Working
NATIONAL ^SUMMIT ON
TRANSPORTATION IN RURAL AMERICA

National Center for Rural Road Safety

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Addressing Rural Challenges: Technology and Connected Vehicles

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UDOT
Keeping Utah Moving

CHALLENGES WE FACE

- Congestion
- Safety
- Travel and Transit Reliability
- Expanded Traveler Information
- Truck Parking (I-15 / I-80 / I-70)
- Managing Freight Movements
- Winter Inversion / Poor Air Quality
- Specific Road Weather Information
- Reliable / Real-time Construction Information

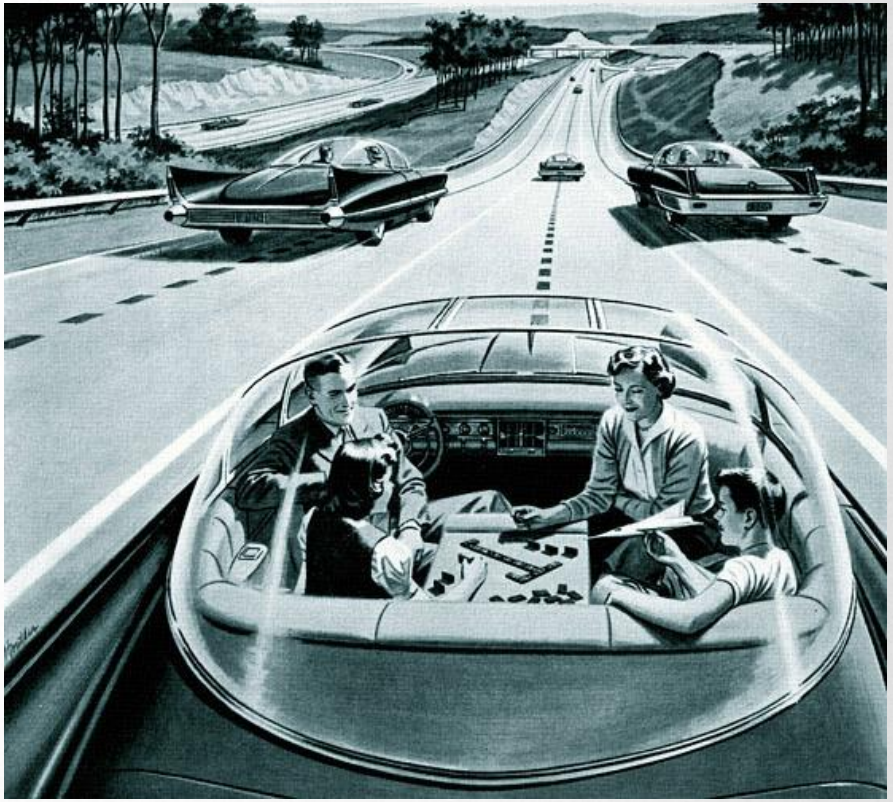
CONNECTED VEHICLE TECHNOLOGY CAN HELP US

OVERVIEW

- New Technologies:
  - Automated vs. Connected Vehicles
  - What is Happening, and Where?
- Connected Vehicle Applications
  - Early Applications
  - Rural Applications
- Tools and Resources

AUTOMATED VEHICLES

Electricity may be the driver. One day your car may speed along an electric super-highway, its speed and steering automatically controlled by



AUTOMATED VEHICLES

- Automated Features:
  - LiDAR
  - Digital Imagery
  - Radar
  - GPS
- Open Road Testing in:
  - Mountain View CA, Phoenix, Austin, Kirkland WA
  - 1.5 million self-driving miles

VEHICLE AUTOMATION

THE TRANSITION BETWEEN PARTIALLY AND HIGHLY AUTOMATED DRIVING REPRESENTS A MAJOR STEP.

The Ultimate Driving Machine®

STEP CHANGE

Driver only	Assisted	Partially automated	Highly automated	Fully automated
Driver performs longitudinal **AND** lateral control at all times.	Driver performs longitudinal **OR** lateral control at all times.	Driver must actively monitor the system at all times.	Driver no longer needs to actively monitor the system.	Longitudinal and lateral control tasks are performed entirely by the vehicle, within specific applications. The driver does not need to monitor the system.
 e.g. Speed Limit Info	 e.g. Parking Assistant	 e.g. Traffic Jam Assistant	Longitudinal and lateral control tasks are performed by the vehicle (for a certain period of time and/or in specific situations).	
No actuated assistance systems.	The other (longitudinal or lateral) control task is performed by the vehicle.	Longitudinal and lateral control tasks are performed by the vehicle (for a certain period of time and/or in specific situations).		

Regulated by law and introduced into the market.

Not regulated by law and under research.

