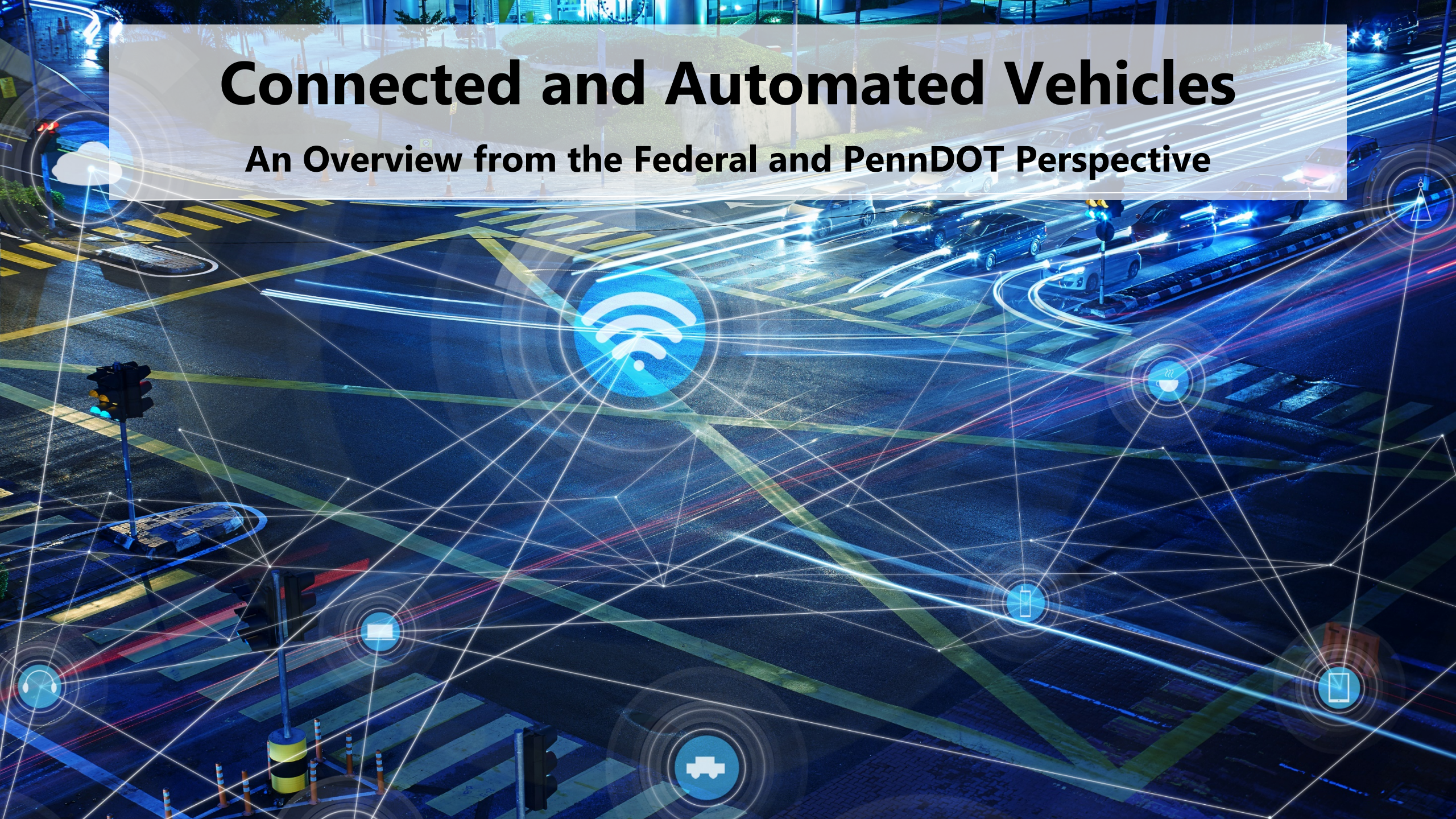


Connected and Automated Vehicles

An Overview from the Federal and PennDOT Perspective

Presentation Agenda

- The Need
- Background
- Benefits
- Timelines
- USDOT Activities
- Pennsylvania’s Program
- PA AV Summit

Lives lost on our transportation system in 2017

39,141

Crashes due to human error

94%

Fatalities involved in drinking and driving in 2017

11,000

Fatalities where speeding was a factor in 2017

10,000

Fatal crashes involving distracted drivers in 2017

13,500

Annual % of roadway fatalities from crashes involving large trucks

13%

Victims in fatal large truck crashes who were not an occupant of the truck(s) involved

