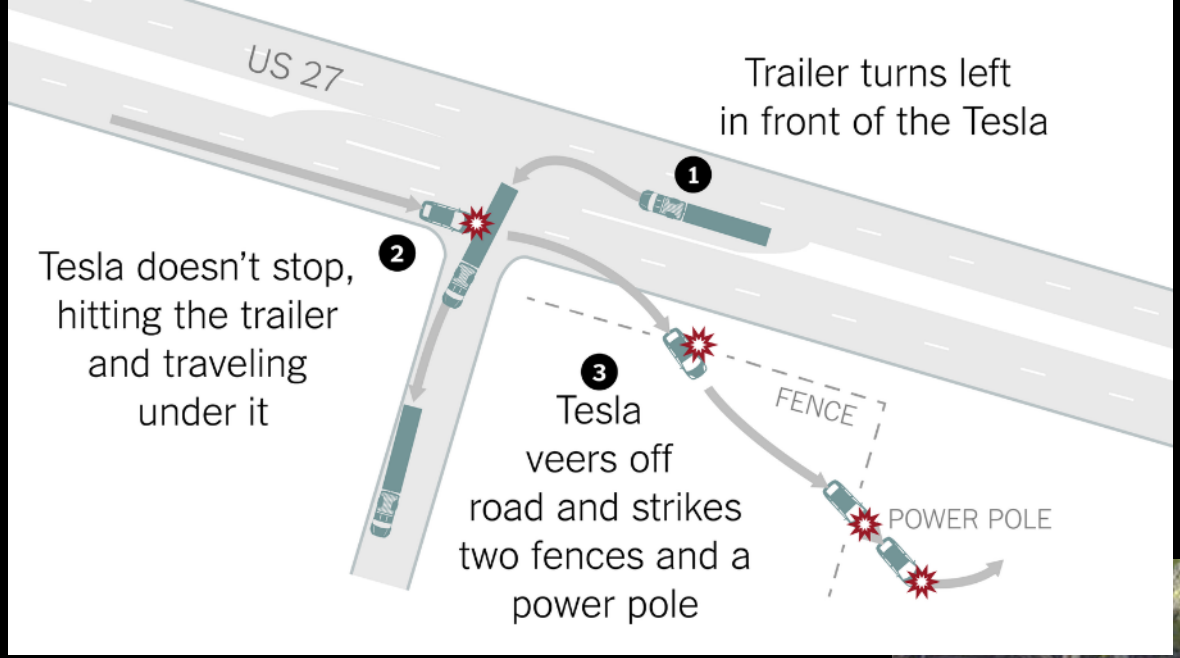
SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	*Monitoring* of Driving Environment	Fallback Performance of *Dynamic Driving Task*	System Capability *(Driving Modes)*
***Human driver* monitors the driving environment**						
0	**No Automation**	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	**Driver Assistance**	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	**Partial Automation**	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	**Conditional Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	**High Automation**	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	**Full Automation**	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