(Source: BASt Working Group 2012)

EXISTING AUTOMATED APPLICATIONS

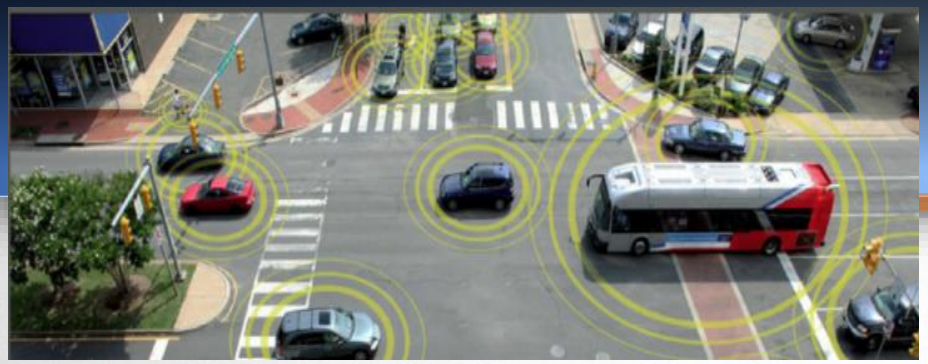
- Lane Departure Warnings / “Lane Assist”
- Adaptive Cruise Control
  - Freeway Driving: automated braking, acceleration, lane change
- Collision Warning
- Automated braking
- Unoccupied self parking

“By the time we get to the autonomous vehicle,

it won’t be that big of a deal”

- Bill Ford,

Executive Chairman, Ford Motor Co

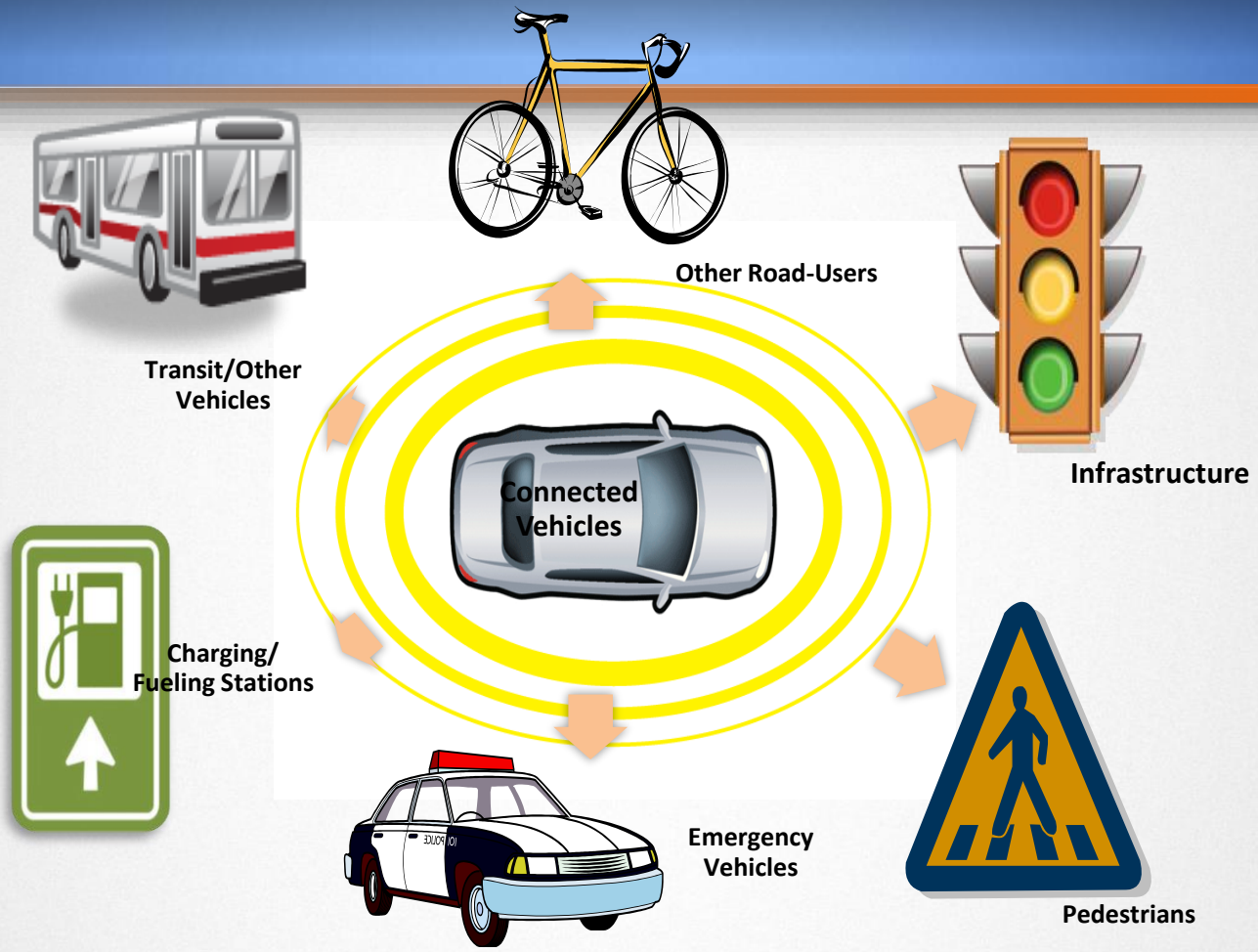


CONNECTED VEHICLES

- The Connected Vehicle system will combine technologies:
  - advanced roadside infrastructure,
  - wireless communications,
  - advanced vehicle sensors,
  - onboard computer processing, and
- – to provide vehicles the capability to detect threats and hazards on the roadway and to communicate this to the driver through alerts and warnings.

