Preparing for the Future
Critical Issues in Vehicle Automation

2018 PAPA Bus Tour

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It's tough to make predictions, especially about the future.

-Yogi Berra
PREPARING for the FUTURE

- Designate a Champion(s)
- Stay Informed
- Understand the Implications
- Start Small & Work With Partners
- Develop a Plan
PREPARING for the FUTURE

Designate a Champion(s)

Stay Informed

Understand the Implications

Start Small & Work With Partners

Develop a Plan
AV Policy Task Force

Government:
- U.S. Department of Transportation
- Federal Highway Administration
- Pennsylvania State Police
- Pennsylvania Insurance Department
- Pennsylvania Department of Community & Economic Development
- Pennsylvania Turnpike
- City of Pittsburgh

Academia:
- Carnegie Mellon University
- Penn (University of Pennsylvania)
- Penn State

Advocacy:
- AAA
- American Trucking Associations
- Pennsylvania Motor Truck Association
- Pennsylvania Association of Fish and Game
- PennDOT

Industry:
- GM
- Uber
- Global Automakers
- SAE International
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Autonomous
Audi RS 7 piloted driving concept
Driver assistance systems
10/14

Front camera:
- Audi active lane assist
- ACC with Stop&Go function
- Speed limit display
- Audi pre sense / front / plus
- Audi adaptive light

Front radar sensors:
- ACC with Stop&Go function
- Audi pre sense / front / plus

Ultrasonic sensors at side:
- Park assist with display of surroundings

Front, rear and top-view cameras:
- Parking system plus with front and rear camera
- Park assist with front and rear camera

Ultrasonic sensors at rear:
- Parking system plus with front and rear camera
- Park assist with display of surroundings

Ultrasonic sensors at front:
- ACC with Stop&Go function
- Parking system plus with front and rear camera
- Park assist with display of surroundings

Infrared camera:
- Night vision assistant with highlighting of detected pedestrians

Rear radar sensors:
- Audi side assist
- Audi pre sense rear / plus

Crash sensors:
- Front protection adaptivity
- Side protection
- Rear impact protection
Challenges

- Difficulty of Detection
- Dynamic Environments
- Limited Information
Infrastructure Requirements

- Line Paint
- Retroreflectivity
- Asset Databases
- Pavement Condition
Connected Automated
Challenges

Communication Uncertainty

Mass Deployment of Infrastructure

Speed of Automation
Levels of Automation

<table>
<thead>
<tr>
<th>Level</th>
<th>Automation Type</th>
<th>Description</th>
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<tbody>
<tr>
<td>0</td>
<td>No Automation</td>
<td>Zero autonomy; the driver performs all driving tasks.</td>
</tr>
<tr>
<td>1</td>
<td>Driver Assistance</td>
<td>Vehicle is controlled by the driver, but some driving assist features may be included in the vehicle design.</td>
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<tr>
<td>2</td>
<td>Partial Automation</td>
<td>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.</td>
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<tr>
<td>3</td>
<td>Conditional Automation</td>
<td>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.</td>
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<td>4</td>
<td>High Automation</td>
<td>The vehicle is capable of performing all driving functions under certain conditions. The driver may have the option to control the vehicle.</td>
</tr>
<tr>
<td>5</td>
<td>Full Automation</td>
<td>The vehicle is capable of performing all driving functions under all conditions. The driver may have the option to control the vehicle.</td>
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</tbody>
</table>
National Groups

- AASHTO - STMSO TWG 5
- AAMVA - AV Best Practices
- V2I Deployment Coalition
- Pooled Fund Studies
- TRB & NC HRP
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The Need For HAVs

- **1,188** Roadway Fatalities in 2016
- **264m** Annual Hours of Delay
- **133m** Gallons of Fuel Wasted Annually
- **950k** Physically Disabled Citizens
- **769k** Licensed Drivers aged 75+
AVs in Pennsylvania

- Carnegie Mellon University
- Aurora
- Volvo
- Uber
- Royal Truck & Equipment, Inc.
- APTIV
- Argo AI

pennsylvania
DEPARTMENT OF TRANSPORTATION
Legislation
Preparing for the Future

Senate Bill 427 – General AV Testing
House Bill 1637 – Genera AV Operation

House Bill 1958 – Platooning / Autonomous Work Zone Vehicles
Senate Bill 1096 – Platooning / Autonomous Work Zone Vehicles

House Bill 2300 – Autonomous Shuttle
How Will Our Roads Change?