Levels Depend on Circumstances

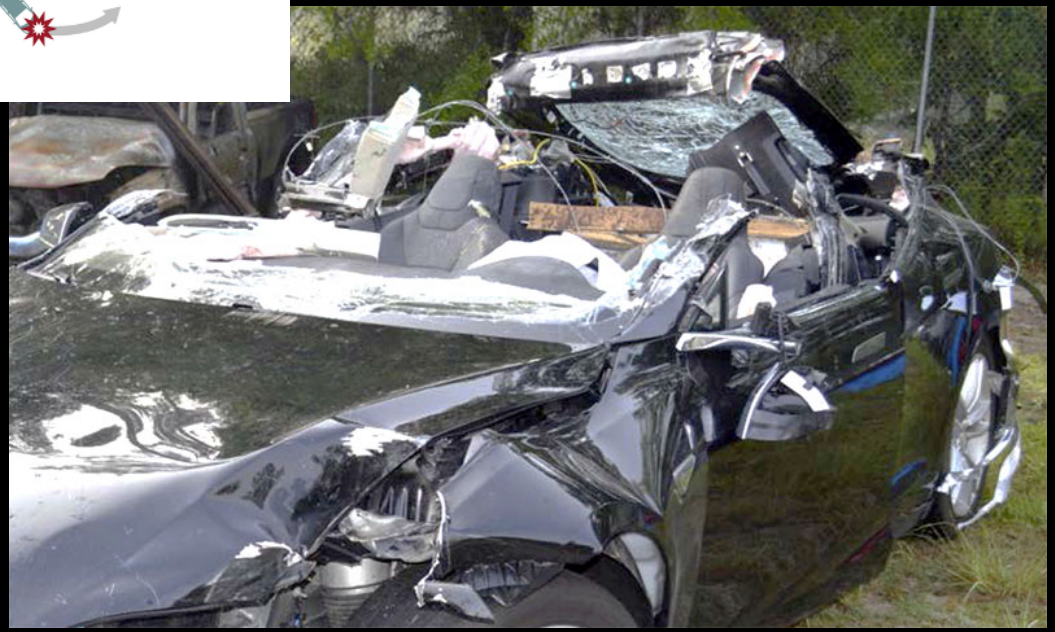


Critical implications:

- Human operator expectations, “re-engagement”
- Where certain vehicles can safely operate