82%

Compared to the average worker, professional drivers are…

10 TIMES

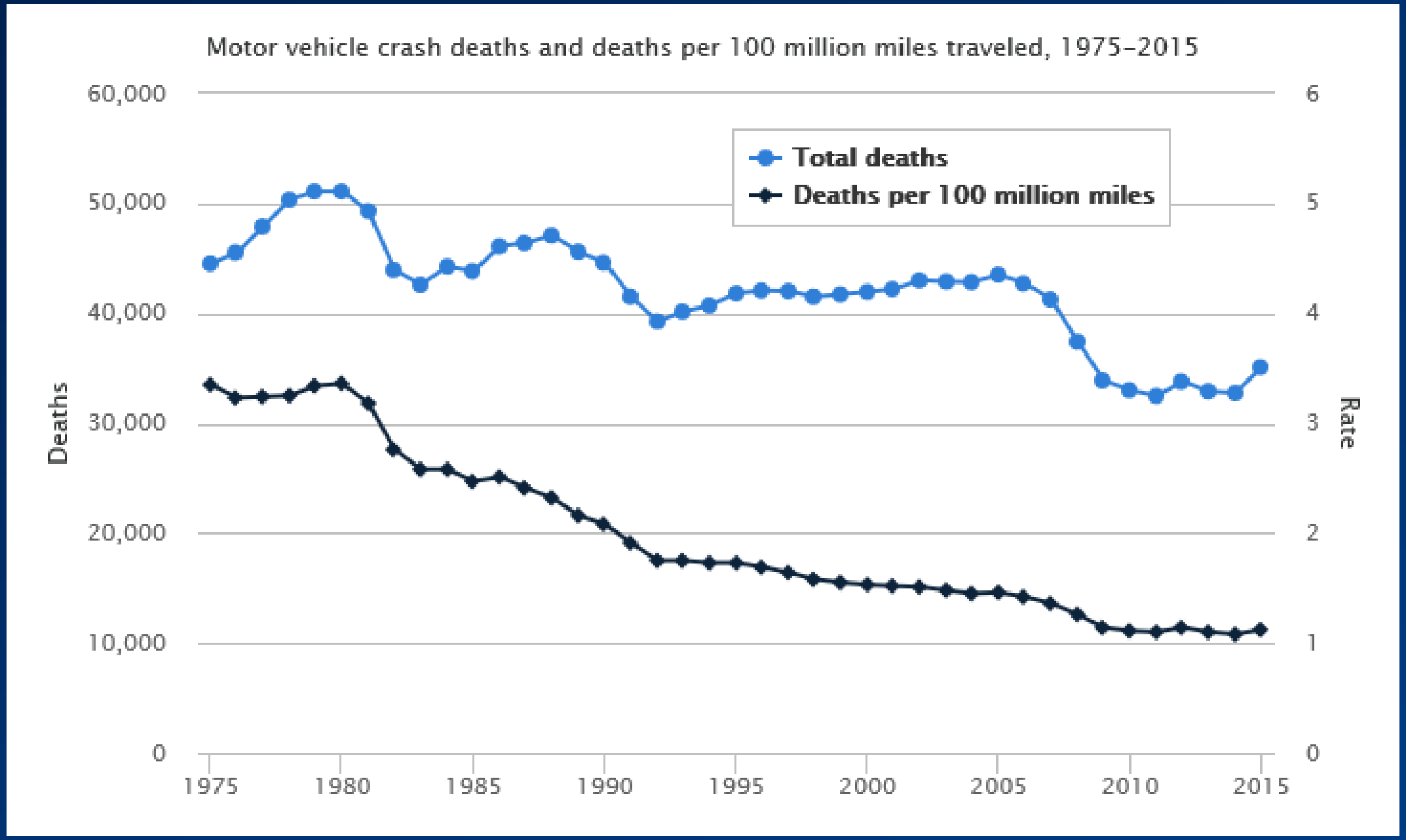
…more likely to be killed on the job

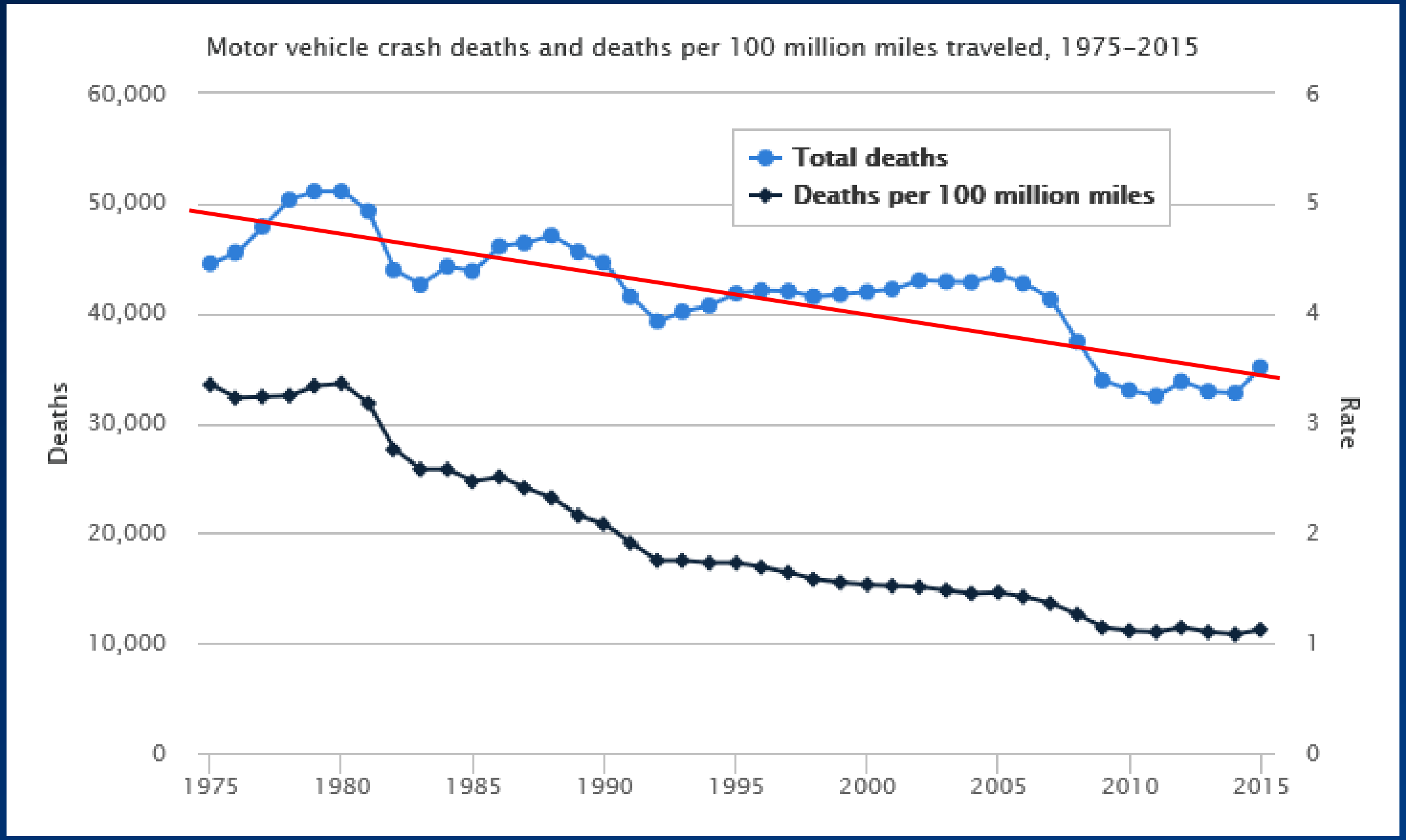
Pedestrians killed by motor vehicles in 2017, representing 16% of all motor vehicle fatalities

5,977

Average highway rail grade crossing fatalities per year

253


Motor vehicle crash deaths and deaths per 100 million miles traveled, 1975–2015
Total deaths
Deaths per 100 million miles
Deaths
Rate
60,000
50,000
40,000
30,000
20,000
10,000
0
6
5
4
3
2
1
0
1975
1980
1985
1990
1995
2000
2005
2010
2015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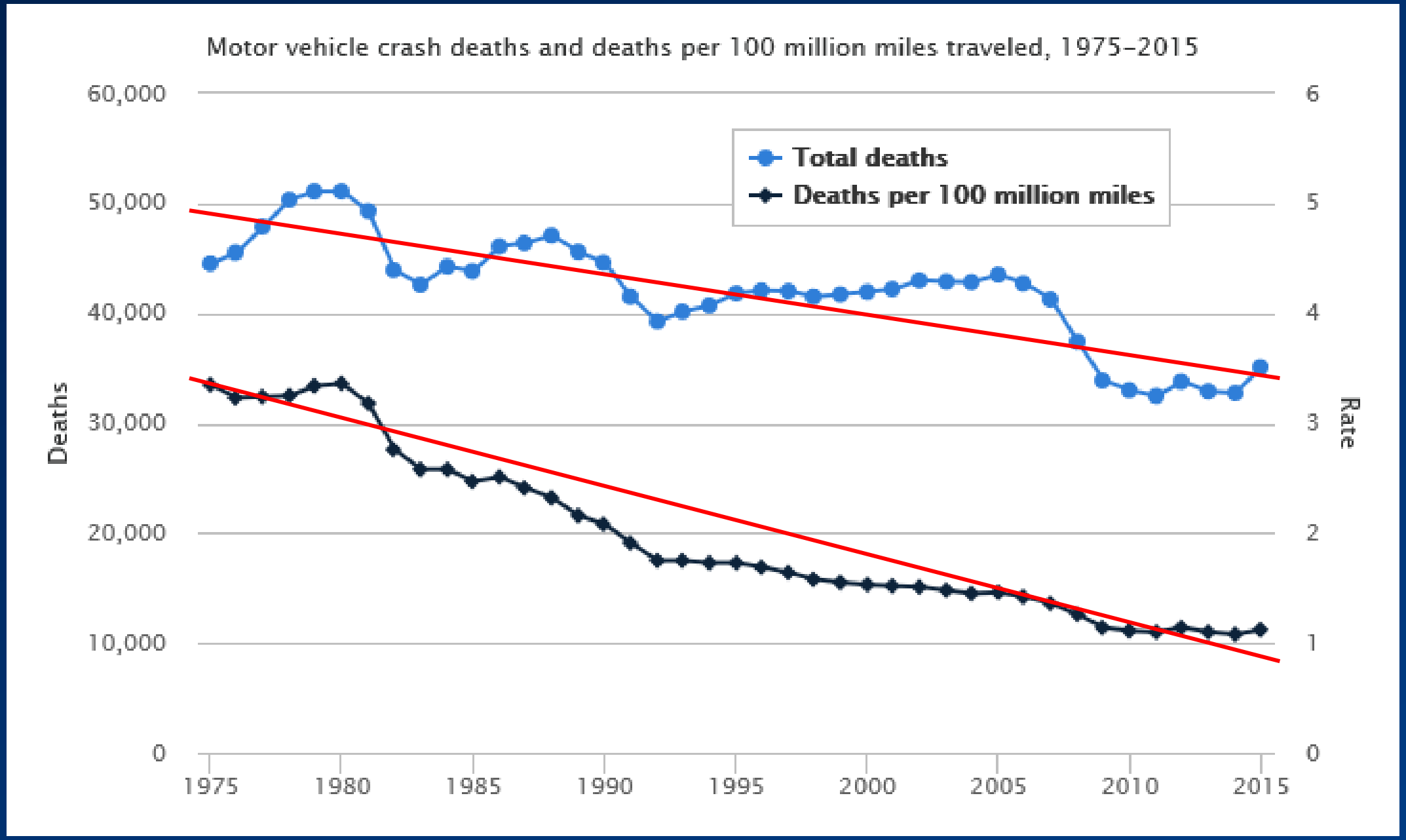
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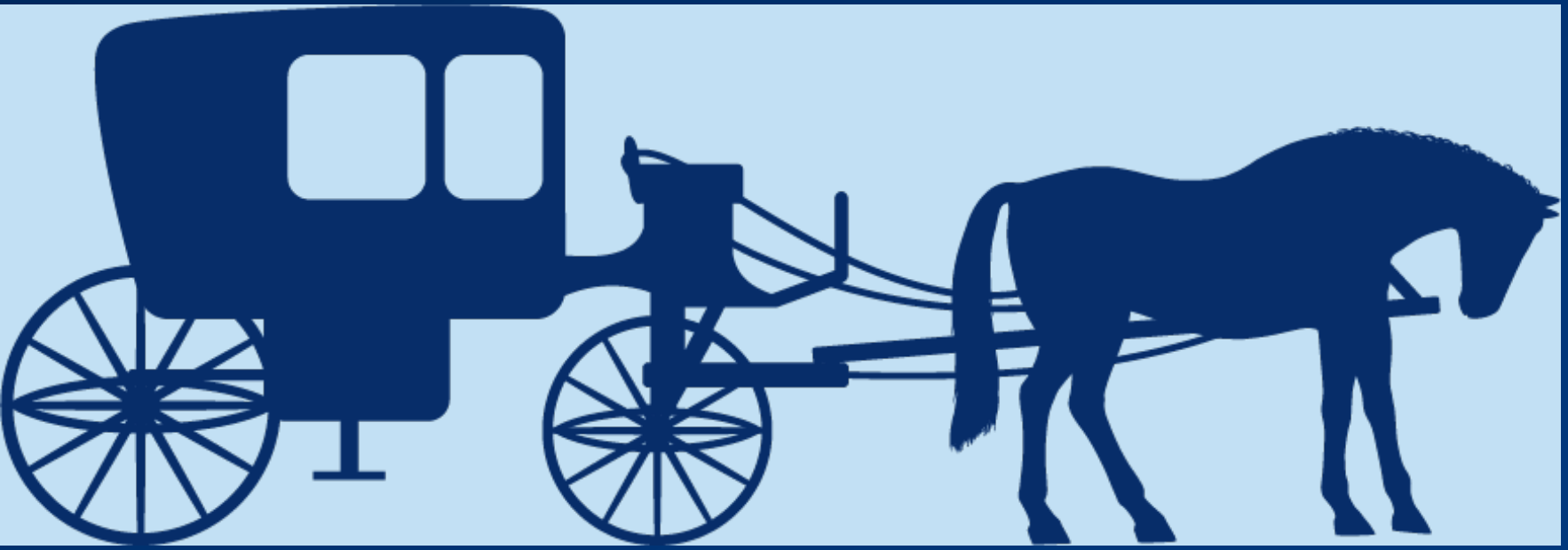
1975
1980
1985
1990
1995
2000
2005
2010
2015

“If I had asked people what they wanted, they would have said faster horses.”