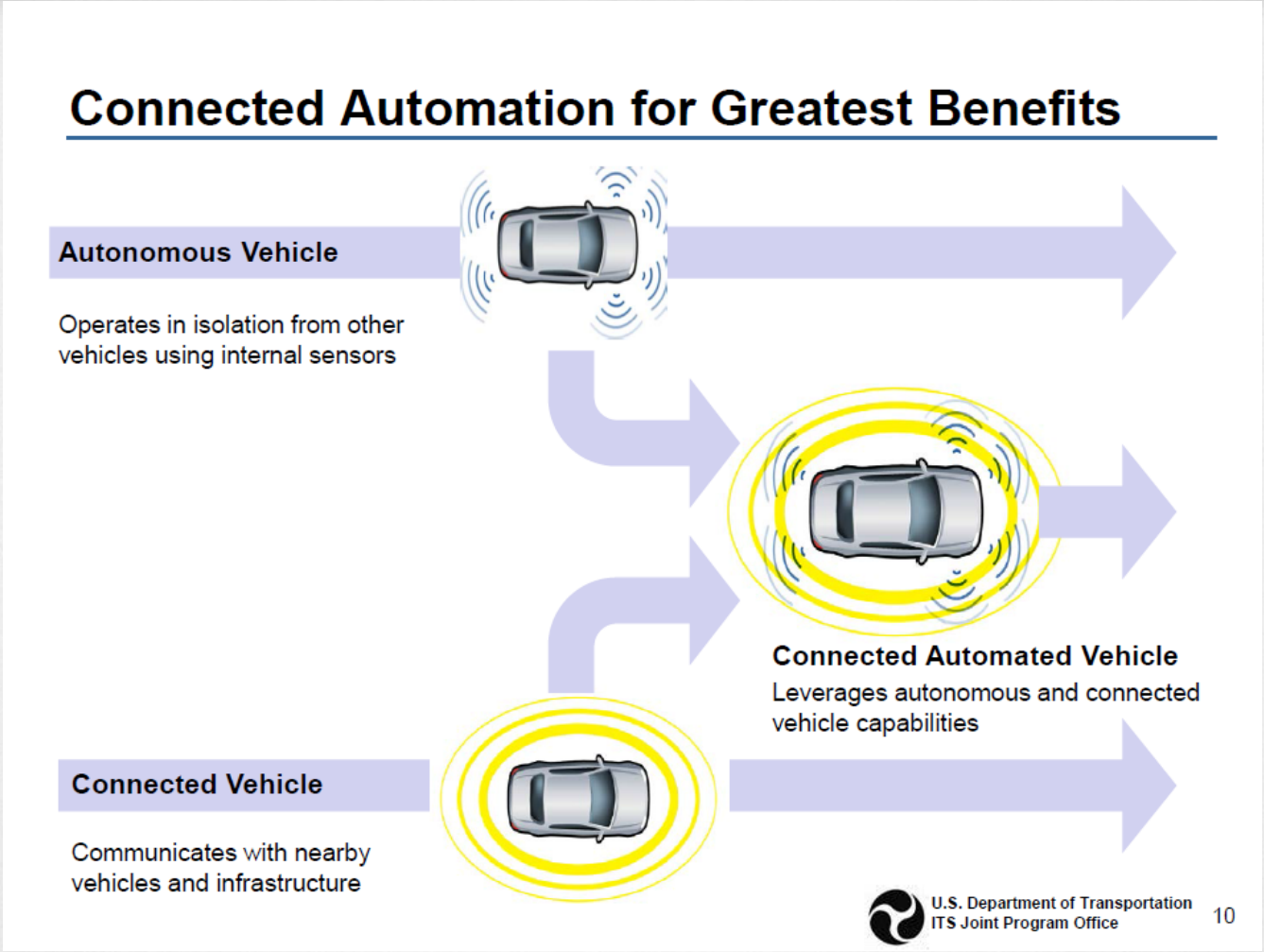
5.9 GHz DSRC Radio

CONNECTED VEHICLES



Could potentially address up to 80% of non-impaired driver crash scenarios

CONNECTED AUTOMATION



WHEN WILL THESE CHANGES TAKE PLACE?

