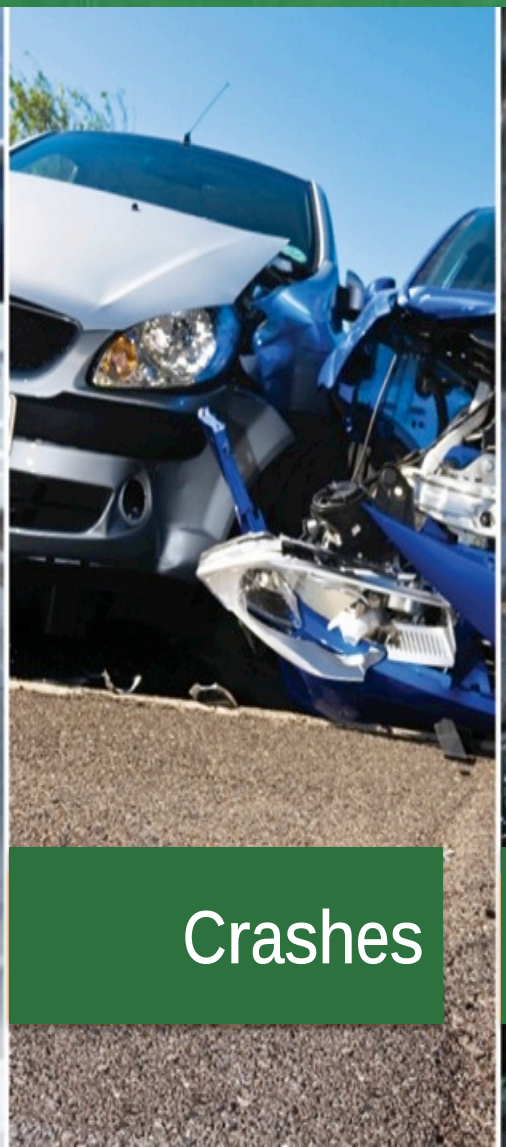
Connected Vehicles 101



Connected vs. Automated Cars

The driver is the difference

Connecting

- Cars that “talk”
- Cars that “listen”
- *Driver still operates*

Automating

- Transmission
- Cruise control
- Windshield wipers
- Parallel Parking
- …
- Self-Driving Cars

Photo Source: Thinkstock and Wikimedia Commons

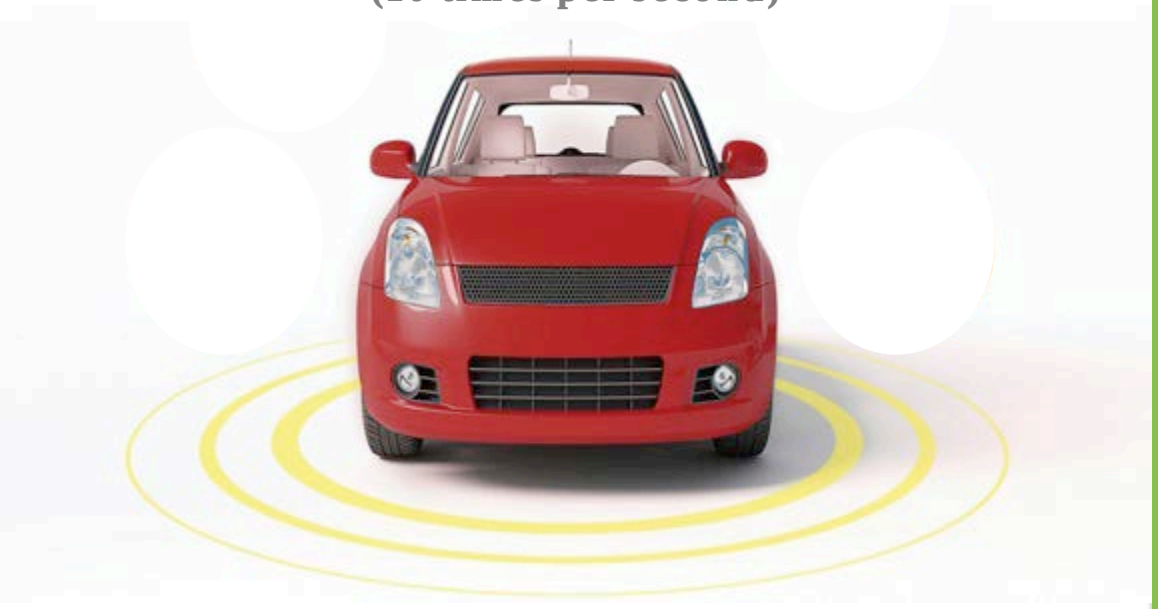
Connected vehicles can help.

They use wireless communication between vehicles and infrastructure to help prevent crashes, make travel easier, and curb pollution.

Photo Source: Thinkstock

All vehicles, regardless of type, will communicate with each other using a wireless technology called Dedicated Short-Range Communications (DSRC).

