ACES Primer
(Autonomous, Connected, Electric, and Shared Vehicles)

Preparing our Region for Autonomous & Connected Vehicles
Miniconference – April 26, 2019
What will the world truly look like in 2075?

- All vehicles SAE Level 5, fully IoT capable, and non-fossil fuel
What will the world truly look like in 2075?

- All commercial trucking driverless and platooned
What will the world truly look like in 2075?

- Downtown cores only accessible to shared AVs, bikes, and peds
What will the world truly look like in 2075?

• Signal-less intersections the norm – vehicles negotiate space-time dynamically
What will the world truly look like in 2075?

- Car ownership limited to rural areas where most own a share of a pooled vehicle
What will the world truly look like in 2075?

• SAE Level 0-4 cars/motorcycles operate under historic licenses on non-freeways and are seen as infrequently as a horse and buggy.
What will the world truly look like in 2075?

• It depends on a combination of how we plan it, what people place emphasis on as important, and what the incentives are

• With connected and automated vehicles, this can be a wide spectrum

• How do we get there?
  • Multidisciplinary Collaboration
  • Testing and Validation
  • Public Engagement
  • Urban, Regional, and Rural Planning
  • Artificial Intelligence
  • Navigating the “messy middle”
CV

Shared

EV

AV

V2V
V2I
V2X

IoT

WiRover

[Images of vehicles and technology]
Traffic Fatalities Rising

Nationally:
- 2015-2016, Largest two-year increase in 50 years
- In 2017, 37,133 deaths
- 90+% Attributable to Human Error

Wisconsin:

Pedestrian deaths now up to 15% of all traffic deaths

Sources: NHTSA, NSC, WisDOT
Advanced Driver-Assistance Systems (ADAS)

- **Back-Up Camera**: Shows you a view behind your car when backing up.
- **Automatic Emergency Braking System**: May brake for you if a front-end crash is imminent.
- **Blind Spot Monitor**: Helps you know what cars might be hidden to your left or right.
- **Lane Departure & Lane Keeping Systems**: Warns you if you’re drifting out of your lane and may steer you back.
- **Automatic Parallel Parking**: Helps you safely navigate into a parallel spot. You control braking, it controls steering.

MyCarDoesWhat.org
A website that answers all your questions about new car safety technologies.

…and so much more
SAE Levels of Vehicle Automation

0. No Automation
   Zero autonomy; the driver performs all driving tasks.

1. Driver Assistance
   Vehicle is controlled by the driver, but some driving assist features may be included in the vehicle design.

2. Partial Automation
   Vehicle has combined automated functions, like acceleration and steering, but the driver must remain engaged with the driving task and monitor the environment at all times.

3. Conditional Automation
   Driver is a necessity, but is not required to monitor the environment. The driver must be ready to take control of the vehicle at all times with notice.

4. High Automation
   The vehicle is capable of performing all driving functions under certain conditions. The driver may have the option to control the vehicle.

5. Full Automation
   The vehicle is capable of performing all driving functions under all conditions. The driver may have the option to control the vehicle.
Connected Vehicles – Overview

- Vehicle-to-Vehicle (V2V)
- Vehicle-to-Infrastructure (V2I)
- Vehicle-to-Anything (V2X)
  - Pedestrians
  - Bicycles / motorcycles / mopeds
- Connected everything – Internet of Things
- Basic Safety Messages (BSM) broadcast every 1/10th of a second
  - Vehicle position, speed, heading, acceleration, size, brake system status
- Vehicles and infrastructure need to be equipped to gain benefit
Vehicle to Vehicle Communications
Road Hazard Notification
Vehicle to Infrastructure Communications
Intersection Warning
Biggest Issues Surrounding AV/CV

- Vehicle Cybersecurity
- Information Privacy
- Vehicle Ethics
- Crashworthiness
- System Disengagements / Driver Re-Engagement
- Complex Driving Situations
- Deep Learning / Artificial Intelligence
- Vehicle Assertiveness
- **Technology is coming – Will we shape it or let it shape us?**
**ACES Primer**

**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, Mandel 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

- **MRMC Corridor**
  - WisDOT, IDOT, IL Tollway

**WISCONSIN AUTOMATED VEHICLE PROVING GROUNDS**

International
Breadth, Complexity, Edge Cases

Autonomous Vehicle Research and Development

- Big Data/IT
- Software/Algorithms
- Liability
- Legal Aspects
- Ethics

- Communications and Marketing
- Safety
- Outreach
- First/Last Mile
- Health Care
- Food Deserts
- Those Unable to Drive

- Social Equity
- Economic Impact

- User Acceptance/Human Factors

- Policy

- Physical Simulation
- Field Testing
- System Resilience
- Planning

- Hardware/Sensors
- Closed Course
- Real World

- Agricultural
- Data Integrity
- Cybersecurity
- Privacy

- Urban
- Regional
- Rural

- Environment
- Safety
- Air Quality
- Energy
Madison CV/AV Corridor – Connected Corridor

• Satisfies SPaT Challenge
• 26 DSRC deployment
• TSP/MMITSS application
• Transit/VRU interaction apps
• Red light violation warning
• V2I general testing
• Simulation-to-design
• Preparation for 5G
Madison CV/AV Corridor – Connected Corridor

Research and Development Projects
Automated Shuttle Deployment

ROADWAY INTERACTIONS
- Other Vehicles
- Pedestrians
- Bicyclists
- Infrastructure

USER INTERACTIONS
- User Acceptance
- Passenger Comfort
- Usage Statistics
- Survey Responses

SYSTEM DATA
- Basic Vehicle Data
- Sensor Data
- Operating Data
- Vehicle Security

OPERATIONAL DATA
- Operating Limitations
- Obstacle Detection
- Winter Performance
- Changing Traffic Patterns

CONNECTED DATA
- Vehicle to Infrastructure
- Vehicle to Anything
- External Sensors
- Data Processing

Closed Course
- Living Lab
- On-Road Demonstrations
- College Campus
- First/Last Mile
- Tribal / Rural

Simulation Environment
Project Chrono – CV/AV Simulation

- CAVE (Connected autonomous vehicle emulator)
- Multi-agent support
- Vehicles built from subsystems
- DSRC simulation
- LiDAR/Radar simulation
HAVI – Human AV Interaction

- Full-scale driving simulation
- Partial automation research
- Driver reengagement
- Disengagement scenarios
- Driver attentiveness / distraction
- ADAS/CV driver notification strategies
- AV interaction with human drivers
- Vehicle assertiveness
SC&C – Smart and Connected Communities

- Dynamic routing
- First-mile/last-mile connectivity
- Food and transit deserts
- Shared Madison data platform
- Smart parking algorithms
- IoT compatibility
- Urban analytics
REACT – Resident Engagement on Automated and Connected Technologies

- Rural engagement workshops
- Aging community outreach
- Low-income community outreach
- Users with disabilities
- Vulnerable industry sector research
- Public outreach and education events
- Multidisciplinary graduate degree development
That’s great, but what should we do?

• When should states, regions, cities, and municipalities get involved with ACES?
• How should states, regions, cities, and municipalities get involved with ACES?
• What transportation and/or transportation-related problems does your municipality currently have?
• Which groups of your citizens have a disproportionate amount of transportation issues?
• What are the limitations of the current system in serving these citizens?
• What origins/destinations have the greatest transportation needs?
Thank You

Stay Engaged

Visit: WiscAV.org

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