- Today – Automated features on many new cars
- 2017 – GM to have DSRC on luxury models
- 2020 – Google / Ford driverless car available
- 2020 – DSRC on all new light vehicles
- 2020 – Highly automated car available (BMW)
- 2025 – Fully automated car available (Bosch)
- 2035 – Most cars will have DSRC on board

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)

Road Weather

- Motorist Advisories and Warnings (MAW)
- Enhanced MDSS
- Vehicle Data Translator (VDT)
- Weather Response Traffic Information (WxTINFO)

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-Traveler Information
- 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

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

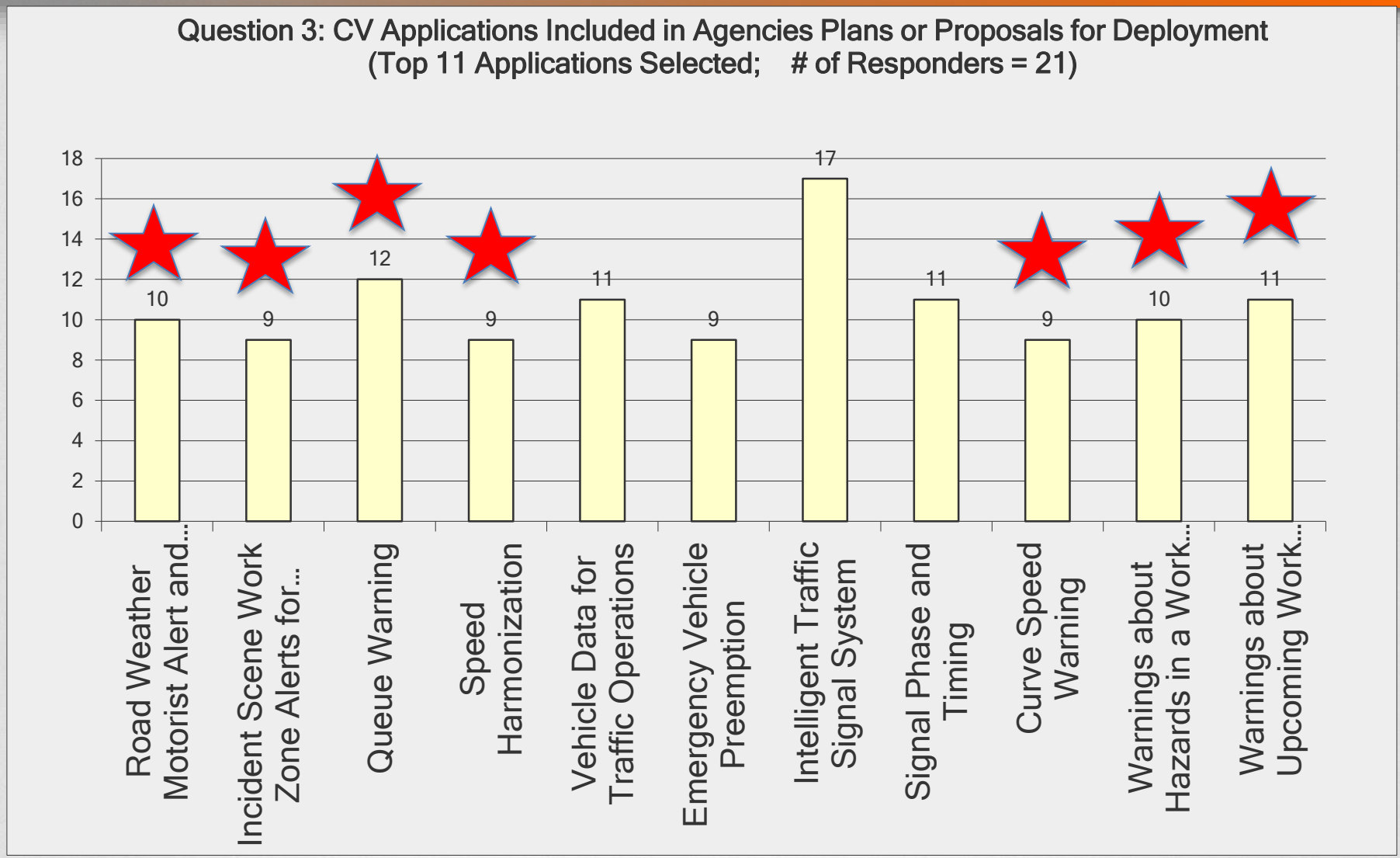
Mobility

- 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

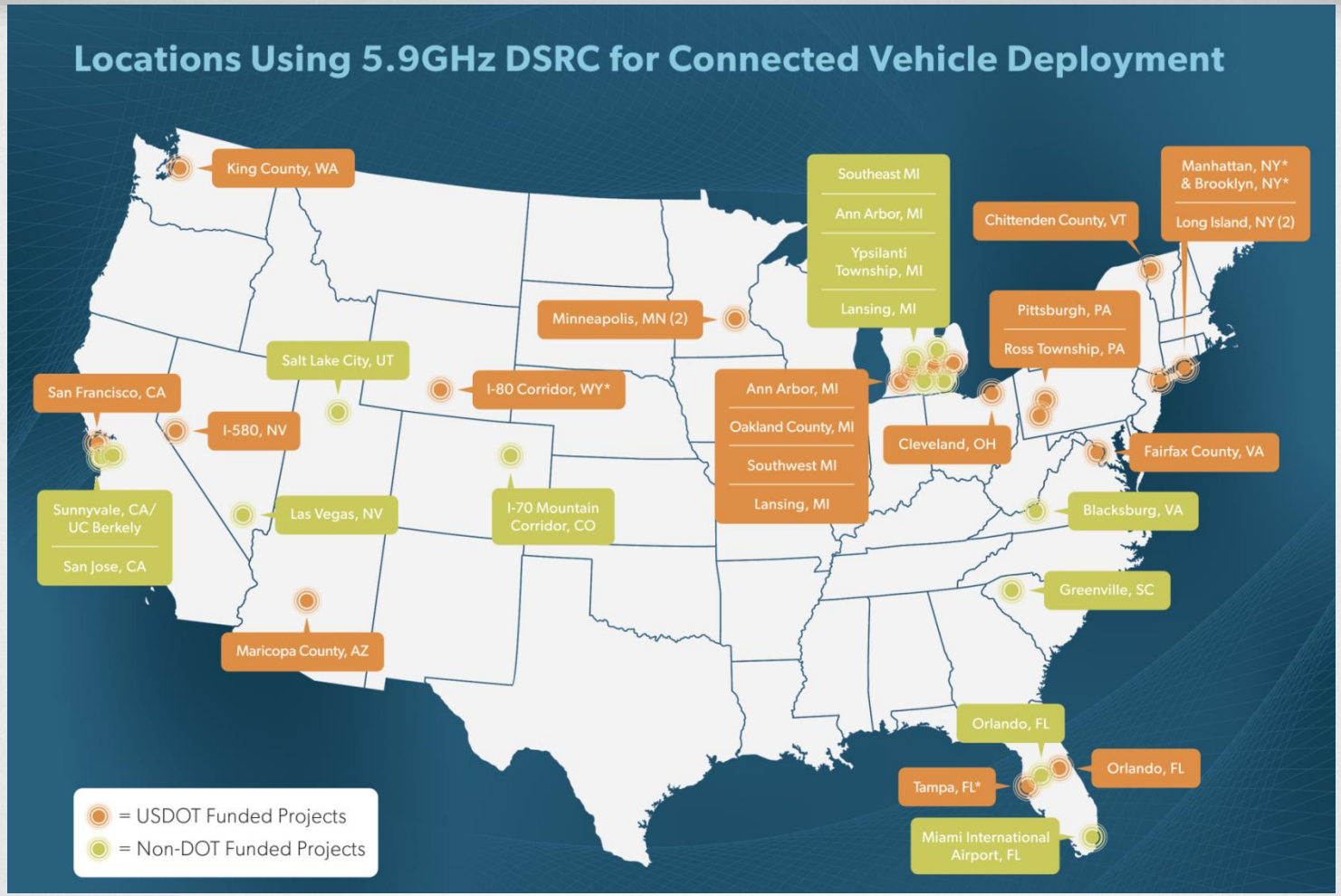
Smart Roadside

- Wireless Inspection
- Smart Truck Parking

CV APPLICATIONS INCLUDED IN PLANS OR PROPOSALS



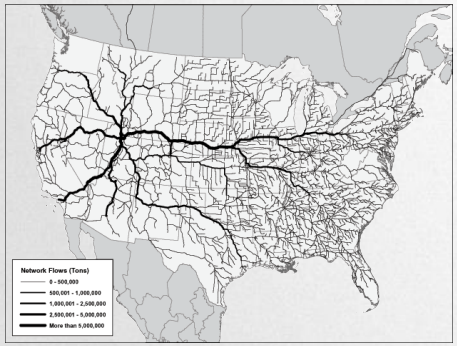
DSRC DEPLOYMENTS



Source: Kevin Gay, USDOT
and Suzanne Murthy, OmniAir Consortium

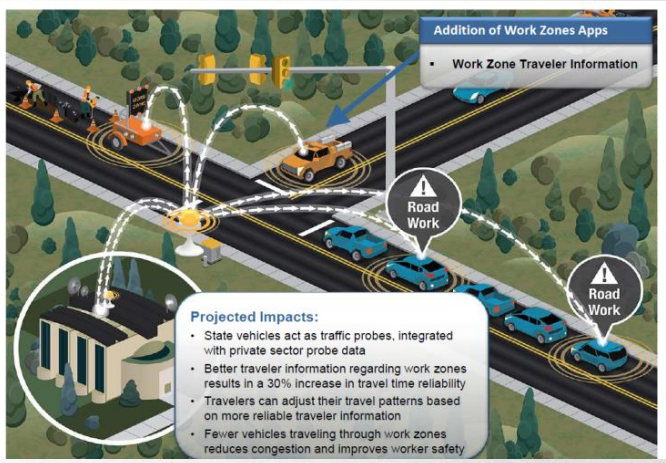
RURAL CONNECTED VEHICLE APPLICATIONS