J2735 Basic Safety Message
(10 times per second)

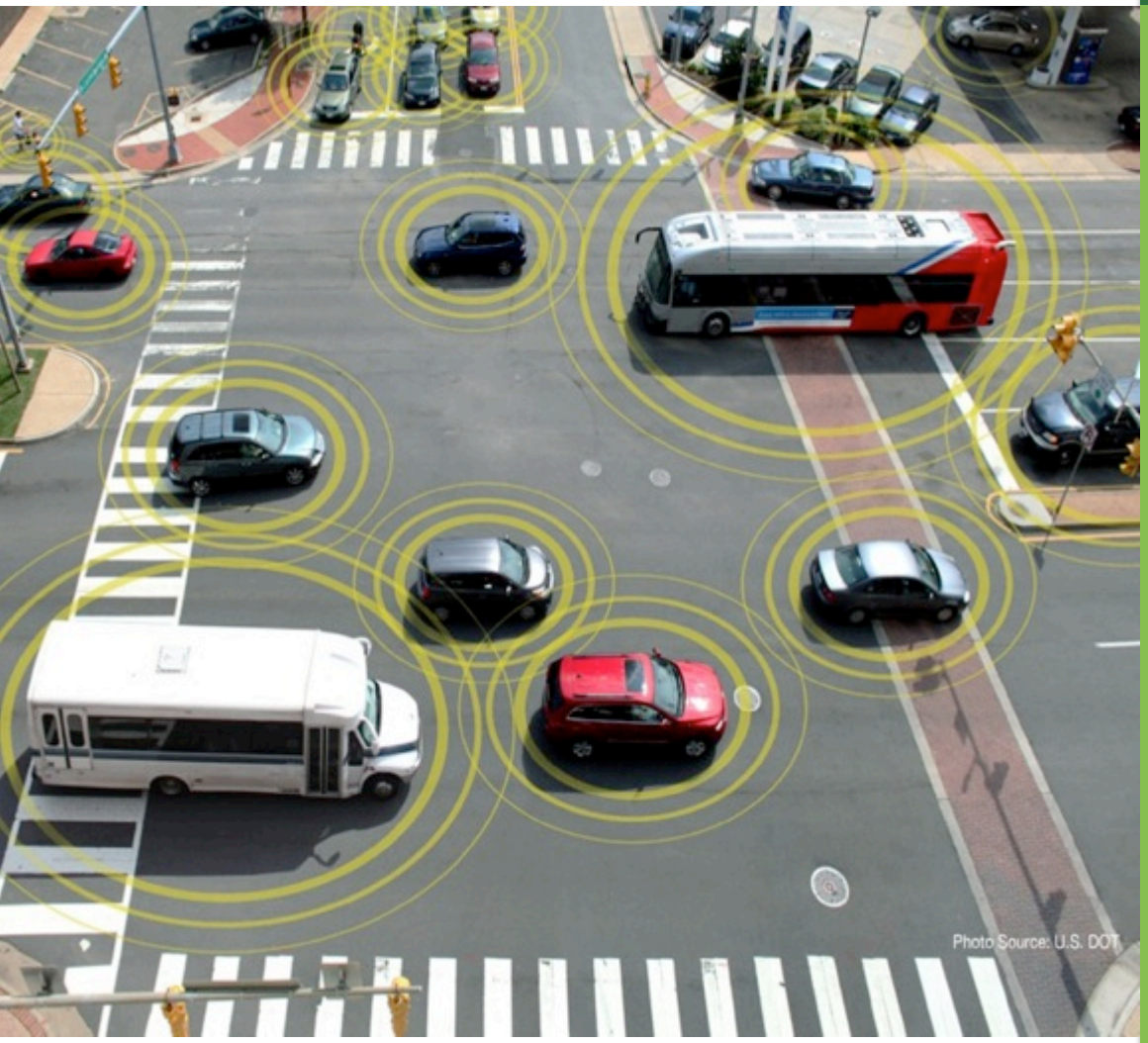


Basic Safety Message	
Temporary ID	Speed
Time	Heading
Latitude	Acceleration
Longitude	Brake System Status
Elevation	Vehicle Size