- Henry Ford

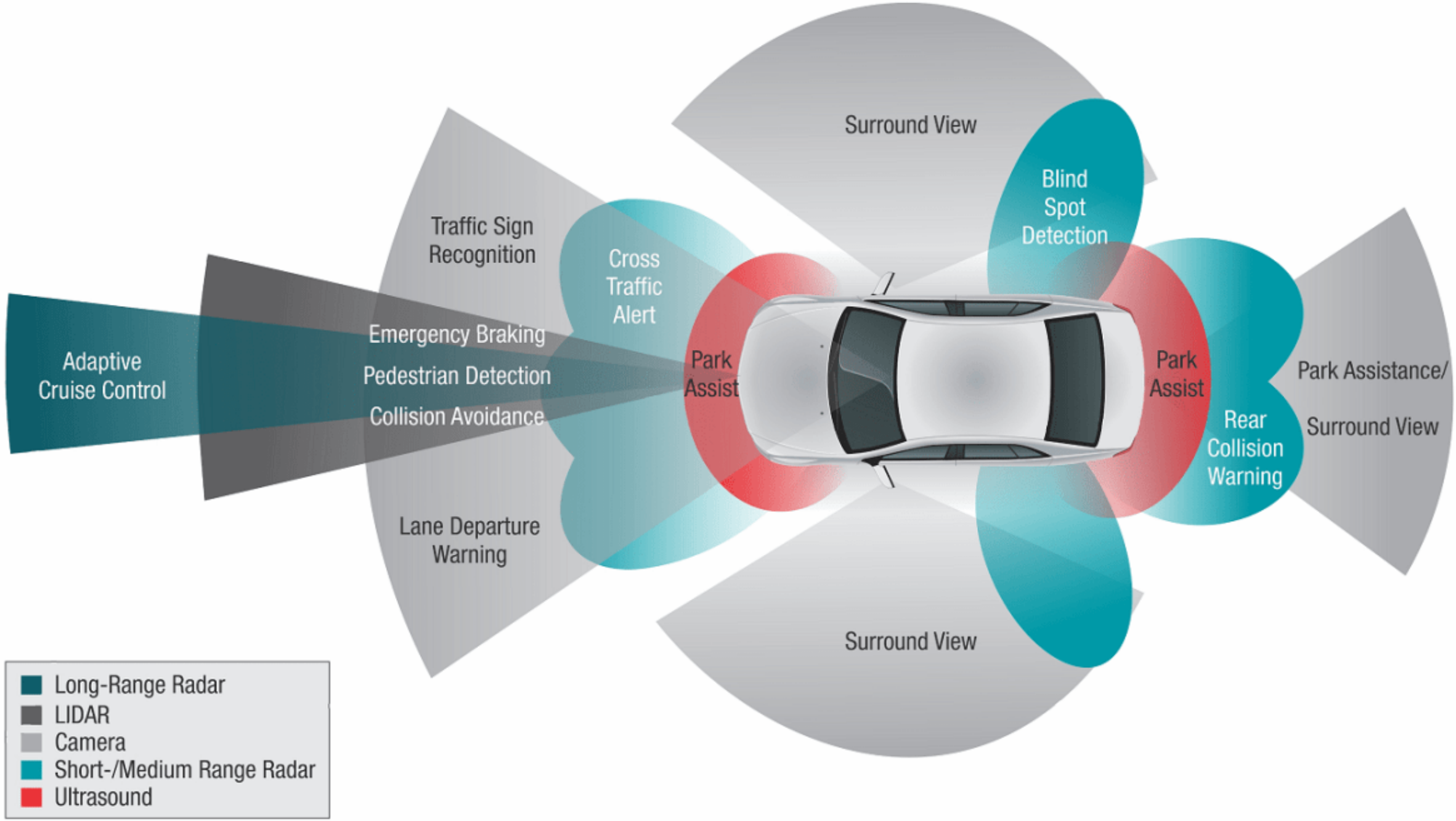


The 5 levels of driving automation

For on-road vehicles

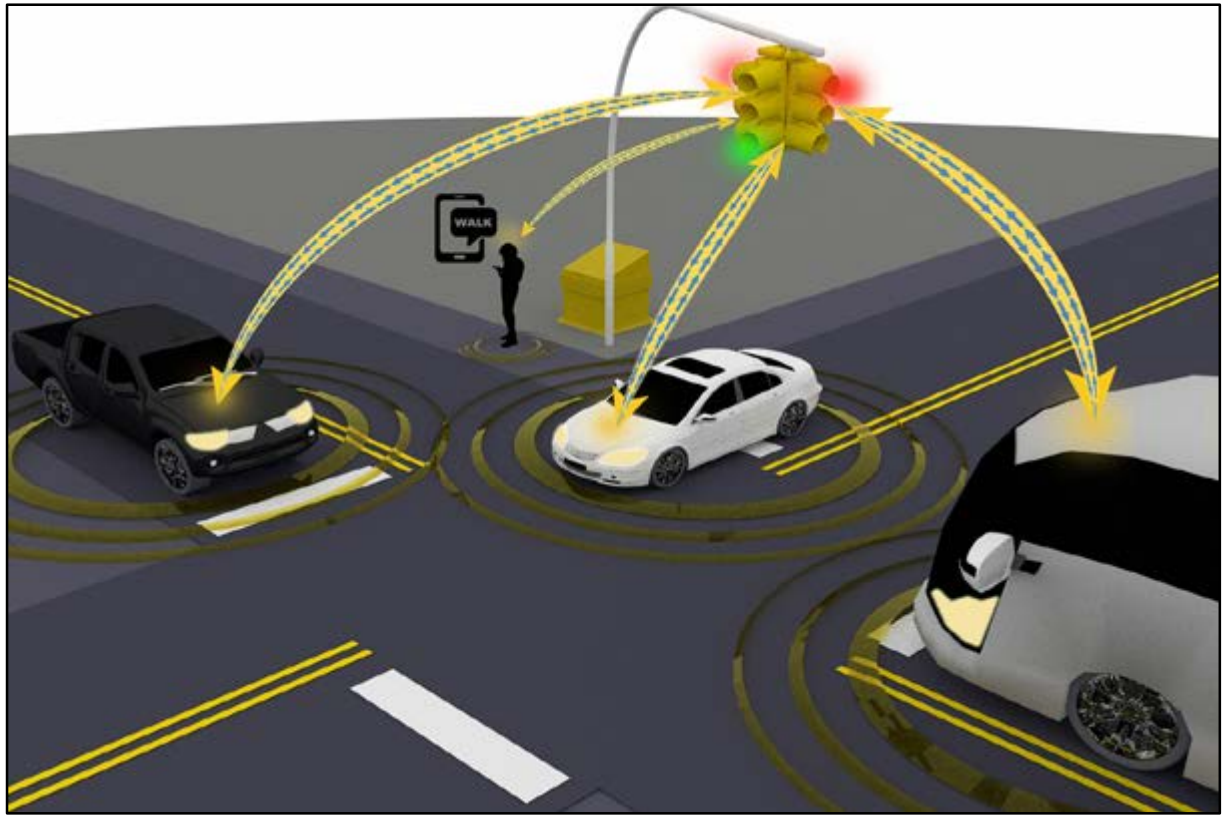
Human driver *Automated system*

		Steering and acceleration/ deceleration	Monitoring of driving environment	Fallback when automation fails	Automated system is in control
Human driver monitors the road	0 NO AUTOMATION				N/A
	1 DRIVER ASSISTANCE				SOME DRIVING MODES
	2 PARTIAL AUTOMATION				SOME DRIVING MODES
Automated driving system monitors the road	3 CONDITIONAL AUTOMATION				SOME DRIVING MODES
	4 HIGH AUTOMATION				SOME DRIVING MODES
	5 FULL AUTOMATION				


Surround View
Blind Spot Detection
Traffic Sign Recognition
Cross Traffic Alert
Adaptive Cruise Control
Emergency Braking
Pedestrian Detection
Collision Avoidance
Park Assist
Park Assist
Park Assistance/ Surround View
Rear Collision Warning
Lane Departure Warning
Surround View
Long-Range Radar
LIDAR
Camera
Short-/Medium Range Radar
Ultrasound

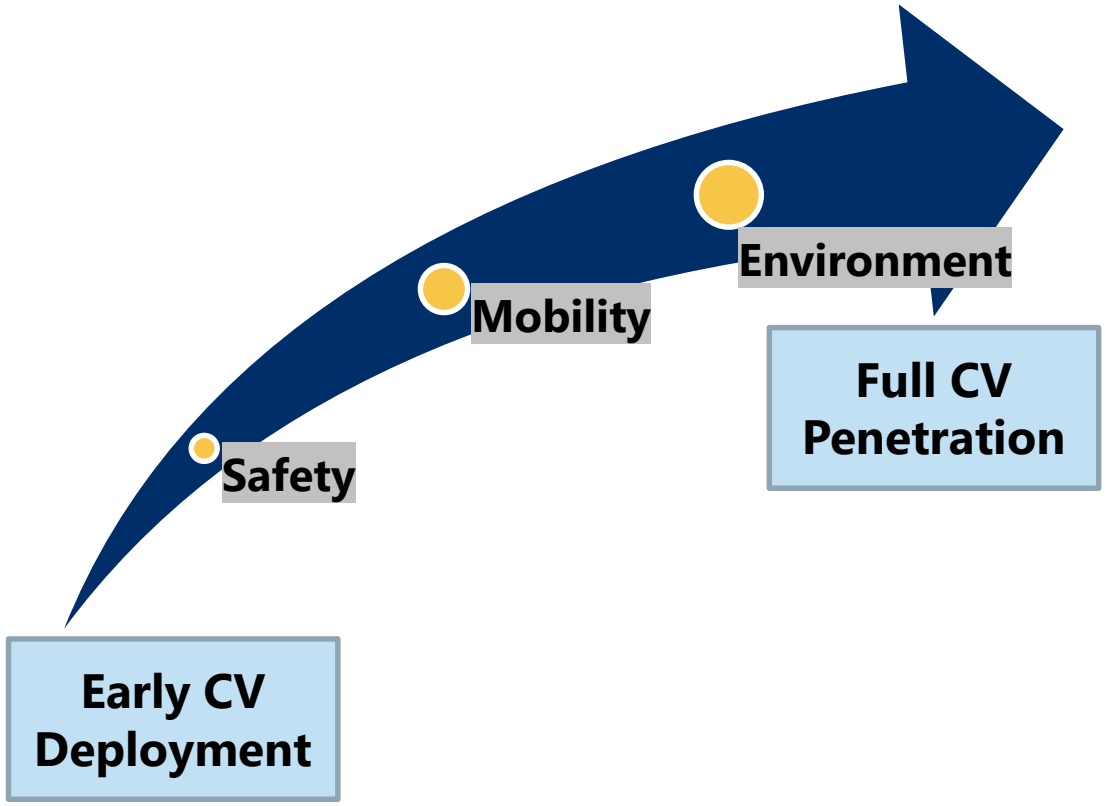
Connected Vehicles

Vehicle-to-Vehicle (V2V)



