Module 9: Emerging Technologies
Session Purpose

• Introduce the concepts and state of Emerging Technologies

• Provide understanding of:
  • What are today’s Emerging Technologies?
  • Why are they important?
  • What are the benefits?
  • Examples of leadership actions
What are Today’s Emerging Technologies?

• Connected Automated Vehicles

• Smart Cities

• Mobility as a Service

• Big Data
What are Connected Vehicles?

- Wireless technology connecting vehicles to each other and to roadside infrastructure

- Connections may be
  - Vehicle-to-Vehicle (V2V)
  - Vehicle-to-Infrastructure (V2I)
  - Vehicle-to-Other (V2X)
Examples of Connected Vehicles Applications

- V2I Safety
  - Red light violation warning
  - Curve speed warning
  - Stop sign gap assist
  - Reduced speed zone warning
- V2V Safety
  - Forward collision warning
  - Left turn assist
  - Blind spot/lane change warning
- Road Weather
  - Motorist advisories and warnings
  - Enhanced decision support
- Mobility
  - Signal priority
  - Emergency vehicle pre-emption
  - Dynamic speed harmonization
  - Queue warning
What are Autonomous Vehicles?

- Automated vehicles use on-board sensors, cameras, global positioning, and telecommunications to help perform safety-critical driving functions such as steering, acceleration and braking - without direct driver input.
- Automated does not always mean self-driving.
### Levels of Vehicle Automation

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

**Here Today**

**Being Tested**
Merging into CAV Terminology

Autonomous Vehicle
Operates in isolation from other vehicles using internal sensors

Connected Vehicle
Communicates with nearby vehicles and infrastructure

Connected Automated Vehicle
Leverages autonomous and connected vehicle capabilities
Policy Issues Still Being Explored

• Privacy
• Cyber-Security
• Data ownership
• USDOT authority
  • NHTSA: Regulate safety equipment in vehicles
  • FHWA: Provide guidance on roadside infrastructure
• Driver and vehicle licensing
  • NHTSA distraction guidelines
• Market driven
  • 5G vs. DSRC
Discussion

• Are connected and autonomous vehicles operating in your region?

• What planning opportunities are there for CAV at your agency?

• Have you deployed, or considered deploying roadside infrastructure to support CAV?
What is a Smart City?

• Urbanized areas that use data and connectivity to improve mobility

• Common challenges to address
  • First/last-mile service for transit users
  • Goods movement efficiency
  • Coordinating data collection and dissemination across systems
  • Reducing inefficiency in parking systems and payment
  • Reducing carbon emissions
  • Optimizing traffic flow
Example Technologies from Smart City Challenge

- Autonomous vehicles for first and last-mile
- Dynamic curb parking reservation and space sensing to expedite freight loading and unloading
- Improved and expanded charging systems for electric vehicles
- Connected vehicles, bicyclists and pedestrians
- Unified data analytics platforms across modes to improve decision making
What is Mobility as a Service (MaaS)?

• A shift from personally-owned vehicles, toward transportation provided as a service

• Enhanced through better integration of modes
  • Use multiple modes to complete trips
  • Payments coordinated across modes
Examples of Mobility as a Service

- Ridesharing
- E-hailing
- Bike sharing
- Car sharing
- On-demand transit
- Scooters
What is Big Data?

• Use of data across modes and transportation sectors to perform analysis, make decisions and provide information to improve mobility

• New methods to collect, transmit, sort, store, share, aggregate, fuse, analyze, and apply these data will be needed for management and operations of transportation systems
Example Uses of Big Data

- Using data sets to perform complex simulations and identify congestion causes and mitigation
- Building comprehensive origin-destination models to identify potential alternatives for commuters
- Analyzing transit usage and passenger first and last-mile needs to adjust service
- Analyzing changes in transportation network to better understand impact on travelers
- Using real-time data to actively manage transportation systems
Why are Emerging Technologies Important?

• Auto industry is moving forward with CAV
  • Crash Avoidance Metrics Partnership (CAMP) with USDOT is developing V2V safety apps for connected vehicles

• There are private-sector autonomous vehicles on roadways already
  • EasyMile, Waymo (Google) and Uber
  • Audi claims to have Level 4 vehicles and Cadillac has Level 3
  • Tesla users operating in “autopilot” mode, but really just Level 3
    • Has had high profile crashes due to unsafe operation by owners
Why are Emerging Technologies Important?

• Smart Cities can provide integration between transportation network and other city elements
• Smart Cities can cost-effectively leverage existing data and systems to improve mobility
• Mobility as a Service is increasing in demand, especially among younger travelers
• Mobility as a Service may require changes in transportation infrastructure
  • Parking for shared cars
  • Facilities for changing modes during trips
What are the Benefits?

• Improved mobility and efficiency
  • Makes travel available to more people
  • Reduces costs related to vehicle ownership
  • Smoother traffic flow and coordination with traffic operations

• Improved safety
  • Crash avoidance
  • Better information about roads for drivers and vehicles
  • More awareness of interaction between vehicles, pedestrians and bicyclists
What are the Benefits?

• More efficient freight, transit and emergency vehicle operations
  • Better truck staging and flow in traffic
  • Improved signal priority for transit and emergency services

• Enhances existing data to perform more accurate analysis and real-time operations
Discussion

• What data do other agencies have that would benefit your operations?
• What data do you have that you can share with other agencies?
• What challenges do you anticipate your agency having in supporting Mobility as a Service?
Leadership Actions

• Engage in institutional collaborations
  • V2I Deployment Coalition – SPaT Challenge
  • Transportation Research Board

• Be aware of and engage in discussion of major policy issues
  • Policies regarding connected and autonomous vehicles
  • Data privacy concerns
  • Funding for emerging technologies versus traditional transportation strategies
Leadership Actions

• Take advantage of learning and training opportunities
  • National Highway Institute
  • USDOT Professional Capacity Building (Connected Vehicle 101 and 102)
• Learn how to plan, design and deploy
  • Understand integration with existing services
  • Understand impact to infrastructure
  • Learn the needs of your community
Resources

• Connected Vehicle Pilot Deployment Program
  • https://www.its.dot.gov/pilots/

• V2I Deployment Coalition
  • https://transportationops.org/V2I/V2I-overview

• USDOT Automated Vehicle Activities
  • https://www.transportation.gov/AV

• USDOT Smart City Challenge
  • https://www.transportation.gov/smartcity

• Transportation Research Board Innovative Mobility Services: Issues and Opportunities
  • http://www.trb.org/PolicyStudies/InnovativeUrbanMobilityServicesIssuesOpportunities.aspx

• USDOT Enterprise Data
  • https://www.its.dot.gov/research_areas.enterprise.htm