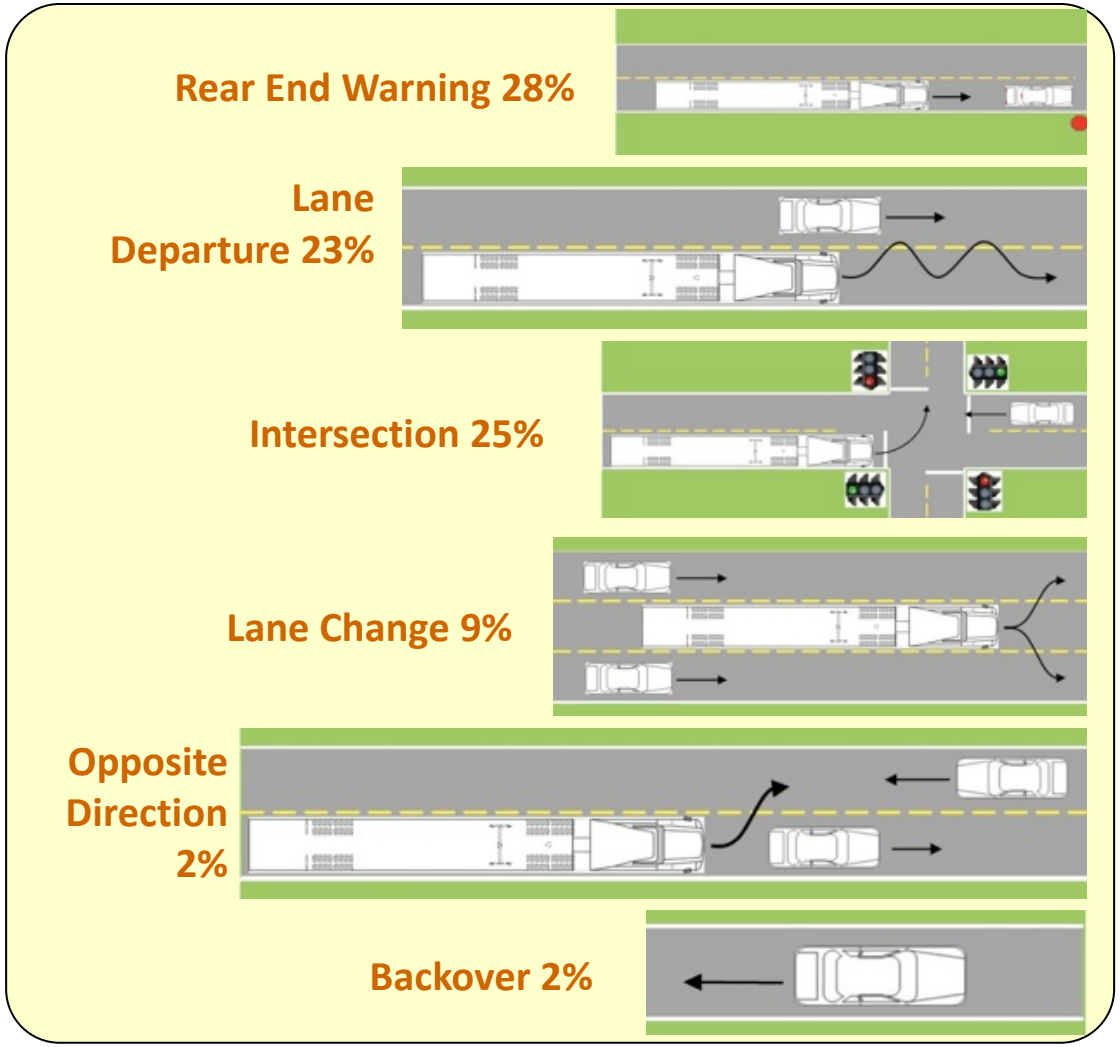
NHTSA has initiated rulemaking to require all new passenger cars and light duty trucks to include DSRC.

Not all connected vehicle communications have the same requirements.

Cellular and WiFi communications might also be effective for less frequent messages or non safety critical applications.



Connected vehicles have the potential to address up to 81% of unimpaired crash scenarios.



Connected vehicles have the potential to address up to 81% of unimpaired crash scenarios.

Connected vehicles will provide drivers with warnings to help them avoid crashes.

Trucks, transit, and emergency vehicles are connected vehicles too.

The vehicle information communicated does not identify the driver or vehicle, and technical controls have been put in place to help prevent vehicle tracking and tampering with the system.