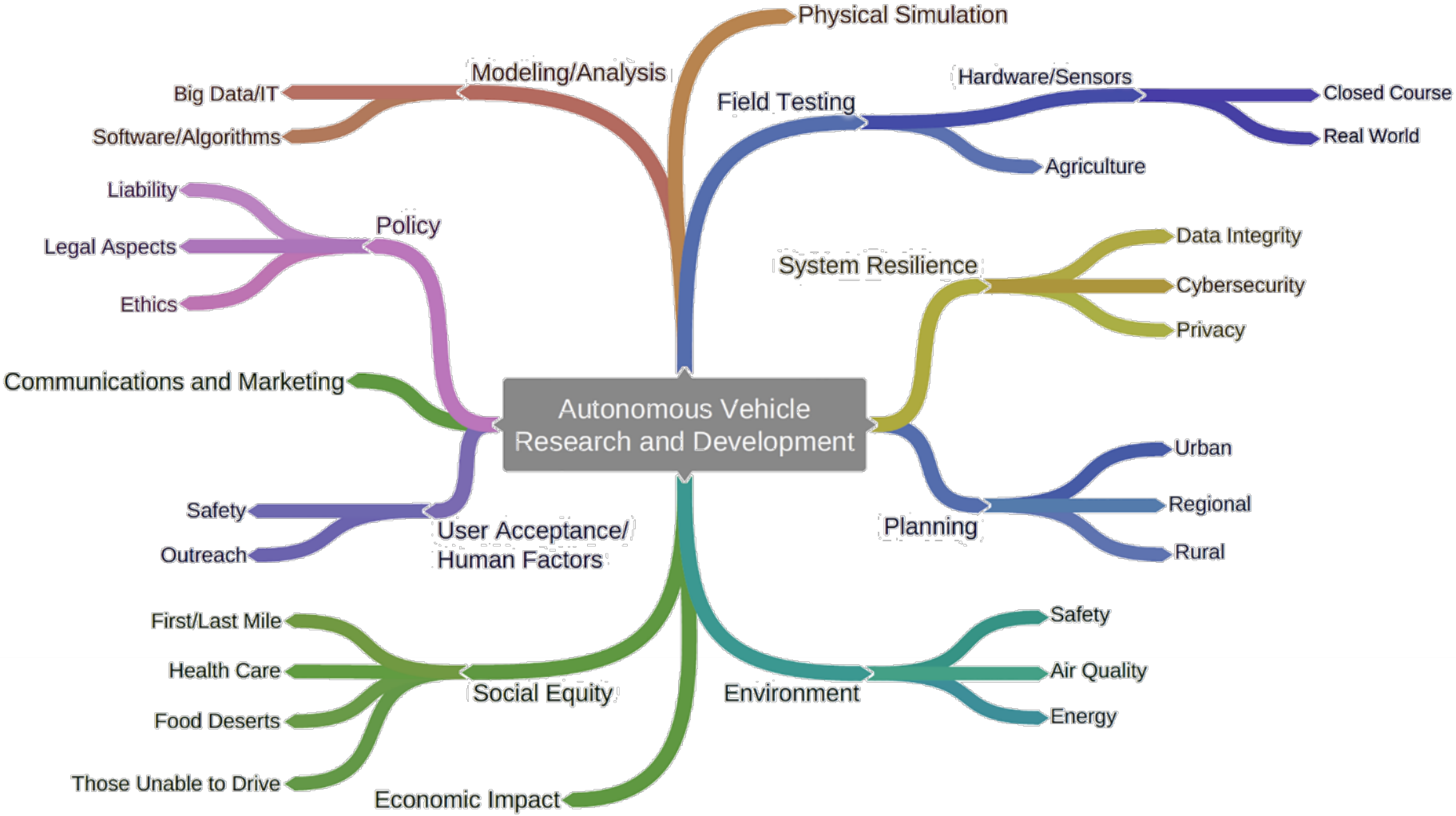
Tesla
Florida
May 2016



Tesla, March 2017

Uber, March 2017

Breadth, Complexity, Edge Cases



(An) AV Timeline

2015
- driver assistance common
- some partial automation available to consumers

2020
- limited / conditional AVs widely available to consumers

2025
- autonomous shared mobility fleets

2030
- high automation required in all new vehicles

2035
- human operation is the exception in many places

2040
- transition to driverless largely complete
- fleet turnover continues…

2100

- Any estimate is debatable
- We are only at the beginning of a long transition period

Federal AV Policy

- Released Sep 20, 2016
- Updated Sep 12, 2017
- Voluntary guidelines
  - Not regulations
- Level 3+ Only
- 12 Safety Elements
- Guidance for State Policy