Vehicle-to-Infrastructure (V2I)

Benefits of Connected Vehicles



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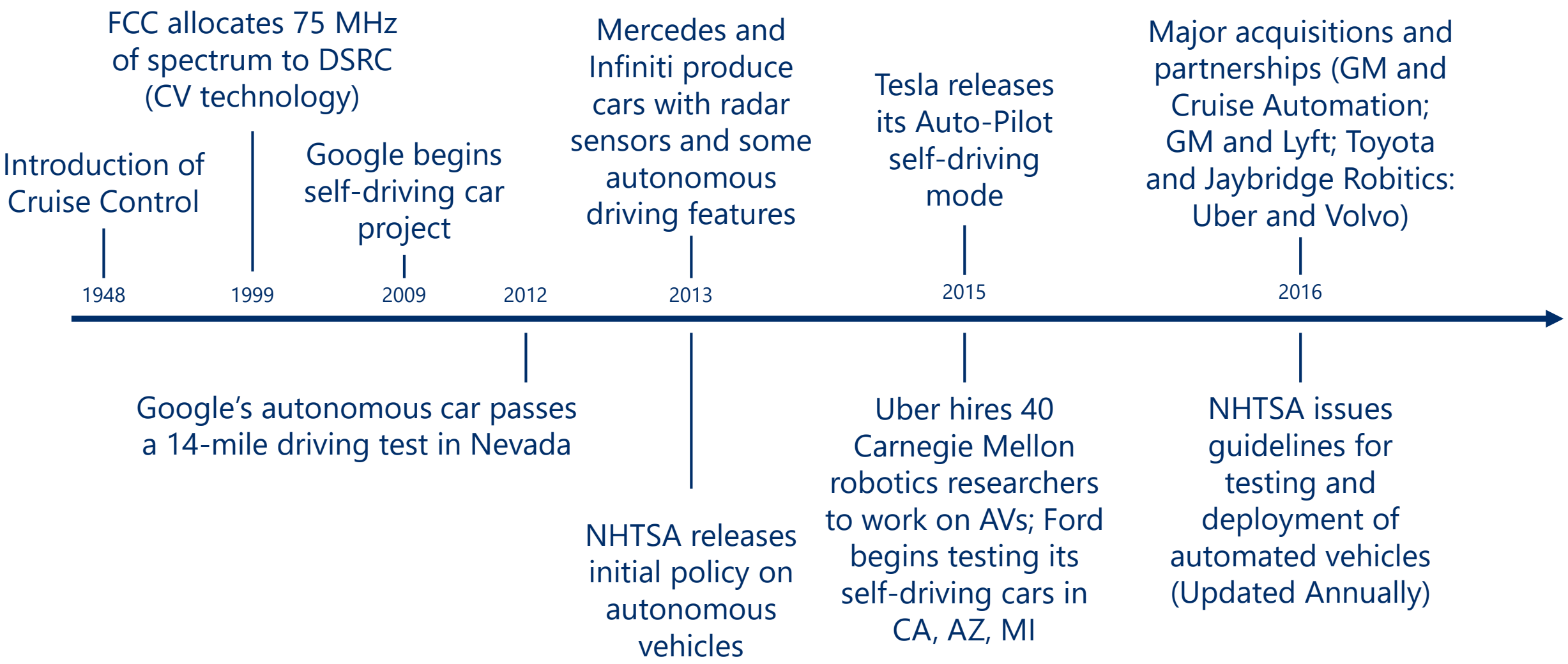
Historical Timeline



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Industry Timeline

2018 to 2019



2020 to 2024









2025 to 2029


2030 +

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Preparing for the Future of Transportation

An Update on Automated Vehicle Initiatives and Policy in the United States

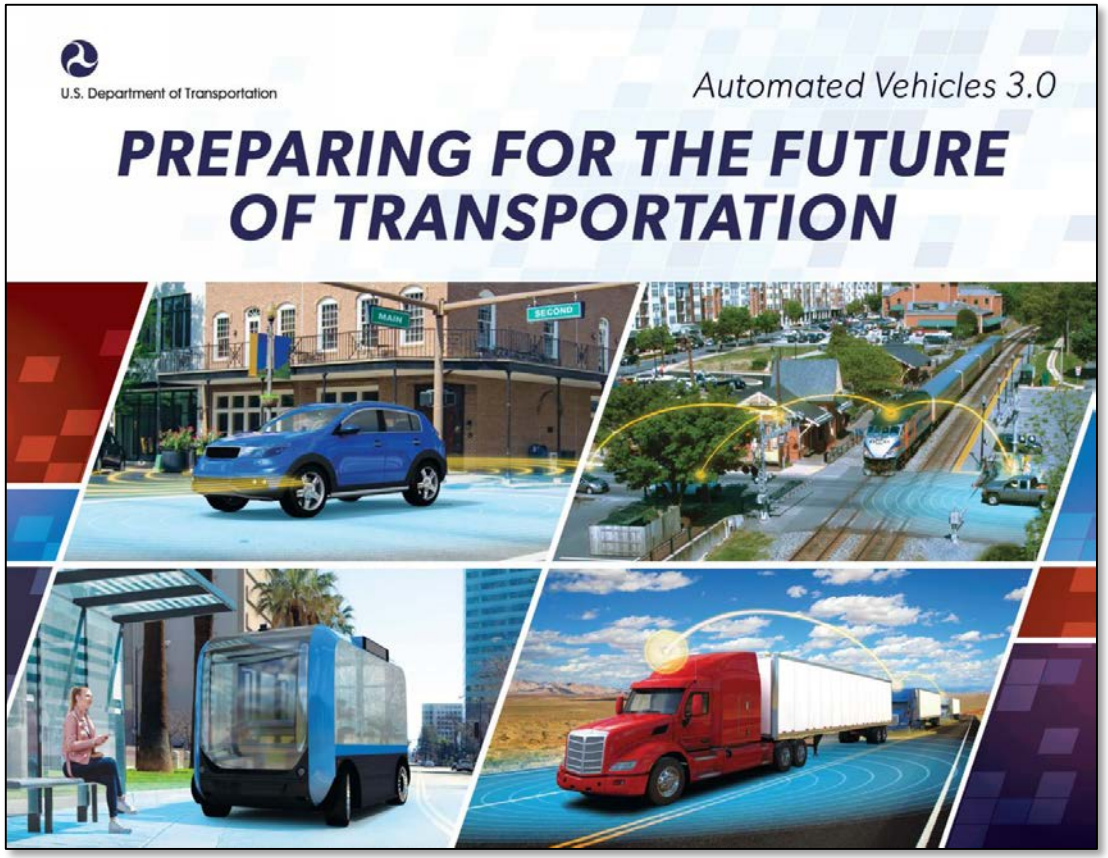
Map of U.S. Automated Vehicle Test Sites

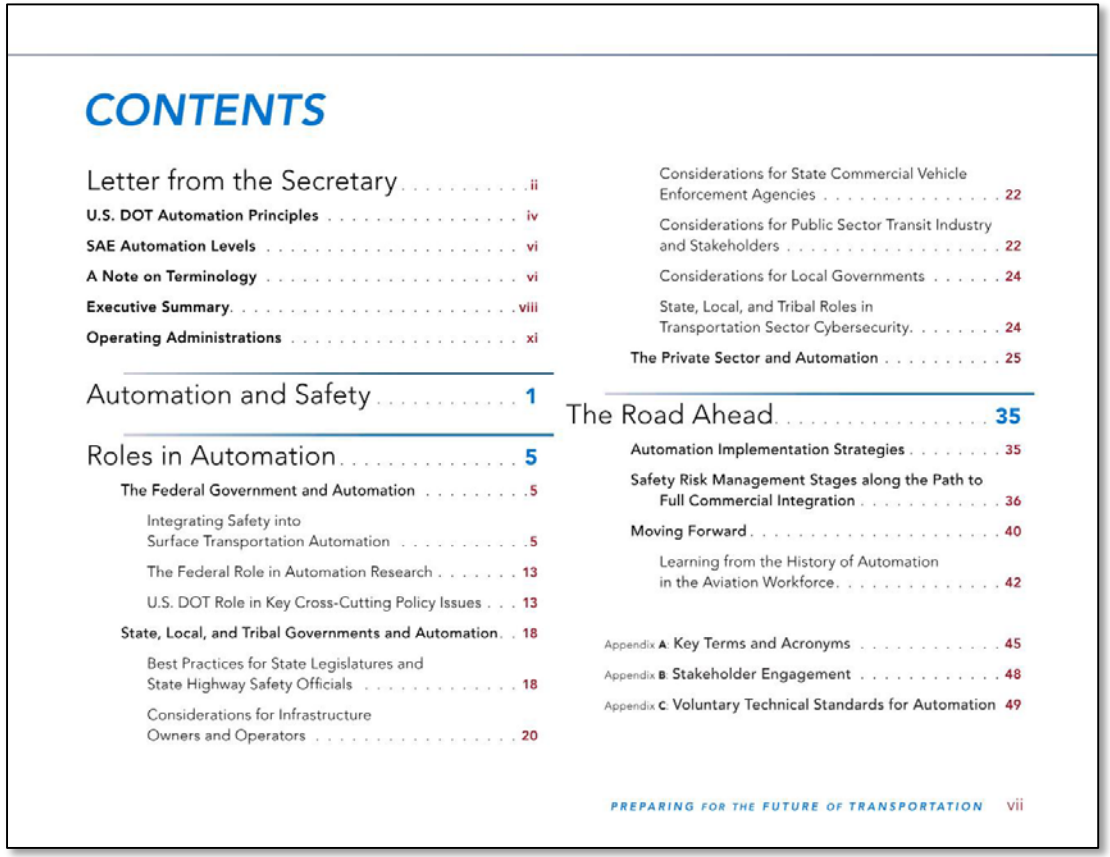
Source: NHTSA/Volpe Center – March 2019

USDOT Initiatives and Policy

AV 3.0 supports the safe development of automated vehicle technologies by:

