How Connectivity Supports Automated Vehicle Operations
Automated Vehicles Offer Transformative Safety Benefits for Transportation

5.6%
Increase in Fatalities from 2015 to 2016

94%
Percentage of Fatal Crashes Involving Human Choice or Error

Automated Vehicle Technologies Can Reduce Vehicle Crashes

Source: NHTSA
Automated Vehicles Could Have Significant Impacts on Mobility

INRIX Traffic Data 2016

- Total cost of congestion to all drivers in the U.S.: $300B
- Percentage of all driving time spent in congestion per driver: 9%
- Hours spent in congestion by the average U.S. commuter: 42
- Cost of congestion to the average U.S. driver: $1,400

INRIX US Traffic Hotspot Study 2017

- New York had more traffic hotspots than any other city, costing drivers $64 billion by 2026
- Los Angeles has 10 of the 25 worst traffic hotspots in America, costing L.A. drivers an estimated $91 billion over the next 10 years
- I-95 in Washington D.C. was the worst overall traffic hotspot, which caused 1,384 traffic jams, stretched 6.4 miles and lasted 33 minutes on average

The fast-rising VMT is making things worse
Automated Vehicles Introduce Both Potential Benefits and Challenges

Potential Benefits
- Reduction in vehicle crashes
- Improved mobility for elderly, disabled, & those unable to drive
- Improved convenience of travel

Potential Challenges
- Could lead to more or less efficient operations of the highway system
- Increases in VMT and congestion
- Land use implications, sprawl
Automated Vehicles Still Face Technical Challenges

Onboard sensors (e.g., cameras, lidar) are strictly line-of-sight
- AVs have difficulty detecting vehicles, objects or incidents far ahead, or hidden behind other objects
- AVs may not be able to execute crash avoidance maneuvers quickly enough, for example, at blind intersections, for sudden braking events several cars ahead in traffic, etc.

Accurate interpretation of sensor data may be challenging
- AVs may have degraded sensor performance due to weather conditions (e.g. fog, snow, heavy rain)
- AVs may not be able to interpret signage/signals (e.g. complex intersections, work zones)

Vehicles that cannot communicate cannot cooperate
- It is difficult for vehicles to cooperate with other vehicles based only on sensor detection
- AVs that are not able to cooperate effectively with each other – could cause increased congestion, less harmonized traffic flow, less efficient transportation system performance
What is Connectivity?

- **Vehicle-to-vehicle** and **vehicle-to-infrastructure** communications enable the vehicle to exchange data with nearby vehicles and roadside infrastructure.
- Different communications technologies (e.g. LTE, DSRC, Satellite) are utilized depending on the performance requirements of the applications.
Connectivity Offers Potential Solutions

More accurate signal phase and timing (SPaT) information from traffic signals

More accurate detection of nearby vehicles, pedestrians, objects

More cooperation between vehicles for smoother traffic flow

Connectivity Can Provide Additional Data

Non-Connected Automated Vehicles

Vehicle slowing 300 feet ahead.

Connected Automation

On-board sensors only collect data within their line-of-sight. Connectivity can extend upon and provide additional information.

Objected detected 2 miles ahead, traffic slowing.
Communication between vehicles or between vehicles and the infrastructure could simplify interactions where human deduction is currently used.

Automated Vehicles That Communicate Can Cooperate

You first!

Thanks!

When can we go?
Connectivity Enables Cooperative Automation

Cooperative Automation
• Uses vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) connectivity.
• Enhances the safety and efficiency of Automated Driving Systems.
• Provides greater situational awareness and efficiency.
Examples of Cooperative Automation

- Cooperative Automated Light Vehicle and Truck Platooning
- Signalized Intersection Approach and Departure
- Automated Traffic Flow Optimization
- Lane Change/Merge Operations
Light Vehicle and Truck Platooning Application

- Platoons can operate cooperatively on highways to increase efficiency and smooth traffic flow
- Reduced drag improves fuel efficiency
Signalized Intersection Approach and Departure

- Allows vehicles to approach and depart an intersection in an coordinated manner
- Increases efficiency and decreases fuel consumption by enabling V2I communications with intersections on the roadway.
- Signalized Intersection Approach & Departure project results:
  - 22% fuel economy improvement with partial automation
  - Time saved from reducing start-up loss

Full Video
https://www.youtube.com/watch?v=l753gGLJAcg
Lane Change/Merge and Freeway Merge Applications

- Involves negotiation with nearby vehicles to create a gap for safe merging.
- Can improve highway operations and smooth traffic flow
Automated vehicles will need connected vehicle technology

Cooperative Automation

Connectivity
Situational Awareness
Multi-Sensor Integration
Cybersecurity
Interoperability
For More Information:

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