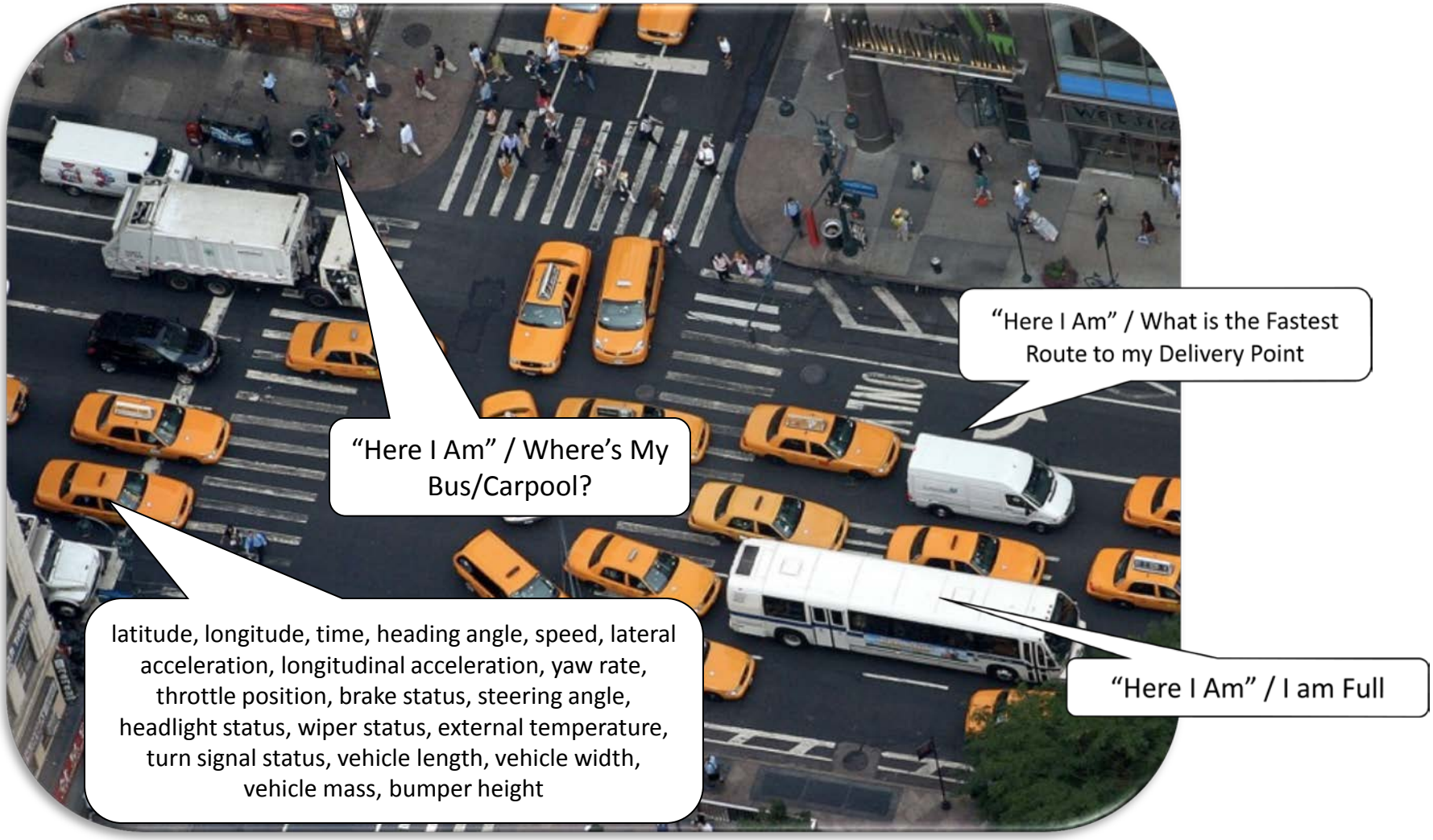
Imagine if the cars in front of you could send you information about dangerous road conditions ahead, such as icy roads, fog, heavy rain, and snow.

Imagine your car informing you of available parking on the next block, your cell phone telling you a cab is approaching, or your car helping you find a rideshare partner.

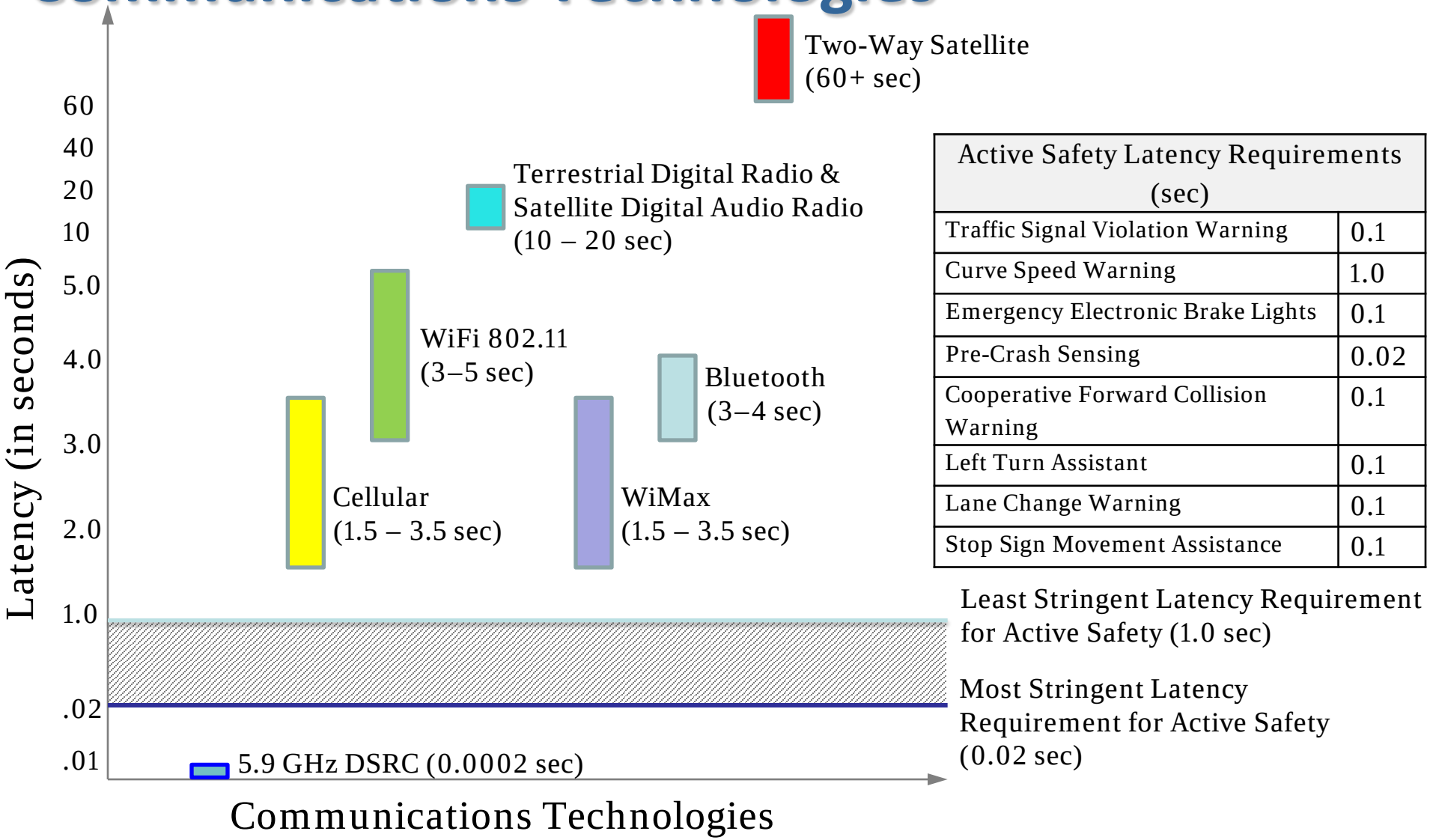
Consider the ways in which increased travel information can help the environment. *Connected vehicles can help.*