- Providing new multi-modal safety guidance
- Reducing policy uncertainty and clarifying roles
- Outlining a process for working with USDOT as technology evolves





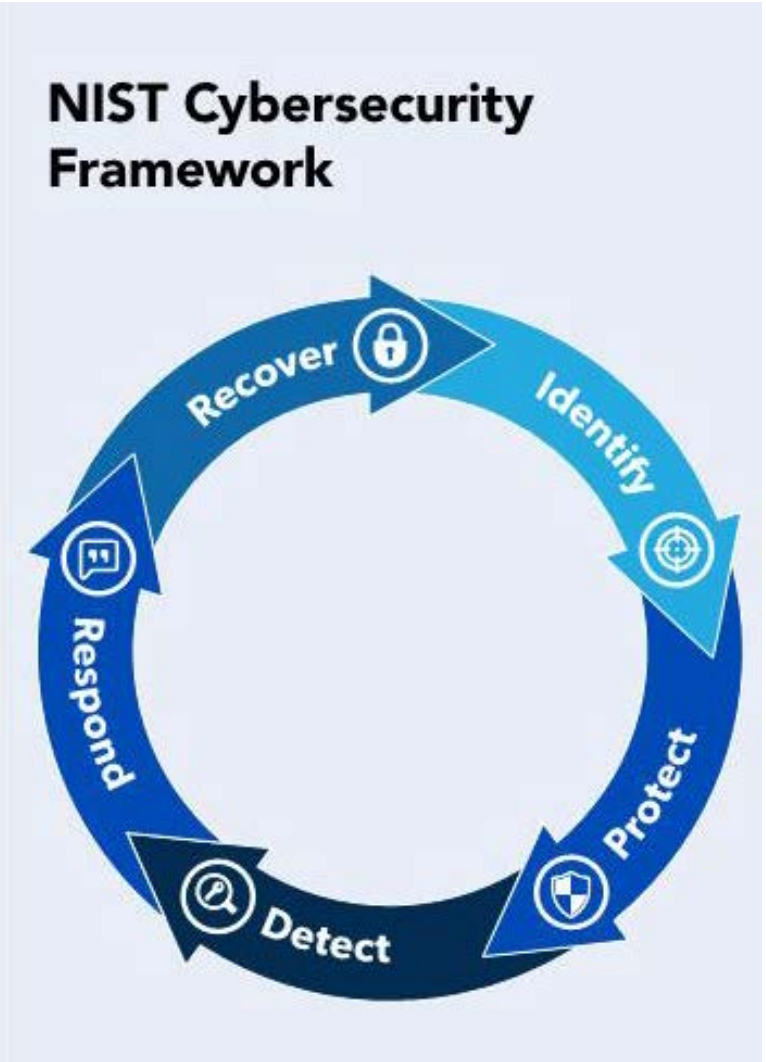
CONTENTS

Vehicle Cybersecurity

NHTSA's multi-faceted research approach

- Leverages the National Institute of Standards and Technology (NIST) Cybersecurity Framework
  - Encourages industry to adopt practices that improve the cybersecurity posture of their vehicles in the U.S.

NHTSA's goal is to collaborate with the automotive industry to proactively address vehicle cybersecurity challenges, and to continuously seek methods to mitigate associated safety risks



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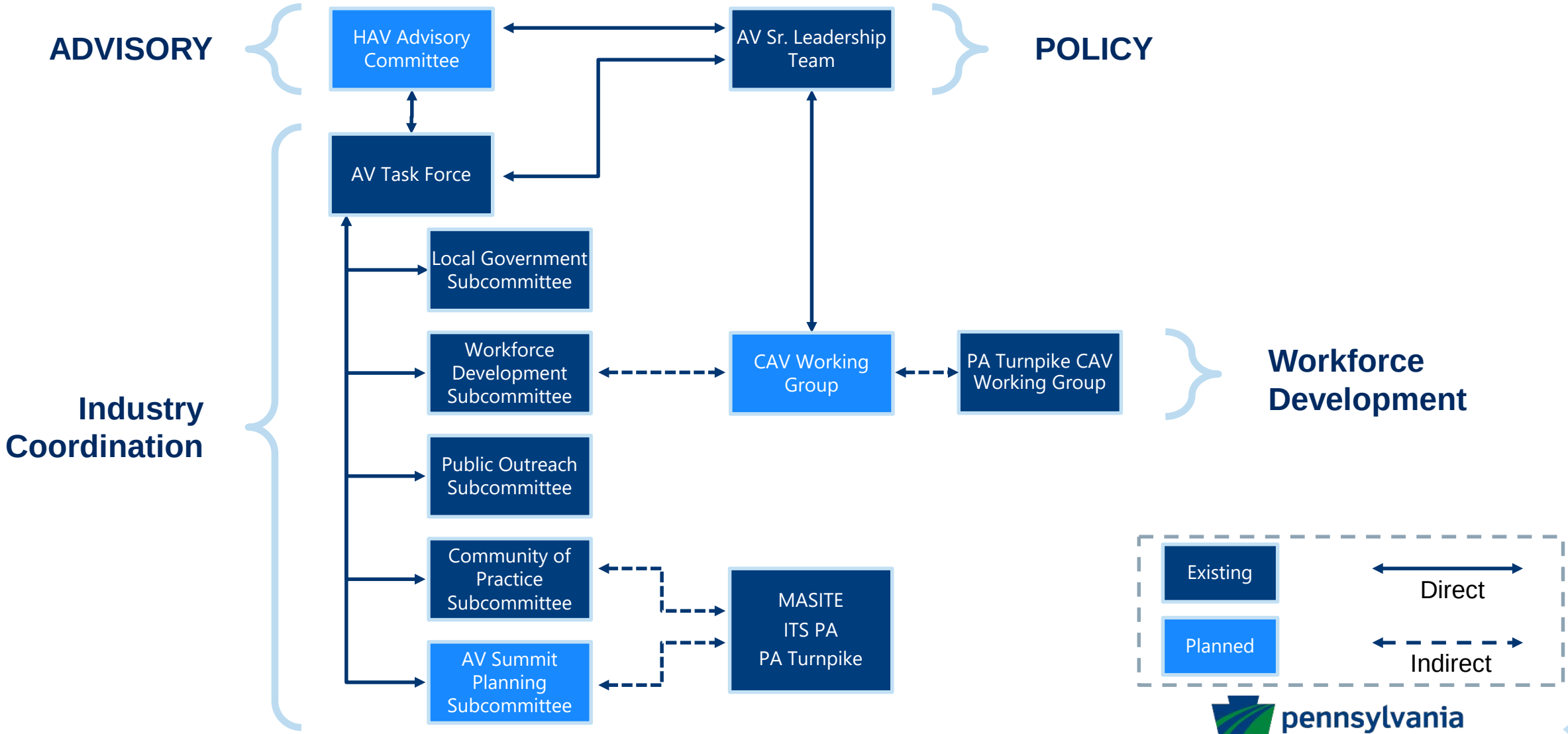
Preparing for the Future of Transportation

An Update on Automated Vehicle Testing in Pennsylvania

CAV Groups



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AV Task Force

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Public Sector:

U.S. Department of Transportation
Federal Highway Administration

PENNA TURN PIKE

pennsylvania
STATE POLICE

PA pennsylvania
DEPARTMENT OF COMMUNITY & ECONOMIC DEVELOPMENT

pennsylvania
INSURANCE DEPARTMENT

PDA pennsylvania
DEPARTMENT OF AGING

pennsylvania
DEPARTMENT OF EDUCATION

PENNSYLVANIA PUC
PUBLIC UTILITY COMMISSION

TRI-COUNTY TCRPC
REGIONAL PLANNING COMMISSION

DELAWARE VALLEY dvrpc
REGIONAL PLANNING COMMISSION

CITY OF PITTSBURGH

City of ALTOONA Pennsylvania

Academia:

Carnegie Mellon University

Penn
University of Pennsylvania

PennState

CCAC

Advocacy:

AAA

masite
THE BIRTHPLACE OF ITE

ATA AMERICAN TRUCKING ASSOCIATIONS

Intelligent Transportation Society ITS PENNSYLVANIA

PMTA
Pennsylvania Motor Truck Association

AFL-CIO

PENNSYLVANIA ASSOCIATION FOR JUSTICE

ifp

AARP

THE EHRLICHMAN GROUP

PPTA
Pennsylvania Public Transportation Association

ECKERT SEAMANS

Industry:

GM

Audi

UBER

TOYOTA RESEARCH INSTITUTE

GlobalAutomakers

SAE INTERNATIONAL

AURORA

PELOTON

ARGO AI

Royal TRUCK & EQUIPMENT, INC.

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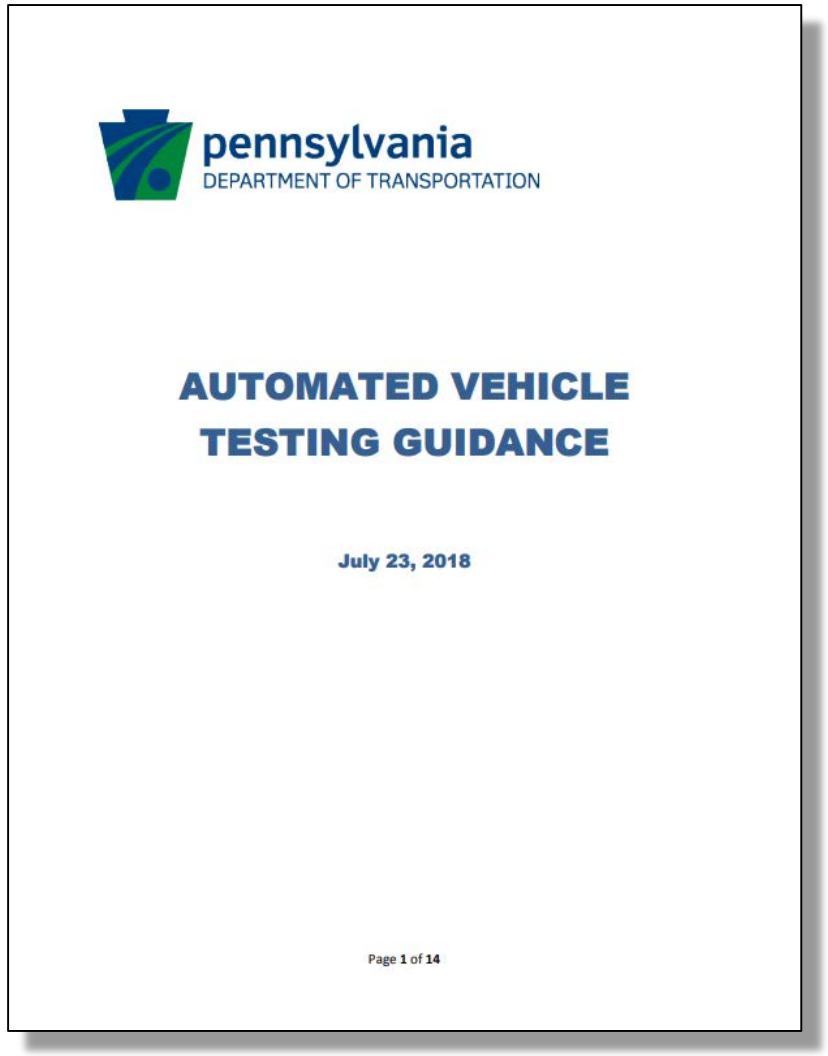
AV Testing Guidance

Guidance strengthen testing safety by focusing on the safety driver, not the AV technology.