- Freight Mobility
  - Truck Parking (Michigan)
  - Winter Driving Conditions / Information
  - Traveler Information including crashes
  - Inspection / Regulatory
  - Technology, such as Platooning
  - Probe / Data sharing



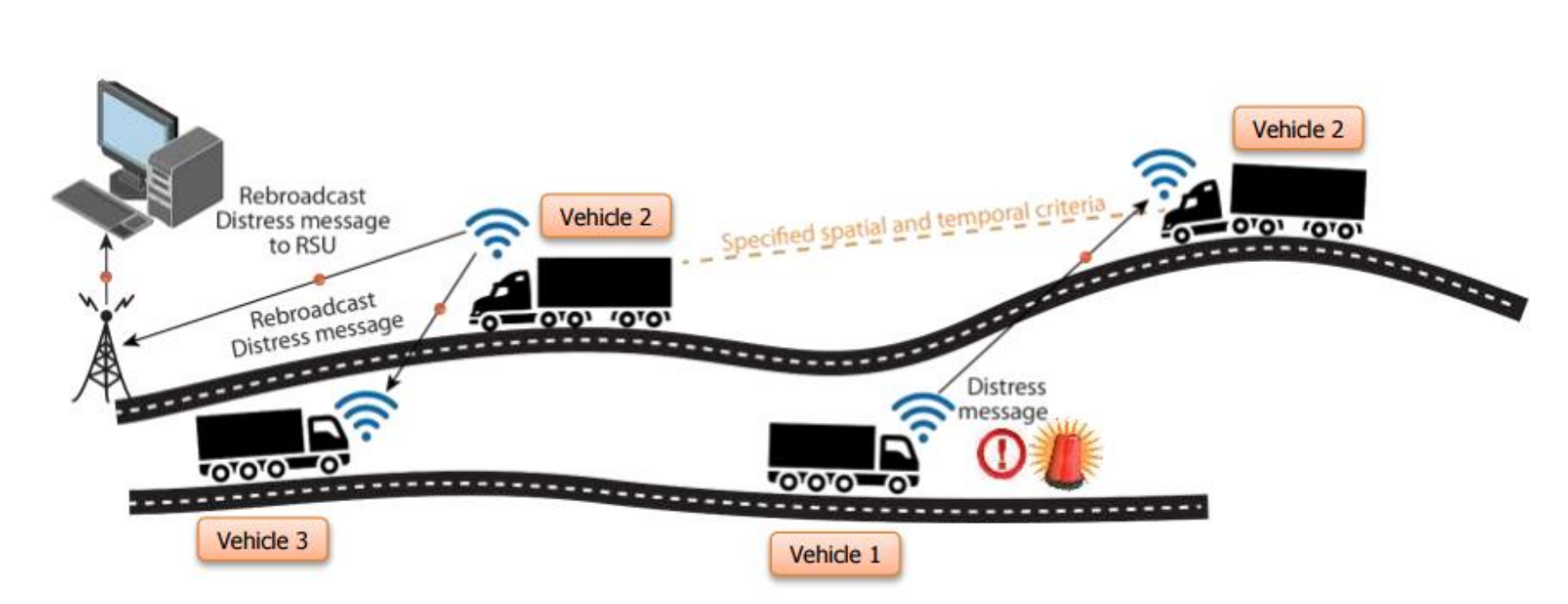
RURAL CONNECTED VEHICLE APPLICATIONS

- Weather Information and Warnings
  - Snow Plows as mobile cameras and probes
  - Variable Speed Limit (Wyoming)
- Work Zones
  - Lane Closure Information / Work Zone Traveler Information
  - Worker Safety
- Safety Information
  - Bridge Height
  - Curve Speed Warnings
  - Queue Warnings