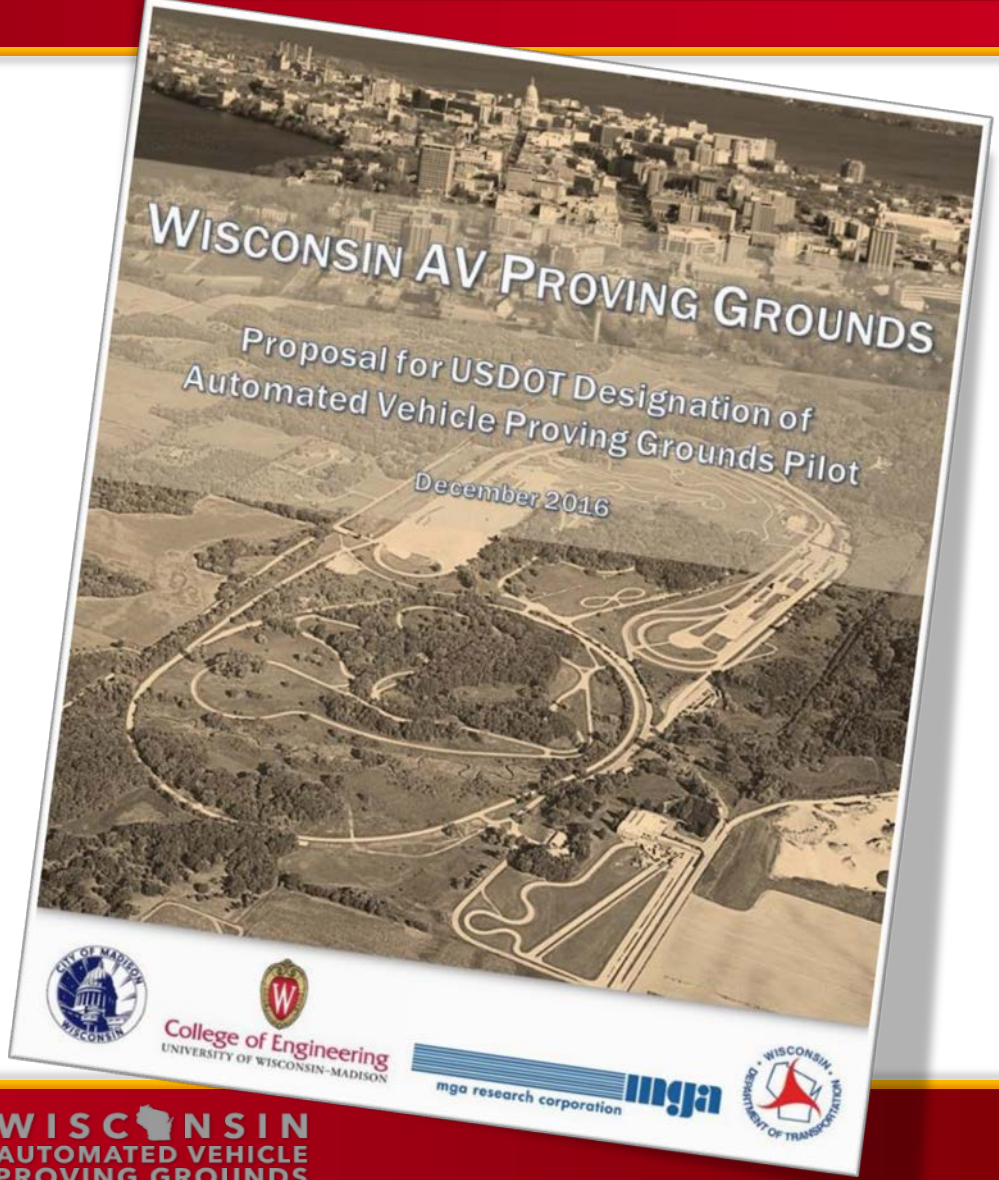
NHTSA's ~~15~~ 12 Safety Elements

1. System Safety
2. Operational Design Domain
3. Object and Event Detection and Response
4. Fall Back (Minimal Risk Condition)
5. Validation Methods
6. Human Machine Interface
7. Vehicle Cybersecurity
8. Crashworthiness
9. Post-Crash **ADS** Behavior
10. Data Recording ~~and Sharing~~
11. Consumer Education and Training
12. Federal, State and Local Laws
13. ~~Privacy~~
14. ~~Registration and Certification~~
15. ~~Ethical Considerations~~