- Update to 2016 AV Testing Policy
- Consulted key stakeholders including multiple AV testers and the AV Policy Task Force
- Guidance is voluntary, but compliance is expected
- Testers must submit a Notice of Testing
  - Tester Information (e.g., contact info and Point-of-Contact)
  - Vehicle Information (e.g., plate number, make/model, and VIN)
  - Safety Driver Information (e.g., name, license number, and training info)
  - Location of planned testing
  - Safety and Risk Mitigation Plan or NHTSA Voluntary Safety Self-assessment
  - Enhanced Performance Driver Training Plan **only if traveling over 25mph with one safety driver
- Letter of Authorization granted to two testers
  - Other applications under review



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AV Testing Guidance – Data Collection Form

Semi-Annual Data Collection Form

To document and measure the progress of HAV testing in Pennsylvania, PennDOT must collect fundamental data from all HAV Testers.

Full Name

Company / Agency

Mailing Address City State Zip

Phone E-mail

Date Reporting Period

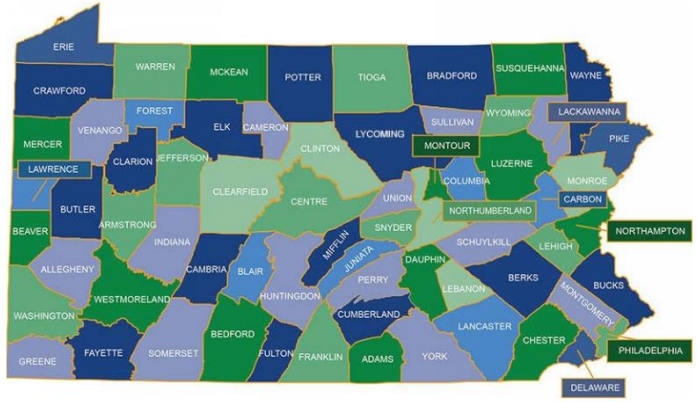
Please indicate the approximate miles traveled by ADS-engaged HAVs in Pennsylvania:

- 0 to 999 miles ☐
- 1,000 to 9,999 miles ☐
- 10,000 to 19,999 miles ☐
- 20,000 to 34,999 miles ☐
- 35,000 to 49,999 miles ☐
- 50,000+ miles ☐

Please indicate where the majority of testing occurred:

- Limited Access Roadways ☐
- Arterial Roadways ☐
- Equal Testing ☐

Please list the counties where HAVs were tested on public trafficways:



Please indicate the approximate number of employees in Pennsylvania involved with HAV testing:

- 0 to 24 Employees ☐
- 25 to 99 Employees ☐
- 100+ Employees ☐
- No Change Since Previous Submission ☐

Please indicate, if applicable, the number of new jobs created in Pennsylvania as a result of HAV testing:

- 0 to 24 Jobs ☐
- 25 to 99 Jobs ☐
- 100+ Jobs ☐
- No Change Since Previous Submission ☐

Please indicate, if applicable, the number of new facilities constructed, purchased, or rented in Pennsylvania as a result of testing:

- 0 to 1 Facilities ☐
- 2 to 4 Facilities ☐
- 5+ Facilities ☐
- No Change Since Previous Submission ☐

AV Testing & Testers

AURORA

Qualcomm

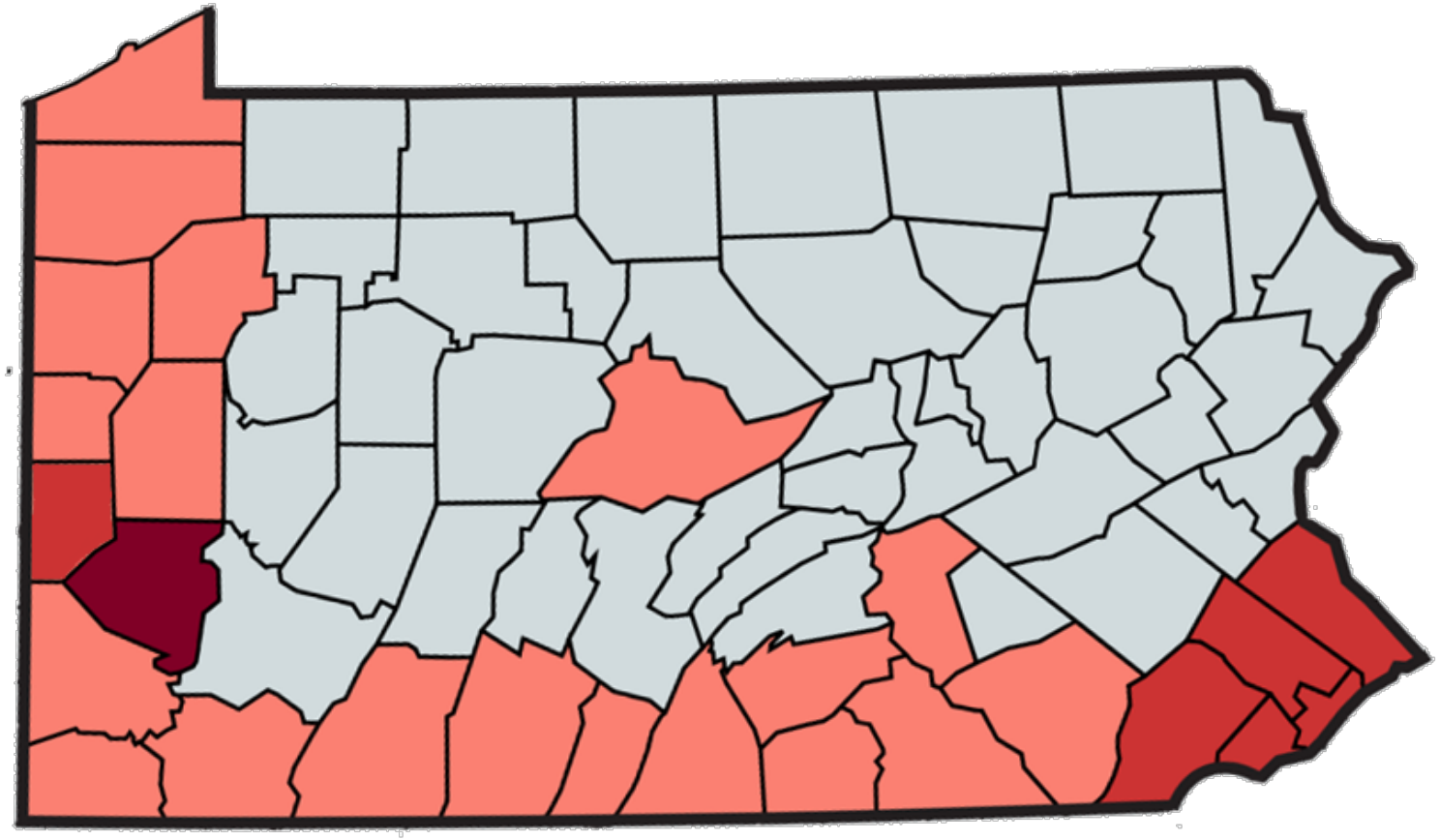
Carnegie Mellon University

UBER

ADVANCED TECHNOLOGIES CENTER

ARGO AI

APTIV



1 tester

5 tester

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Act 117 of 2018

1st AV Legislation in Pennsylvania

- **Automated Work Zone Vehicles**
  - Fully automated vehicles
  - Restricted to active work zones
  - Must be implemented by PennDOT or PA Turnpike
- **Platooning**
  - Limited to two or three buses, military vehicles or motor carriers.
  - Restricted to limited access roadways
  - Must have visual identifier
  - Must submit operations plan for evaluation
  - Policy active – April 22, 2019
- **Highly Automated Vehicle Advisory Committee**