http://www.youtube.com/watch?v=Zuf2VNWGMnY

Connected Vehicles and Travelers

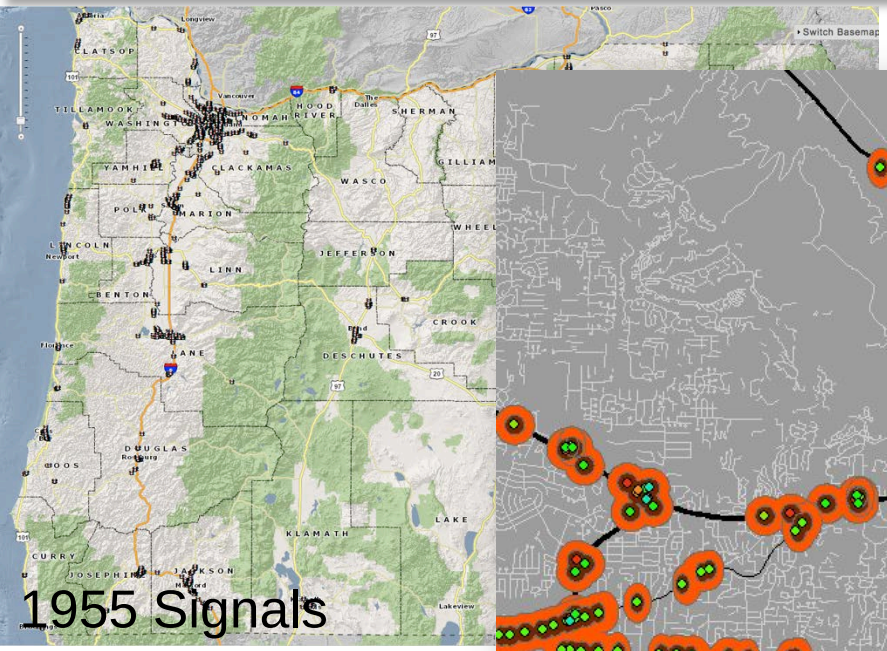


Communications Technologies

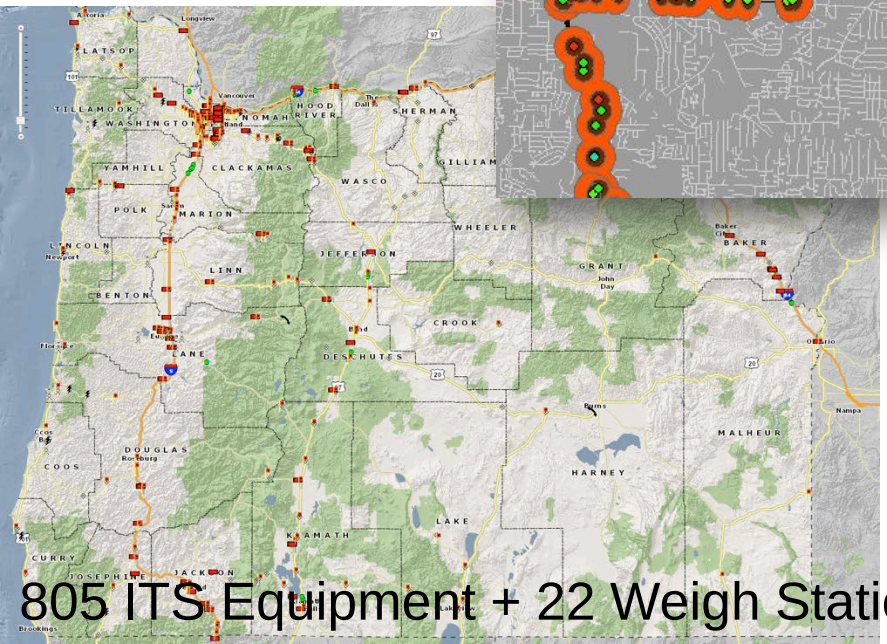


Active Safety Latency Requirements (sec)	
Traffic Signal Violation Warning	0.1
Curve Speed Warning	1.0
Emergency Electronic Brake Lights	0.1
Pre-Crash Sensing	0.02
Cooperative Forward Collision Warning	0.1
