

WYOMING DOT CONNECTED VEHICLE PILOT

IMPROVING SAFETY AND TRAVEL
RELIABILITY ON I-80 IN WYOMING



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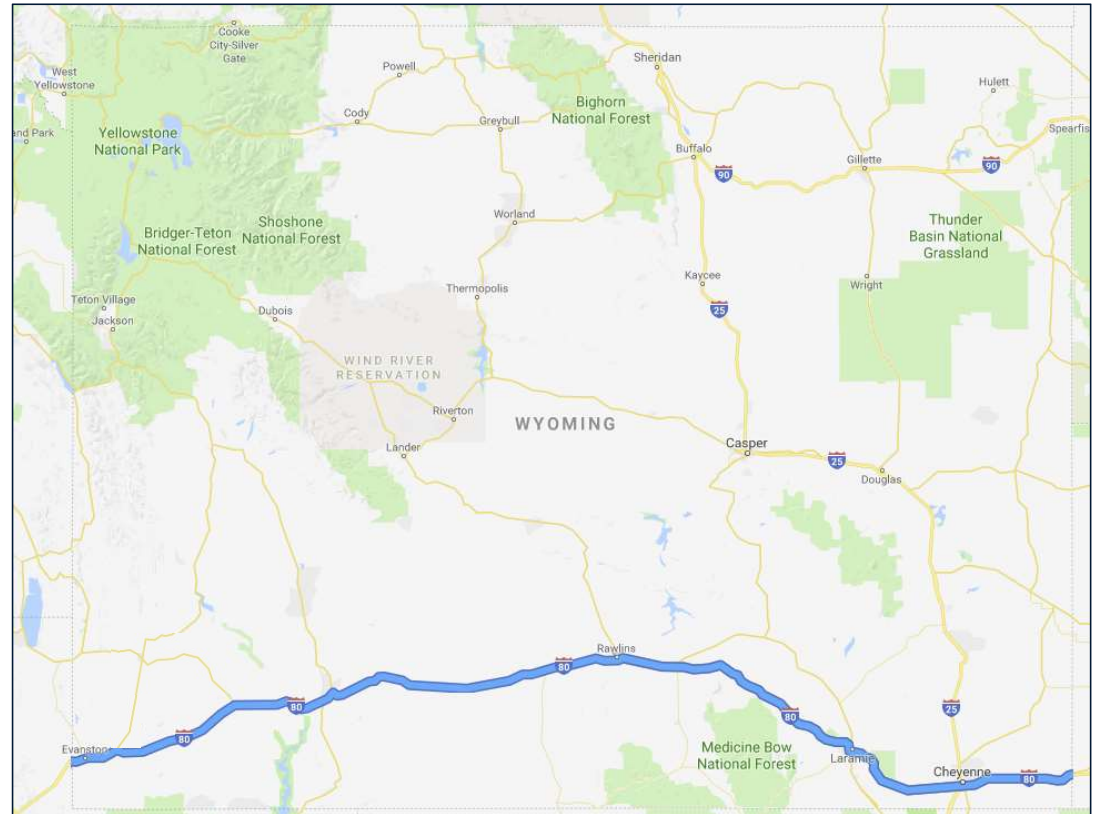
Gonzaga University

Wyoming CV Pilot Team



I-80 Corridor

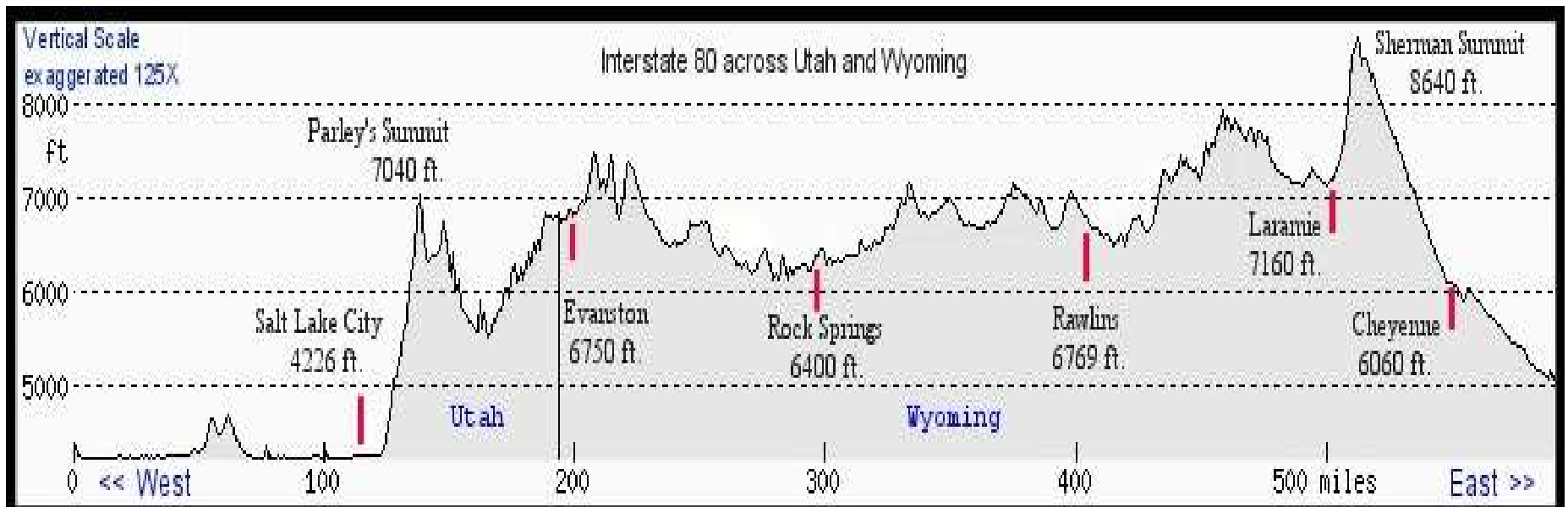
- 402-mile corridor along Wyoming's southern border
- >32 million tons of freight per year
- Truck volume 30-55% of total traffic stream on an annual basis
 - Seasonal peaks as high as 70%