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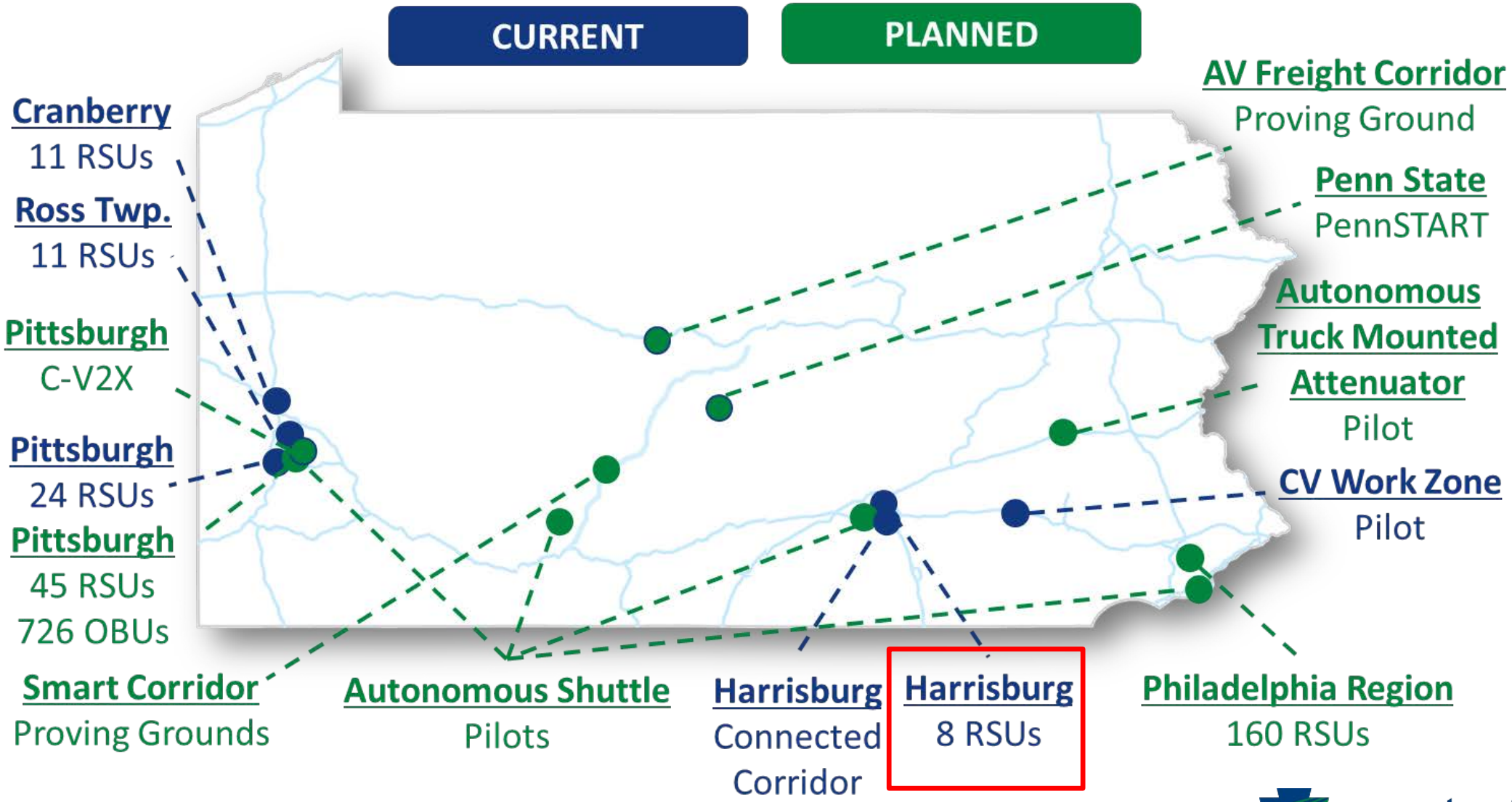
CAV Deployments



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Statewide CAV Strategic Plan

5 objectives per business area.
Each includes:

- Foundational Needs
- Existing Gaps
- Applicable Day 1 Uses
- Recommend Actionable Steps
- Appropriate Level of Investment
- Timeframe
- Impacts to Existing and Planned Initiatives
- Metrics
- Assumptions
- Impacts to the Capability Maturity-Model

PennSTART

Partnership between PennDOT, PA Turnpike, and Penn State

- **Focus Areas**
  - Traffic Incident Management
  - Connected/Automated Vehicles
  - ITS/Tolling/Signals
  - Transit
  - Commercial Vehicles
  - Bike/Ped.
  - Aviation including UAV
- **Approach**
  - Feasibility Study [completed 2018]
  - ConOps/Business Plan/Facility Requirements [Ongoing]
  - Design [Fall 2019]
  - Construction [Fall 2020]
  - Operation [Spring 2022

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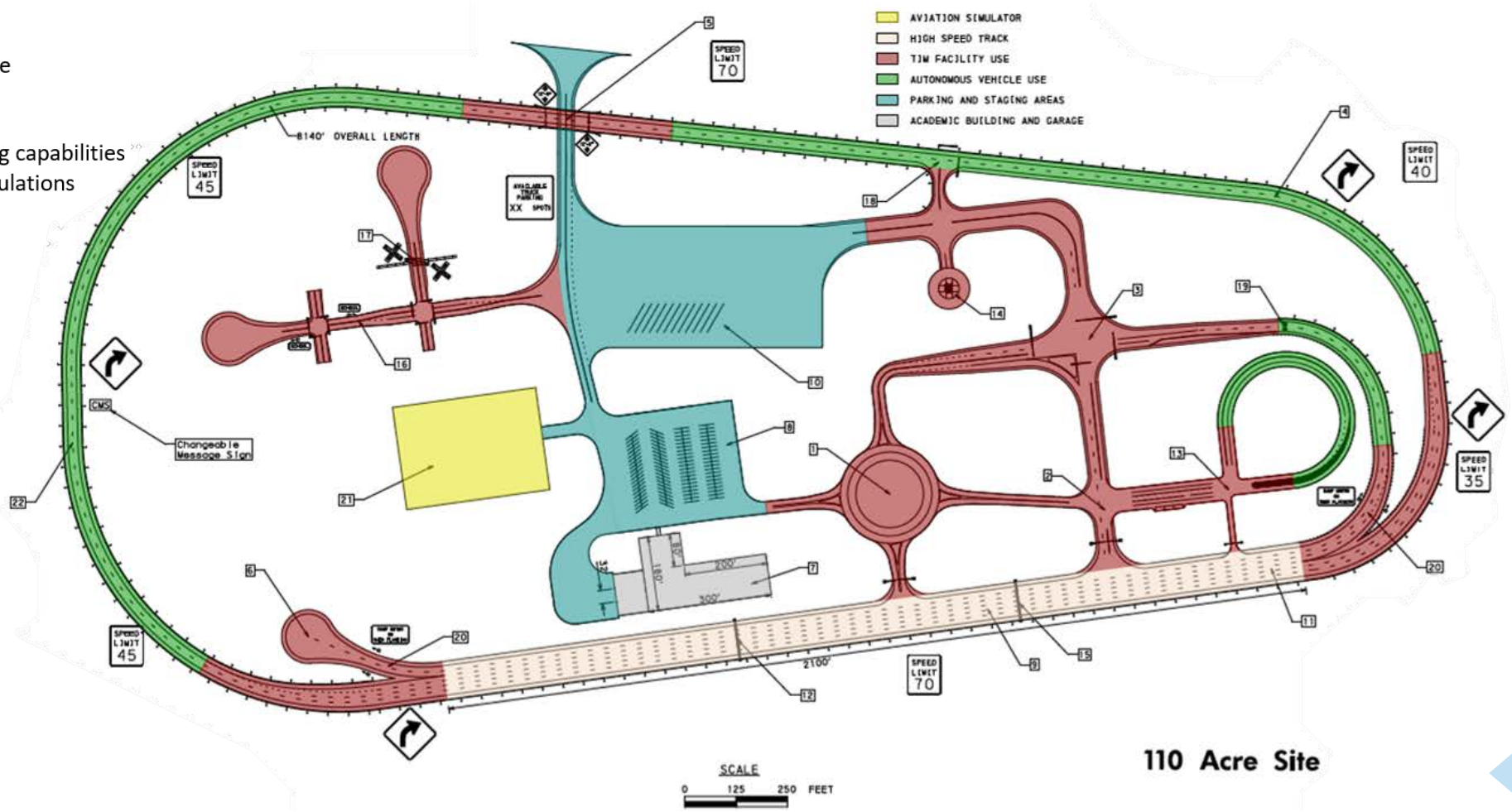
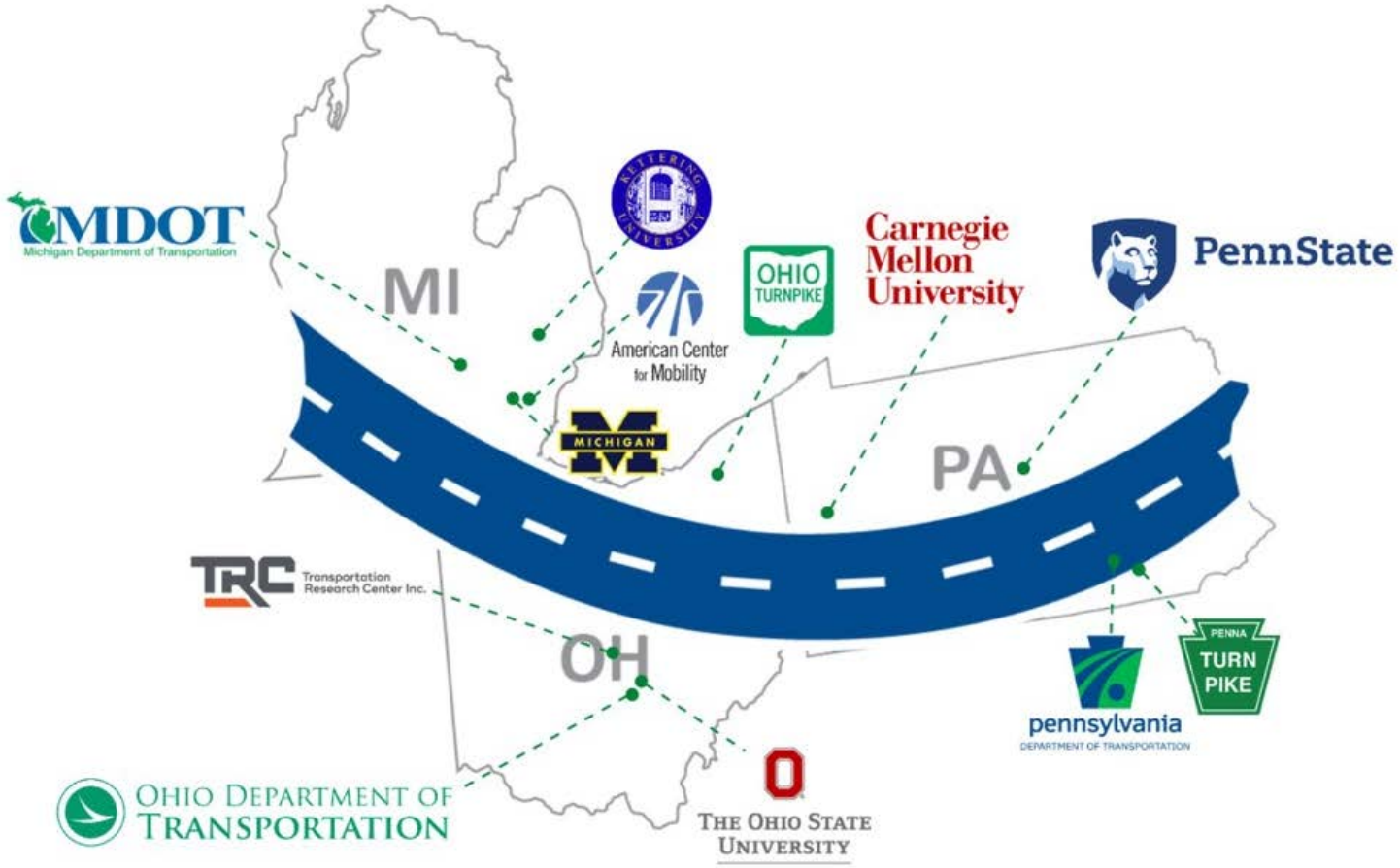
Conceptual Facility Design