USDOT AV Proving Grounds

- Peer network
- Advise government
- Validate industry
- Awarded January 2017

…no funding



Ten Designated AV Proving Grounds

College of Engineering
UNIVERSITY OF WISCONSIN–MADISON

Range of RDT&E Environments

GREAT LAKES TRANSPORTATION
ENTERPRISE INSTITUTE

Simulation

Lab

Closed Track

Controlled Demo

Limited Facility

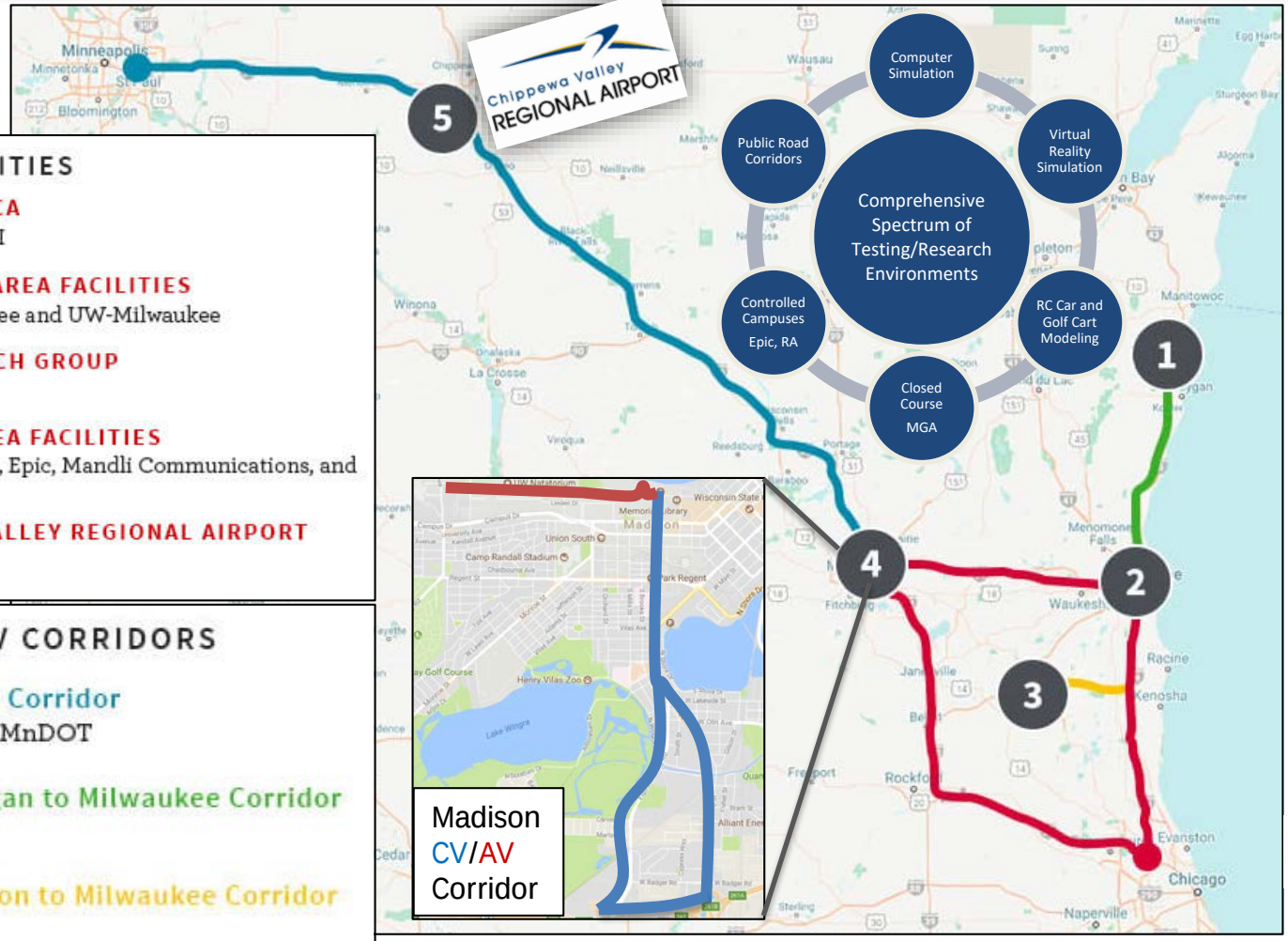
Public Roads

TESTING FACILITIES

1. **ROAD AMERICA**
   Elkhart Lake, WI
2. **MILWAUKEE AREA FACILITIES**
   City of Milwaukee and UW-Milwaukee
3. **MGA RESEARCH GROUP**
   Burlington, WI
4. **MADISON AREA FACILITIES**
   City of Madison, Epic, Mandli Communications, and UW-Madison
5. **CHIPPEWA VALLEY REGIONAL AIRPORT**
   Eau Claire, WI

PROPOSED AV CORRIDORS

- **MadMSP Corridor**
  WisDOT, MnDOT
- **Sheboygan to Milwaukee Corridor**
  WisDOT
- **Burlington to Milwaukee Corridor**
  WisDOT
- **MRCM Corridor**
  WisDOT, iDOT, IL Tollway