RURAL CONNECTED VEHICLE APPLICATIONS

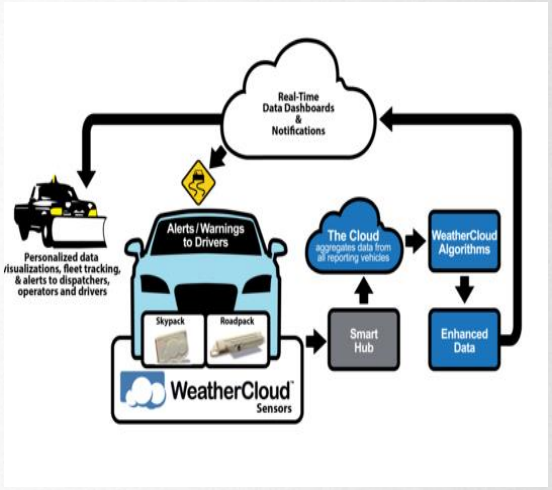
Wyoming Pilot Idea



Source: Wyoming CV Pilot Comprehensive Deployment Plan Webinar

UTAH APPLICATION DEPLOYMENTS

- Multi-modal Intelligent Traffic Signal System (MMITSS)
  - Urban signalized intersection application
- Rural Weather Probes
  - US-40 to SLC
- Truck Platooning
  - Peloton



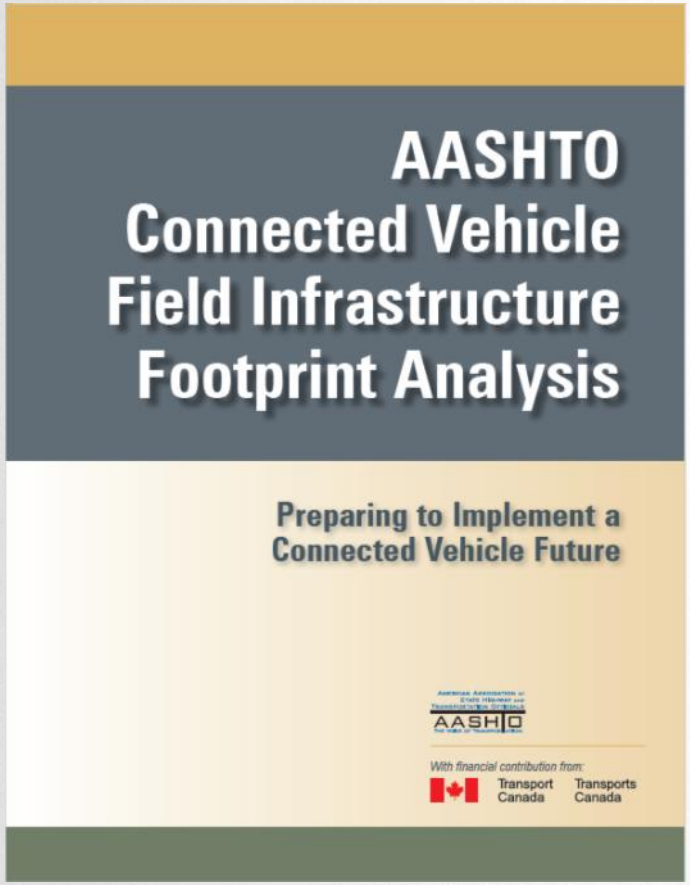
CONNECTED VEHICLES

- What investments could be made to leverage a nationwide fleet of equipped vehicles in support of state and local policy and operational objectives including safety?

- Important issues for state and local agencies:
  - What the deployment decision could mean to you
  - How do you get started?
  - What you need to know to prepare for the emerging connected vehicle environment

TOOLS AND RESOURCES

TOOLS AND RESOURCES



AASHTO Footprint Analysis

- A vision of a national CV infrastructure
- Guidance on:
  - Regional & Nat'l Infrastructure Needs
  - Illustrations of typical deployments
  - System and equipment needs
  - Siting requirements
  - Operations & maintenance issues
  - Deployment cost estimates

http://stsmo.transportation.org/Pages/connected_vehicles_new.aspx

TOOLS AND RESOURCES

- **FHWA Deployment Guidance**
- Planning
- Procurement
- Benefit Cost Analysis
- Interoperability
- Communication Technology
- Hardware Certification
- Security Management / Data Access / Privacy
- Legacy Systems
- Systems Engineering Process
- Deployment Guidelines / Best Practices

Help communities prepare for connected vehicles

Available late 2016

GETTING INVOLVED

- AASHTO Connected and Automated Vehicle Working Group
  - Within the STSMO structure
- Connected Transportation System Pooled Fund Study
  - Lead state: Virginia DOT
- V2I Deployment Coalition
  - Joint effort of AASHTO, ITS-America, ITE
  - Five technical working groups
- ITS-America Connected Vehicle Task Force
- ITE Connected Vehicle Task Force

