Vehicular Applications and 5G

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Connectivity

- 1980: Radio Data System
- 1990: Telematics (e.g. OnStar)
- 2000: Cellular Internet Access
- 2010: WiFi Hotspot + LTE
- 2020: Dedicated Short Range Communications

Areas:
- Wide Area
- Internal Area
- Local Area
## Connected Vehicle Applications

### V2I Safety
- Red Light Violation Warning
- Curve Speed Warning
- Stop Sign Gap Assist
- Spot Weather Impact Warning
- Reduced Speed/Work Zone Warning
- Pedestrian in Signalized Crosswalk Warning (Transit)

### V2V Safety
- Emergency Electronic Brake Lights (EEBL)
- Forward Collision Warning (FCW)
- Intersection Movement Assist (IMA)
- Left Turn Assist (LTA)
- Blind Spot/Lane Change Warning (BSW/LCW)
- Do Not Pass Warning (DNPW)
- Vehicle Turning Right in Front of Bus Warning (Transit)

### Agency Data
- Probe-based Pavement Maintenance
- Probe-enabled Traffic Monitoring
- Vehicle Classification-based Traffic Studies
- CV-enabled Turning Movement & Intersection Analysis
- CV-enabled Origin-Destination Studies
- Work Zone Traveler Information

### Environment
- Eco-Approach and Departure at Signalized Intersections
- Eco-Traffic Signal Timing
- Eco-Traffic Signal Priority
- Connected Eco-Driving
- Wireless Inductive/Resonance Charging
- Eco-Lanes Management
- Eco-Speed Harmonization
- Eco-Cooperative Adaptive Cruise Control
- Eco-Ramp Metering
- Low Emissions Zone Management
- AFV Charging / Fueling Information
- Eco-Smart Parking
- Dynamic Eco-Routing (light vehicle, transit, freight)
- Eco-ICM Decision Support System

### Mobility
- Advanced Traveler Information System
- Intelligent Traffic Signal System (I-SIG)
- Signal Priority (transit, freight)
- Mobile Accessible Pedestrian Signal System (PED-SIG)
- Emergency Vehicle Preemption (PREEMPT)
- Dynamic Speed Harmonization (SPD-HARM)
- Queue Warning (Q-WARN)
- Cooperative Adaptive Cruise Control (CACC)
- Incident Scene Pre-Arrival Staging
- Guidance for Emergency Responders (RESP-STG)
- Incident Scene Work Zone Alerts for Drivers and Workers (INC-ZONE)
- Emergency Communications and Evacuation (EVAC)
- Connection Protection (T-CONNECT)
- Dynamic Transit Operations (T-DISP)
- Dynamic Ridesharing (D-RIDE)
- Freight-Specific Dynamic Travel Planning and Performance
- Drayage Optimization

### Smart Roadside
- Wireless Inspection
- Smart Truck Parking

Source: US Department of Transportation
Connectivity Opportunities and Challenges

Entertainment and Productivity

Safety and Efficiency

Road Sensing
Vehicle Communications

Private Carmaker Cloud

[Diagram of vehicles and cloud connections]

Private Carmaker Cloud
The Automotive Infoverse: Towards Real-time Road Scene Tracking
The Automotive Infoverse

- Design software that permits the rapid development of apps using the infoverse.
- Processing the infoverse to explore how to derive important factors that affect PERCS goals.
- Exploring methods to generate feedback that characterize how these factors affect the specific PERCS goal.
- Develop methods for assuring the quality of data in the automotive infoverse

Aggregating traces of in-built sensor data to create an Information Universe

- Vehicular Context Sensing
- Infrastructure Sensing
- Localization
Mobile Safety Services: Wearable Driver and Car monitoring

- Can wearable devices’ inertial sensors be used to detect driver actions and improve safety?

- Can such devices detect driving?
V2X: Direct Vehicle-2-Everything Connectivity
Connectivity and Safety: Extending the Sensing Range and Active Coordination

Forward Collision Warning (FCW)

Left Turn Assist (LTA)

Intersection Movement Assist (IMA)
Scalability Testing – USDOT/CAMP VSC3

- 200 DSRC equipped vehicles transmitting BSMs
- Conducted on testing grounds with vehicles arranged / driven to model typical and extreme scenarios
Pedestrian Safety Services

- Can devices detect when walk off from a sidewalk into the street?
- Profiles the surface gradient using shoe mounted inertial sensors
- Uses the ground profiles to detect transitions from sidewalk to street via ramps and curbs

New York City
Ramp Transition Patterns
Thank you

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