International

SOUTHEAST UNIVERSITY

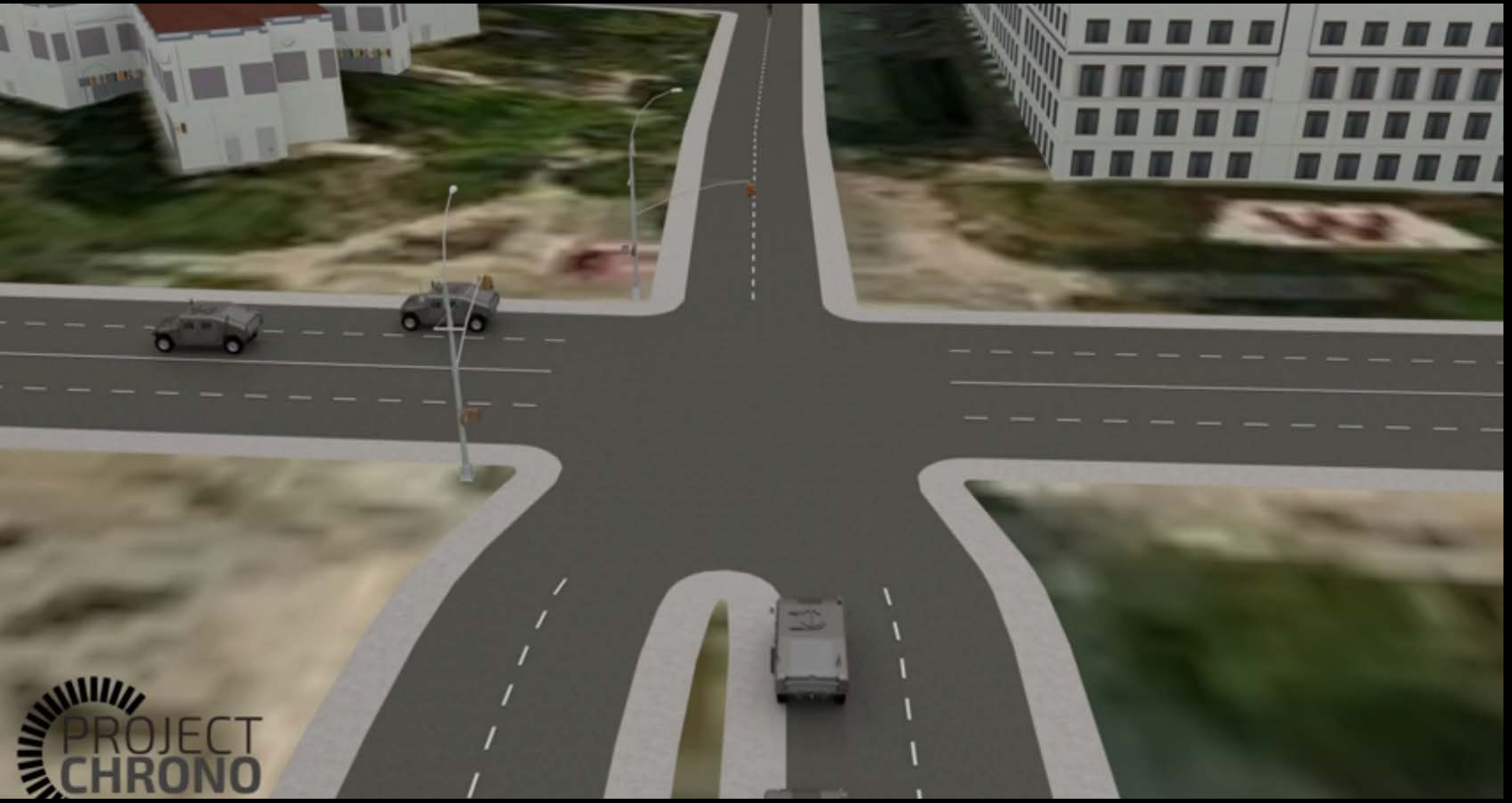
Wisconsin Facilities

UW-Madison College of Engineering

Full Scale Driving Simulator

SBEL
Simulation Based Engineering Lab

WISCONSIN
TOPS
TRAFFIC OPERATIONS & SAFETY LABORATORY


PROJECT
CHRONO

Wisconsin Facilities

MGA Research, Burlington

400 acres, private and secure, numerous testing capabilities

Wisconsin Facilities

Road America, Elkhart Lake

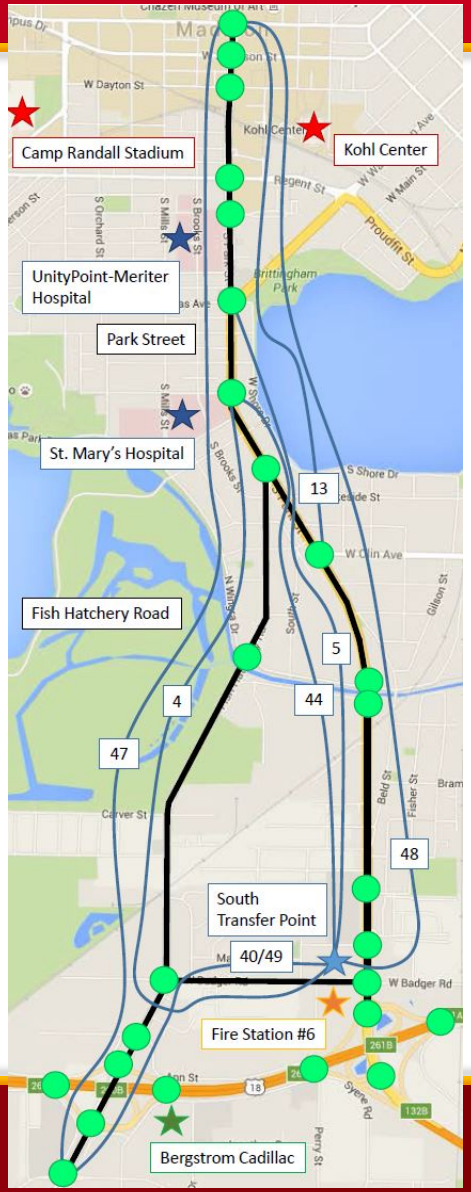
- Road track: 4.05-mile length, 30-foot width
- 1-mile combo paved-dirt track
- 12+ miles off-road
- 10+ miles access roads
- Major race events and media presence

Wisconsin Facilities

- Corporate Campuses
- UW-Madison Campus
- City of Madison

Connected Park Street Corridor

- Piloting CV technology to improve:
  - Safety
  - Mobility
  - Bus on-time performance
  - Equity
- V2I, V2V, V2X
- Madison and Wisconsin as the Upper Midwest hub for CV & AV development



Committee on Automated and Connected Vehicles