- Line Size
- Signage
- Traffic Volume
- Drop-off/Pick-up Locations
- Parking
Impacts on Pavement?
Work ZoneWarnings

Pattern

Speed Reduction

Work Zone Warning
Alerts the driver to use caution when travelling through a work zone.

Portable RSE

Driver Infrastructure Interface (DII) (static or dynamic sign)

Driver Vehicle Interface (DVI) Examples
Safety Alerts

Driver Alerts

Work Alerts

General Alerts
Autonomous TMAs
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Pennsylvania Deployments

**Current**
- Cranberry
  - 11 RSUs
- Ross Twp.
  - 11 RSUs
- Pittsburgh
  - Proving Grounds
  - 24 RSUs
  - Pittsburgh
    - 45 RSUs
    - 726 OBUs
- Smart Corridor
  - Proving Grounds

**Planned**
- Penn State Proving Grounds
- Autonomous Truck Mounted Attenuator Pilot
- CV Work Zone Pilot
- Harrisburg
  - 8 RSUs
- Philadelphia Region
  - 160 RSUs
Active Corridor Management Project

Rail Lines
Super Critical Corridors
U.S. Hwy / Interstates
SEPTA Active Parking Management Garage
Conshohocken Station

Pennsylvania Department of Transportation
Smart Belt Coalition

Attributes:
- 4 Distinct Seasons
- Urban & Rural Roadways
- Multi-jurisdictions

Priorities:
- Freight
- Work Zones
- Traffic Incident Mgmt.
AV Proving Grounds

Pennsylvania Proving Grounds

City of Pittsburgh
Penn State University
PennDOT
Carnegie Mellon

Selected January 2017

Multiple Facilities

City Streets
Closed Test Track
Interstate 99
PennSTART

Connected & Automated Vehicles
ITS/Signals/Tolling
Commercial Vehicles
Traffic Incident Management
Work Zones
Transit
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AV Testing Guidance

- Updated policies to strengthen testing safety
- Requesting (expecting) voluntary tester compliance pending legislation
- Calling on General Assembly to enact testing legislation to authorize PennDOT to oversee safe AV testing
- Met with testers and reconvening Task Force for feedback
- **Focus on Safety Driver**
PA Strategic Plan

THE STRATEGIC PLAN WILL FOCUS ON NINE AREAS:

- Maintenance and Operations
- Design and Construction
- Planning and Research
- Information Technology and Security
- Outreach and Collaboration
- Policy and Legal
- Modal Considerations
- Driver Licensing and Motor Vehicles

Living Document

Near-term and Long-term

45 Objectives

160+ Actionable Steps
Funding for Locals

Act 101 of 2016

Allows for the use of allocated funds, up to $40,000,000, for intelligent transportation system applications, such as autonomous and connected vehicle-related technology, in addition to other specified uses.
Preparing Infrastructure

Specifications

Traffic Signal Controllers

Policies/Standards

Fiber Policy

Standards on the Deployment of Infrastructure to Support Connected and Automated Vehicles
Public Outreach

Speaking Engagements
- Speaking Engagements in 2017:
  - Interviews: 23
  - Regional: 30
  - Statewide: 36
  - National: 14
  - International: 8

AV Demonstrations
- Legislature and key transportation officials
  - 50+ riders
  - Governor Tom Wolf
- 1 mile loop on public roads
- Broad media coverage

Pennsylvania HAV Summit
- 2nd Annual Summit - April ‘18
- 400+ Attendees
- Two Focus Areas
  - Local Governments
  - Workforce Development
Questions?

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