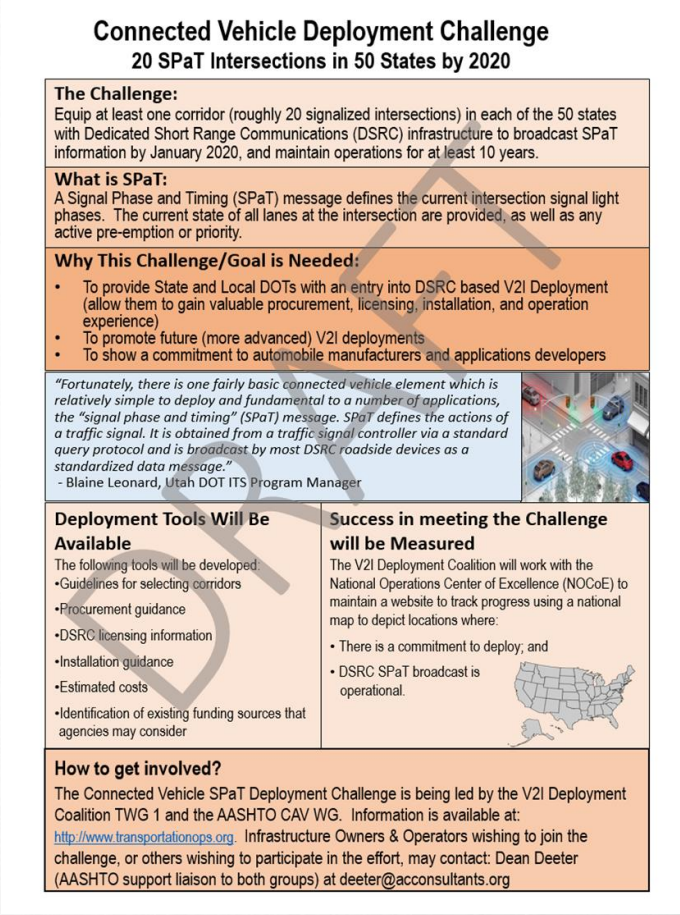
SPaT DEPLOYMENT CHALLENGE

AASHTO & V2I Deployment Coalition Effort

Encourage agencies to deploy DSRC – broadcasting the "signal phase and timing" message – on their corridors

20 Signals along a corridor in each state

Spur Deployment



Connected Vehicle Deployment Challenge

20 SPaT Intersections in 50 States by 2020

The Challenge:
Equip at least one corridor (roughly 20 signalized intersections) in each of the 50 states with Dedicated Short Range Communications (DSRC) infrastructure to broadcast SPaT information by January 2020, and maintain operations for at least 10 years.

What is SPaT:
A Signal Phase and Timing (SPaT) message defines the current intersection signal light phases. The current state of all lanes at the intersection are provided, as well as any active pre-emption or priority.

Why This Challenge/Goal is Needed:

- To provide State and Local DOTs with an entry into DSRC based V2I Deployment (allow them to gain valuable procurement, licensing, installation, and operation experience)
- To promote future (more advanced) V2I deployments
- To show a commitment to automobile manufacturers and applications developers

"Fortunately, there is one fairly basic connected vehicle element which is relatively simple to deploy and fundamental to a number of applications, the "signal phase and timing" (SPaT) message. SPaT defines the actions of a traffic signal. It is obtained from a traffic signal controller via a standard query protocol and is broadcast by most DSRC roadside devices as a standardized data message."
- Blaine Leonard, Utah DOT ITS Program Manager

Deployment Tools Will Be Available
The following tools will be developed:

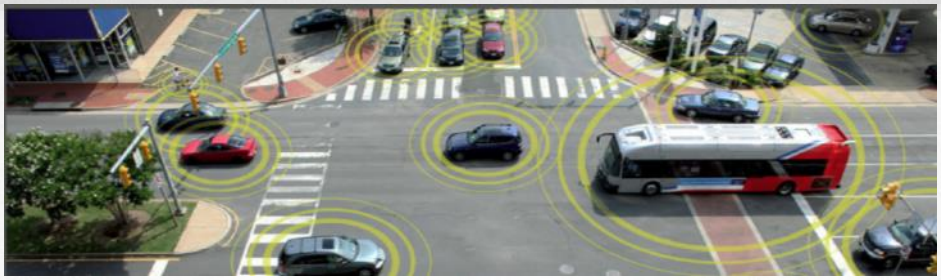
- Guidelines for selecting corridors
- Procurement guidance
- DSRC licensing information
- Installation guidance
- Estimated costs
- Identification of existing funding sources that agencies may consider

Success in meeting the Challenge will be Measured
The V2I Deployment Coalition will work with the National Operations Center of Excellence (NOCoE) to maintain a website to track progress using a national map to depict locations where:

- There is a commitment to deploy; and
- DSRC SPaT broadcast is operational.

How to get involved?
The Connected Vehicle SPaT Deployment Challenge is being led by the V2I Deployment Coalition TWG 1 and the AASHTO CAV WG. Information is available at: http://www.transportationops.org. Infrastructure Owners & Operators wishing to join the challenge, or others wishing to participate in the effort, may contact: Dean Deeter (AASHTO support liaison to both groups) at deeter@acconsultants.org

THE TAKE-AWAY



- Connected and Automated Vehicle Technologies can – and will – help improve rural safety and traveler information
- There are resources to help us begin deployments
- There is no better time than now

QUESTIONS / DISCUSSION