"the removal of barriers to the testing and deployment of automated and connected vehicle technology in Wisconsin"

- May 2017 EO #245
- Sept 2017 Kickoff
- June 2018 Report Due
- Members:
  - Government: WisDOT, WSP, WEDC, Assembly, Senate, Iowa Co Sheriff, Insurance Commissioner
  - Academic/Nonprofit: UW-Madison, Tech Council, ABATE
  - Industry: MGA, Roadview, Waymo, Uber, Tesla, AAM, Global Automakers, Dealers Assn, Harley, Schneider, HNTB

Level 4 Shuttle Demonstration Next Week

College of Engineering
UNIVERSITY OF WISCONSIN–MADISON

DRIVERLESS SHUTTLE DEMONSTRATION

PRESENTED BY: WISCONSIN AUTOMATED VEHICLE PROVING GROUNDS AND GREAT LAKES TRANSPORTATION ENTERPRISE INSTITUTE

Friday & Saturday, November 17 & 18

UW-Madison Engineering Campus

- Friday, 9 a.m. to 3 p.m.
- Saturday, Badger pregame
- See shuttle demonstrations
- Talk with autonomous vehicle researchers

DEMONSTRATION AREA

More info: WiscAV.org or Rafferty@WiscAV.org

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Stay Engaged

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