Left Turn Assistant	0.1
Lane Change Warning	0.1
Stop Sign Movement Assistance	0.1

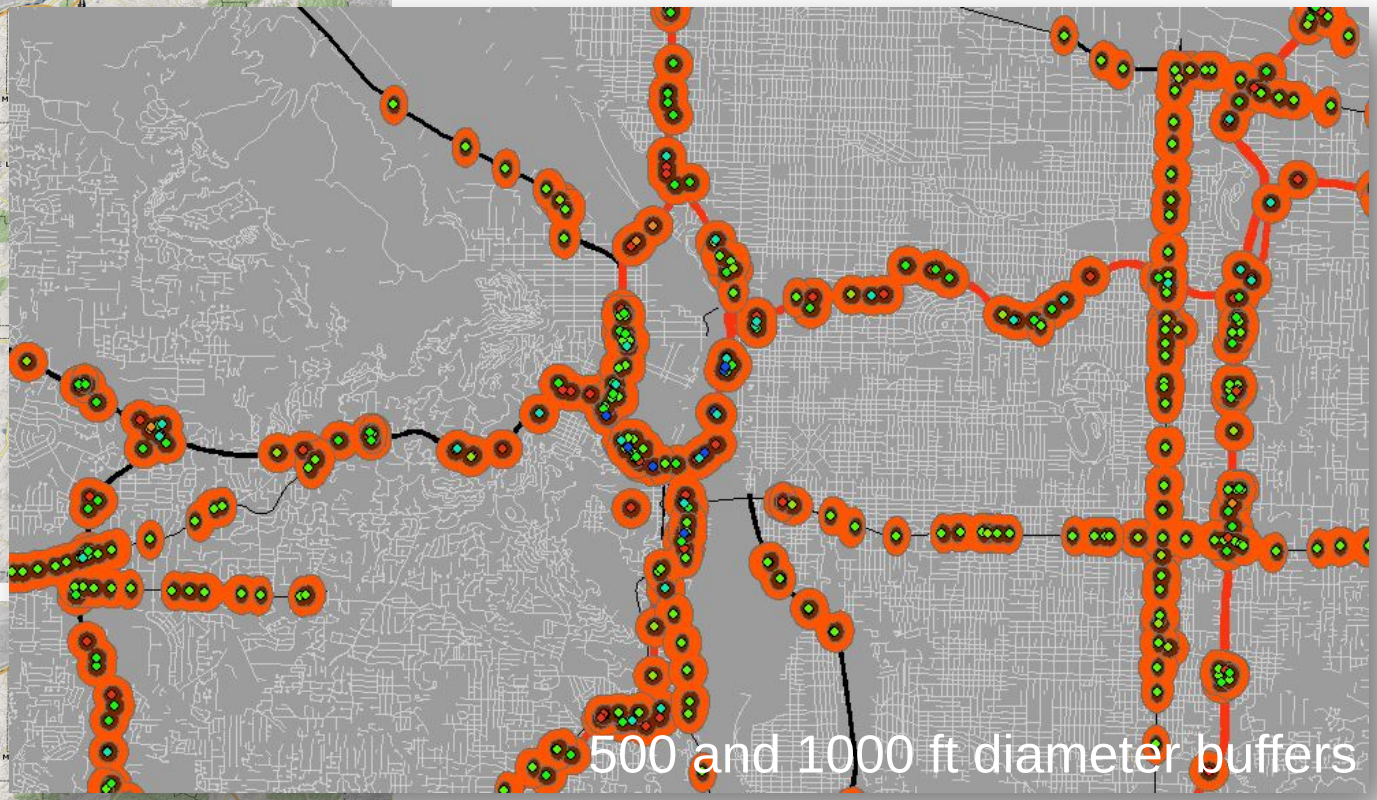
Note: *y*-axis not to scale for illustration purposes
Data source: Vehicle Safety Communications Project – Final Report



1955 Signals



805 ITS Equipment + 22 Weigh Stations



500 and 1000 ft diameter buffers

10% of road network and 40% of VMT are within 1000 feet of ODOT traffic devices.