1. 4 Point Roundabout with area for Green Space
2. Rural Intersections
3. Urban 4 Point Intersection (Leg 1 Simulates Multilane through with Left turn lane, Leg 2 Simulates Multilane through with right turn only, Leg 3 Simulates Left turn and Right turn only with concrete island and signal, Leg 4 Simulates a Typical Intersection layout with left turn into a rural intersection)
4. Automation Test Loop (Will have sections to simulate Type 31-S guide rail, Cable systems, and Concrete Jersey Barrier.)
5. Typical Bridge Section with embankments
6. Truck Turnaround area
7. Academic Building with Classrooms and Labs and Garage
8. Parking Lot Currently Showing 160 spaces
9. High Speed Testing with Return Loop
10. Truck Parking and Staging Area with Smart Truck Parking capabilities
11. 6 Lane Highway Section with on ramp and off ramp simulations
12. Overhead Tolling Gantry
13. City Simulation with Small Radii
14. Helipad
15. Active Traffic Management System
16. Signalized Urban Corridor
17. Railroad at Grade Crossing
18. Signalized Rural/High Speed Intersection
19. Queue Preemption
20. Ramp Meters
21. Aircraft Rescue Fire Fighting and Training Simulator
22. Potential Roadway Flooding Area



Smart Belt Coalition



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Upcoming Activates

- **District DSRC Coordination Plan**
  - July 2019
- **Automated Work Zone Vehicles Policy**
  - August 2019
- **PennDOT/PA Turnpike Test Bench**
  - August 2019
- **AV Testing Guidance 2.0**
  - September 2019
- **CAV Infrastructure Deployment Policy**
  - September 2019
- **AV Incident Response Plan**
  - December 2019
- **CAV "Hotspots" Mapping**
  - March 2020
- **BAA Platooning**

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PTC Initiatives

- CAV Roadmap
- Connected Work Zone Pilot
- Lane Reservation System
- DSRC/C-V2X Test Lab

PENNSYLVANIA

AUTOMATED VEHICLE SUMMIT

-2019-

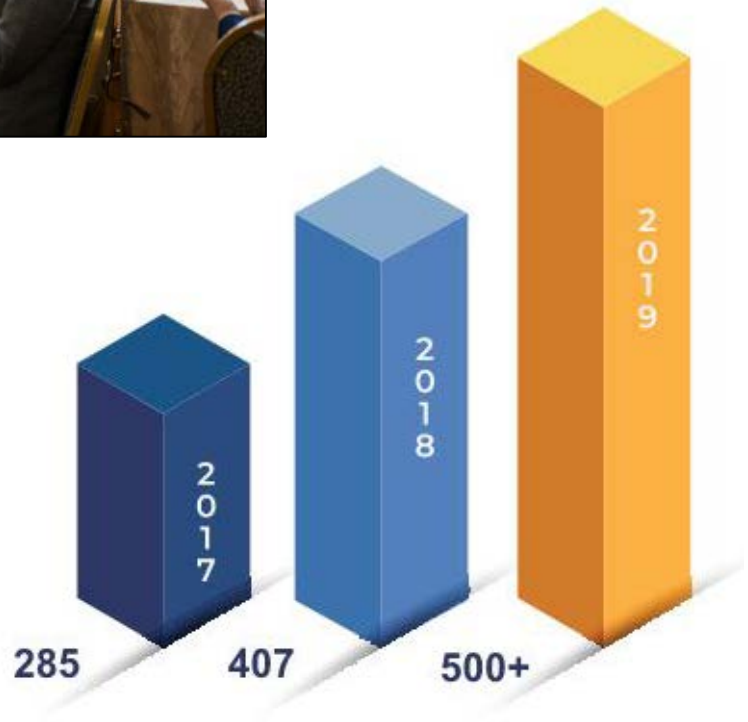
Sept. 4-6 • Pocono Manor, Pa.

www.PAAVSummit.org

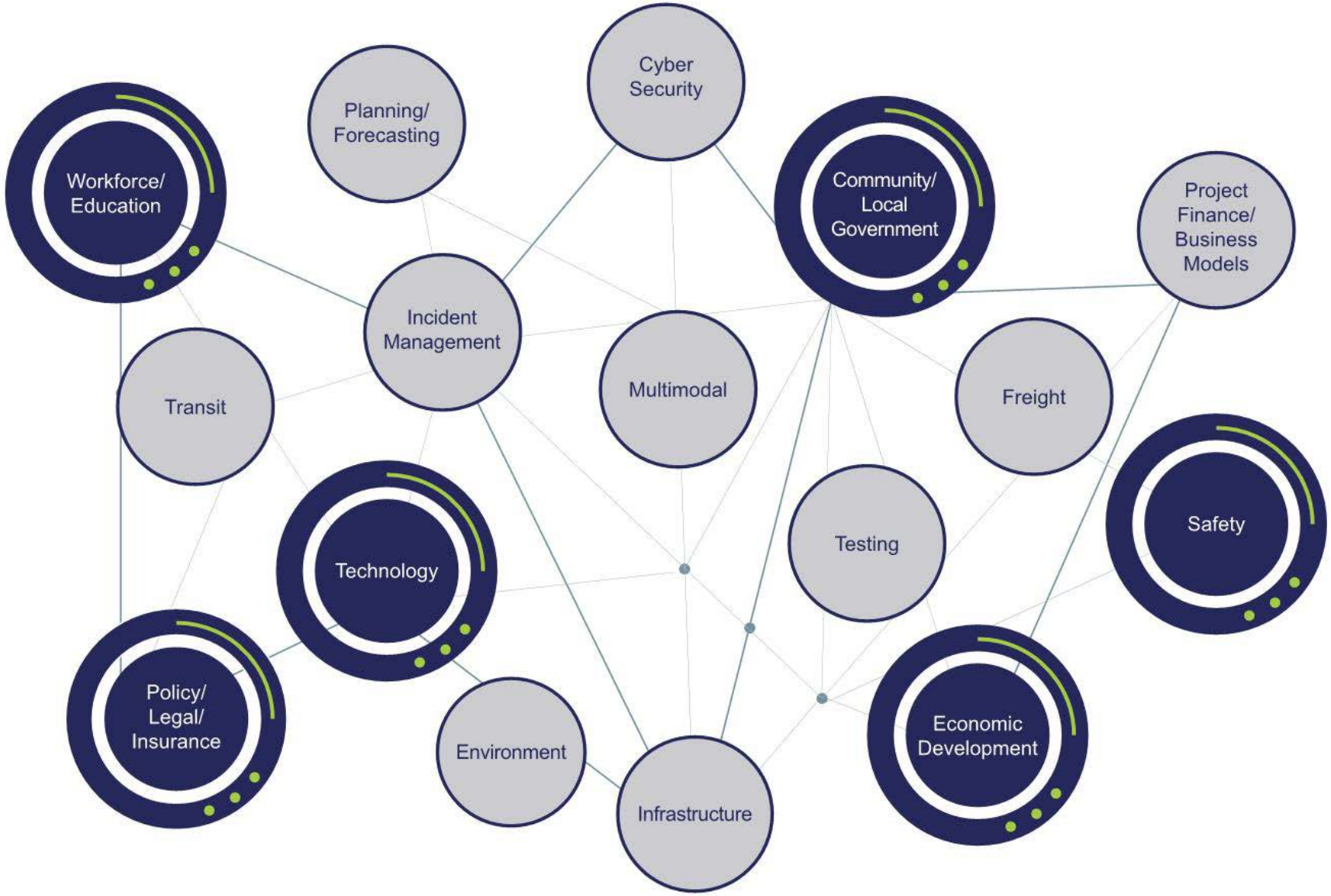
HOSTED BY: Intelligent Transportation Society ITS PENNSYLVANIA; masite THE BIRTHPLACE OF ITE

CONVENED BY: pennsylvania DEPARTMENT OF TRANSPORTATION; PENNA TURN PIKE; PA pennsylvania DEPARTMENT OF COMMUNITY AND ECONOMIC DEVELOPMENT

Attendance is Growing



Leading Industry Topics



Featured Speakers

PA AV Summit 2019

Robin Chase
Co-founder and former CEO
of Zipcar & Co-founder of Veniam

Dr. Erica Groshen
Senior Scholar at Cornell University
School of Industrial & Labor Relations

Mark Rosekind
Zoox Chief Safety Innovation Officer
& former Administrator for National
Highway Traffic Safety Administration

...and more

With the addition of:

Ed Mortimer

Vice President for Infrastructure & Transportation
at US Chamber of Commerce

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QUESTIONS?

“There are almost no limits in terms of what a car can become

- Bill Ford Jr