WYOMING DOT CONNECTED VEHICLE PILOT

WYOMING CONNECTED VEHICLE PILOT DEPLOYMENT UPDATE

IMPROVING SAFETY AND TRAVEL RELIABILITY ON I-80 IN WYOMING

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Connected Vehicle (CV) Pilots intend to accelerate the deployment by:

- Spurring **innovation**
- Encouraging **partnerships**
- Demonstrating potential **benefits** (safety, mobility, environmental)
- Creating sustainable **momentum** for nationwide deployment
I-80 Corridor

- 402-mile corridor along Wyoming’s southern border
- >32 million tons of freight per year
- Truck volume 30-55% of total traffic stream on an annual basis
  - Seasonal peaks as
I-80 Corridor

Heavily instrumented rural corridor

136 Variable Speed Limit Signs
supported by 94 traffic sensors

54 Electronic Message Signs

44 Weather Stations

52 Webcams
A problem worth solving

**Heavy Freight Traffic**
- Major E/W freight corridor
- Freight = over half of annual traffic

**Severe Weather Conditions**
- Roadway elevation
- Heavy winds, heavy snow and fog
- Severe blowing snow and low visibility

**Adverse Impacts on Trucks**
- Higher than normal incident rates
- Multi-vehicle crashes
- Fatalities
Pilot Elements

CV Environment
75 Roadside Units on I-80
400 Vehicles with DSRC Connectivity

V2V Applications
Forward Collision Warning
Distress Notification

V2I Applications
Situational Awareness
Spot Weather
Work Zone Warning

WYDOT’s CV Pilot System

Vehicle System

Wyoming CV System
Roadside Infrastructure
Back office system

External Interfaces
## 5 Focus Areas

<table>
<thead>
<tr>
<th>Focus Area</th>
<th>Details</th>
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<tbody>
<tr>
<td>Manage following speed and distance between vehicles</td>
<td>• By alerting trucks to slowing traffic ahead to prevent multiple-vehicle crashes</td>
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<tr>
<td>Provide custom alerts and advisories</td>
<td>• For vehicles that are at risk due to their weight, profile, or traveling speeds due to high-winds or near work zones, including alerting drivers if vehicles are too tall for bridges</td>
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<td>Provide location-based parking information</td>
<td>• With a focus on directing drivers to safe parking areas in the event of a road closure</td>
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<td>Allow first responders to be notified of a crash automatically</td>
<td>• Based on vehicle metrics, such as airbag deployment</td>
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<td>Use data collected from vehicle’s weather sensors</td>
<td>• Such as the status of windshield wipers and if anti-lock brake systems are activated.</td>
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<tr>
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<td>• This information will be used to develop advisories and forecasts for travel to fleet management centers and the general public.</td>
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Connected Vehicle Pilot: Next Steps

Phase 1
- Planning
- 09/2015 – 09/2016

Phase 2
- Deployment
- 10/2016 – Summer 2018
- 10/2016 – Fall 2020

Phase 3
- Demonstration
- Fall 2018 – 10/2019
- Fall 2020-10/2021

Concept Development
- System Planning Deployment Plan

System Design
- System Build
- System Testing and Acceptance

Real-World Demonstration Evaluation Maintenance
Lessons Learned

- Security Credential (SCMS) Integration
- Radio Integration
- Log File Size
- OBU Failing at Scale
- Vendors
- Network Security
- DSRC Shadow
- Data Volume
**Event Log Size Management**

- Event Logs on the OBU are built for the following:
  - BSM during event
  - BSM every 30 seconds
  - TIM reception (SAT and RSU)
  - Distress Notification
  - Updates
  - Driver Alerts (TIMs, FCW, DN)

- Rotate at 100k in size, then zipped and sent to TMC when RSU is available

- Very limited bandwidth

- Built with binary log file
FCC on 5.9 GHz Spectrum

- November FCC Notice of Proposed Rulemaking (ET Docket No. 19-138)
  - Propose to repurpose lower 45 megahertz (5.850-5.895 GHz) for unlicensed operations to support high-throughput broadband applications
  - Continue to dedicate upper 30 megahertz (5.895-5.925 GHz) for transportation
    - 20 megahertz for V2X
    - Seeking comment on whether 10 megahertz needed for DSCR or use for V2X
Open Source: Pikalert

- Using the Pikalert system developed by the National Center for Atmospheric Research to process CV data
- Provides actionable alerts to TMC operators
- Provides forecast weather and “now-cast” surface conditions
WEATHERCLOUD-EQUIPPED

- Wiper Frequency
- GPS Coordinates/Timestamp
- Ground Temperature
- Ambient Temperature
- Barometric Pressure
- Relative Humidity

BASIC SAFETY MESSAGE

- GPS Coordinates/Timestamp
- Ambient Air Temperature
- Exterior Light
- Wiper Status and Rate
- Brake Status
- Coefficient of Friction
- ABS/Traction/Stability Control Status
- As Available
Vehicle Data Translator

- Environmental logs assigned to WYDOT road segments
  - Updates every one mile and five minutes on I-80
  - Assignment based on location and time of observation

- Both WeatherCloud observations and BSM used as available
Road Weather Hazard Module

- Road segment statistics are used to assess for precipitation, pavement condition, visibility, and blowover hazards.
- Assessments can run without mobile data, but are greatly enhanced by mobile observations.
E-Training
In-Cab Display Unit Layout

Critical Warnings
Advisory Warnings
Speed Limit
Distress Notification Button
Settings Button
Vehicle Speed
Forward Collision Warning

Note: The notifications will remain on the display until the event is over
Connected Vehicle Pilot: Integration

WHAT DOES CONNECTIVITY MEAN?

MORE ACCURATE EN ROUTE ALERTS

BETTER PRE-TRIP & FORECASTED INFORMATION

TIMELY NOTIFICATIONS

FASTER ROADSIDE UPDATES

IMPROVED INFORMATION SHARING
# Speed and Crash Performance Measures

## Improved Speed Adherence and Reduced Speed Variation

<table>
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<tr>
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<tbody>
<tr>
<td>14</td>
<td>Total vehicles traveling at no more than 5 mph over the posted speed (compare before and after CV Pilot)</td>
</tr>
<tr>
<td>15</td>
<td>Total vehicles traveling within +/- 10 mph of 85th percentile speed (compare before and after CV Pilot)</td>
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<tr>
<td>16</td>
<td>Speed of applicable connected vehicles are closer to posted speed when compared to non-connected vehicles</td>
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## Reduced Vehicle Crashes

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| 17 | Number of connected vehicles involved in a crash  
    Initial crashes  
    Secondary crashes |
| 18 | Reduction of the number of vehicles involved in a crash (compare a multi-year average before and after CV Pilot) |
| 19 | Reduction of total and truck crash rates within a work zone area (compare a multi-year average before and after CV Pilot) |
| 20 | Reduction of total and truck crash rates along the corridor (compare a multi-year average before and after CV Pilot) |
| 21 | Reduction of critical (fatal or incapacitating) total and truck crash rates in the corridor (compare a multi-year average before and after CV Pilot) |
Connected Vehicle Pilot

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visit the Wyoming Connected Vehicle Pilot website
https://wydotcvp.wyoroad.info

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