Connected Vehicle Applications (Use Cases)

- As with smartphones, an application here is the use of software to perform a certain function.
  - "A car up ahead has stopped to turn left."
  - "Reduce speed to 25 for the curve ahead."
  - "An emergency vehicle is approaching from the left."
  - "The light will be red for 42 seconds."
  - "Optimal progress speed is 21 mph."
- Some applications link vehicles to each other; others link vehicles to the infrastructure.
- Applications offer diverse benefits and have varying degrees of viability

Connected Vehicle Applications

V2I Safety

Signal Phase & Timing (SPAT)
Red Light Violation/Driver Gap Warning
Curve Speed Warning
Stop Sign Violation/Gap Assist
Spot Weather Impact Warning
Pedestrian Warning
Railroad Crossing Warning
Disabled/Oversized Vehicle Warning

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

Agency Data

Probe-based Pavement Maintenance
Probe-enabled Traffic Monitoring
Vehicle Classification Traffic Studies
CV-enabled Performance Measures
CV-enabled Turning/Intersection Analysis
CV-enabled O-D Studies
Work Zone Traveler Information

Environment

Eco-Approach/Departure 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-Traveler Information
Eco-Ramp Metering
Low Emissions Zone Management
AFV Charging/Fueling Information
Eco-Smart Parking
Dynamic Eco-Routing
Eco-ICM Decision Support System
Dynamic Emissions Pricing

Road Weather

Motorist Advisories & Warnings (MAW)
Enhanced Maintenance Decision Support
Vehicle Data Translator
Weather Response Traffic Info (WxTINFO)

Fee Payment

Tolling
High Occupancy Toll Lanes
Congestion Pricing

Mobility

Advanced Traveler Information System (EnableATIS)

Multimodal Intelligent Traffic Signal (MMITSS)
- Intelligent Traffic Signal System (I-SIG)
- Signal Priority (Transit & Freight)
- Mobile Accessible Pedestrian Signal (PED-SIG)
- Emergency Vehicle Preemption (PREEMPT)

Intelligent Network Flow Optimization (INFLO)
- Dynamic Speed Harmonization (SPD-HARM)
- Queue Warning (Q-WARN)
- Cooperative Adaptive Cruise Control (CACC)
- Next Generation Ramp Metering (RAMP)

Response, Incident, Emergency (RESCUME)
- Incident Guidance Emergency Response (RESP-STG)
- Incident Scene Work Zone Alerts (INC-ZONE)
- Emergency Communications/Evacuation (EVAC)

Integrated Dynamic Transit Operations (IDTO)
- Connection Protection (T-CONNECT)
- Dynamic Transit Operations (T-DISP)
- Dynamic Ridesharing (D-RIDE)

Freight Advanced Traveler Information (FRATIS)
- Freight Dynamic Travel Planning & Performance
- Drayage Optimization

Smart Roadside

Wireless Inspection
Smart Truck Parking

What Apps Suit Oregon?

V2I Safety

Signal Phase & Timing (SPAT)
Curve Speed Warning
Spot Weather Impact Warning
Railroad Crossing Warning
Disabled/Oversized Vehicle Warning

V2V Safety

Agency Data

Probe-based Pavement Maintenance
Probe-enabled Traffic Monitoring
CV-enabled Performance Measures
Work Zone Traveler Information

Environment

AFV Charging/Fueling Information
Eco-ICM Decision Support System

Road Weather

Motorist Advisories & Warnings (MAW)
Enhanced Maintenance Decision Support

Fee Payment

Tolling
High Occupancy Toll Lanes
Congestion Pricing

Mobility

Advanced Traveler Information System (EnableATIS)
Intelligent Network Flow Optimization (INFLO)
- Dynamic Speed Harmonization (SPD-HARM)
- Queue Warning (Q-WARN)
- Next Generation Ramp Metering (RAMP)

Response, Incident, Emergency (RESCUME)
- Incident Guidance Emergency Response (RESP-STG)
- Incident Scene Work Zone Alerts (INC-ZONE)
- Emergency Communications/Evacuation (EVAC)

Freight Advanced Traveler Information (FRATIS)
- Freight Dynamic Travel Planning & Performance

Smart Roadside

Wireless Inspection
Smart Truck Parking

What Apps Suit Oregon?

Enterprise Data Driven Improvement

- Probe-based Pavement Maintenance
- Probe-enabled Traffic Monitoring
- CV-enabled Performance Measures
- Work Zone Traveler Information

Enabled Corridors and Segments

- Advanced Traveler Information System (EnableATIS)
- ICM Decision Support System
- Dynamic Speed Harmonization (SPD-HARM)
- Queue Warning (Q-WARN)
- Next Generation Ramp Metering (RAMP)
- Freight Dynamic Travel Planning & Performance

Fee Payment

- Road User Charging
- Tolling/HOT Lanes/Congestion Pricing

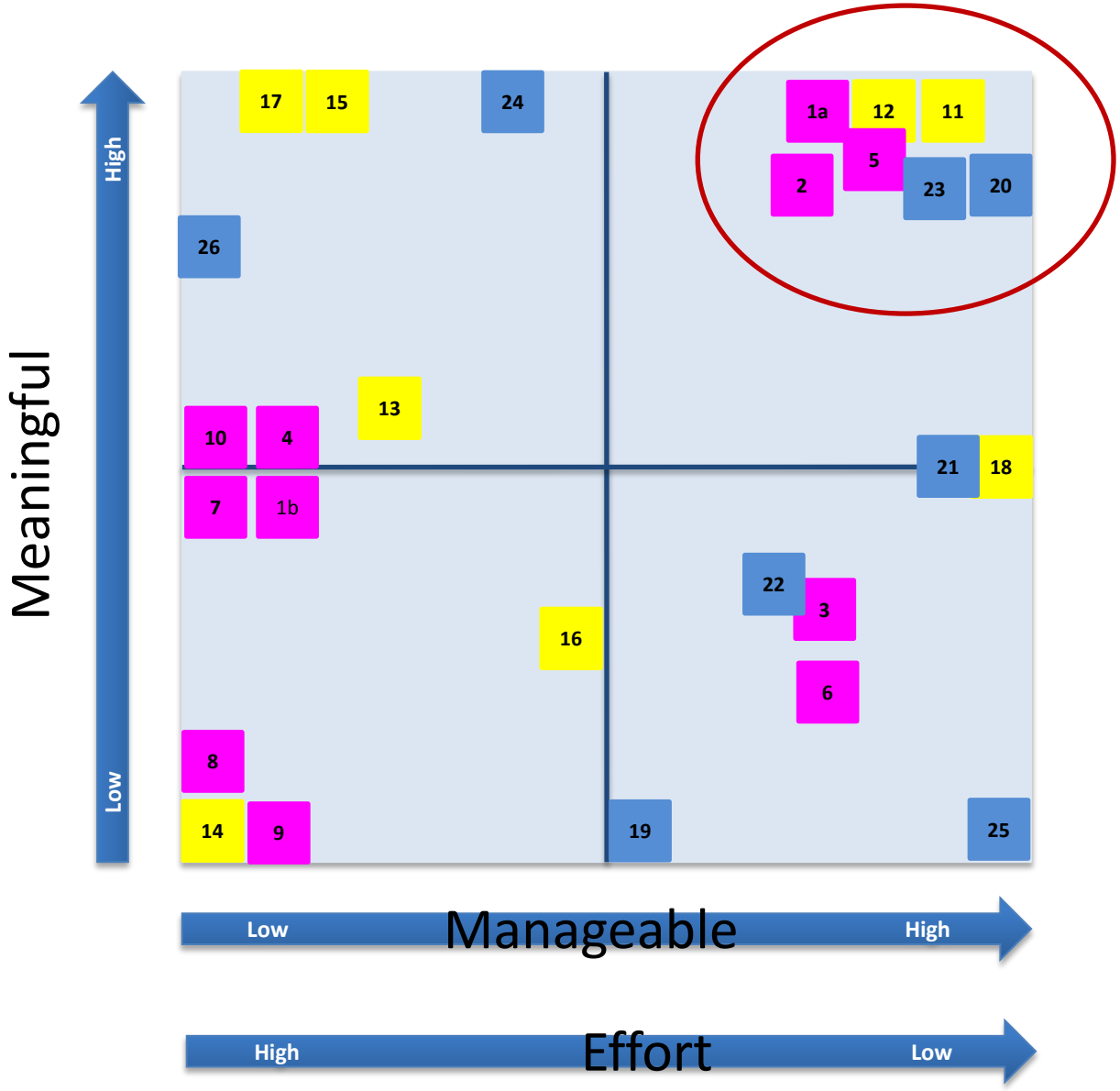
Equipped Roadside Nodes

- Signal Phase & Timing (SPAT)
- Curve Speed Warning
- Spot Weather Impact Warning
- Railroad Crossing Warning
- Disabled/Oversized Vehicle Warning
- AFV Charging/Fueling Information
- Wireless Inspection
- Smart Truck Parking

Enhanced Operations and Responsiveness

- Motorist Advisories & Warnings (MAW)
- Enhanced Maintenance Decision Support
- Incident Guidance Emergency Response (RESP-STG)
- Incident Scene Work Zone Alerts (INC-ZONE)
- Emergency Communications/Evacuation (EVAC)

April 13th C.V. Workshop Triage



Group 1

Group 2

Group 3

CV Applications (4/13 Workshop Triage)

- Advanced Traveler Information System (Enable/ATIS) Deliver
- Dynamic Speed Harmonization (SPO-HARM)
- Freight Dynamic Travel Planning & Response
- Signal Phase and Timing (SPAT)
- Curve Speed Warning
- Probe-enabled Traffic Monitoring
- Motorist Advisories & Warnings (MAW)

Intermodal Oregon: CAV Initiative

- Increase understanding of connected and autonomous vehicles across the agency
- Identify ways in which ODOT should be active (or passive) regarding connected vehicle developments
- Lay a foundation for considering possible impacts of vehicle automation

Thank You! Questions/Discussion

Jon Makler, Region 1 Principal Planner, 503-731-4753