I-80 Corridor



I-80 Corridor



Interstate 80 Corridor



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



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

A problem worth solving

Heavy Freight Traffic

- Major E/W freight corridor
- Freight traffic is 16% of total traffic

1,600+ crashes

1,923 vehicles

\$865.3M

Societal Impact

Trucks

Fatalities

low and fog
and low

er than normal incident

i-vehicle crashes

Connected Vehicle Pilot



Wyoming Connected Vehicle Pilot



DSRC BASED



FREIGHT
FOCUSED



INTEGRATED
WITH TMC



INTEGRATED
WITH WYDOT
FLEETS



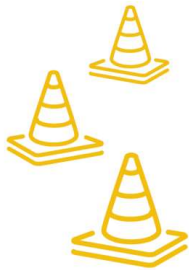
FORWARD
LOOKING



CV PILOT APPLICATIONS



**12V
SITUATIONAL
AWARENESS**



**WORK ZONE
WARNING**



**SPOT WEATHER
IMPACT
WARNING**



**DISTRESS
NOTIFICATION**



**FORWARD
COLLISION
WARNING**

DSRC Connectivity



DSRC BASED

Connectivity

Operates using Dedicated Short-Range Communication (DSRC) over the 5.9 GHz public safety spectrum
 Allows for rapid device connectivity
 Information broadcast 10 Hz

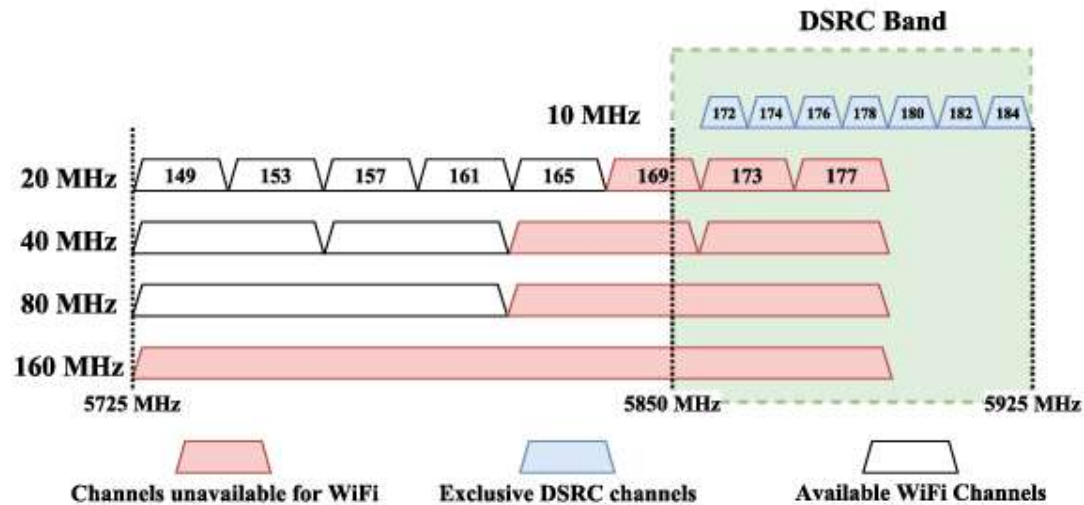


Image: Bin Cheng, Hongsheng Lu, Ali Rostami, Marco Gruteser, John B. Kenney
 Published 2017 in 2017 IEEE Vehicular Networking Conference (VNC)

Connected Vehicle Overview



DSRC BASED

➤ Vehicle to Vehicle (V2V)

- Vehicles send basic messages and distress notifications that are received by nearby vehicles
- Information processed to give meaningful alerts to drivers for
 - Speed harmonization
 - Crash avoidance



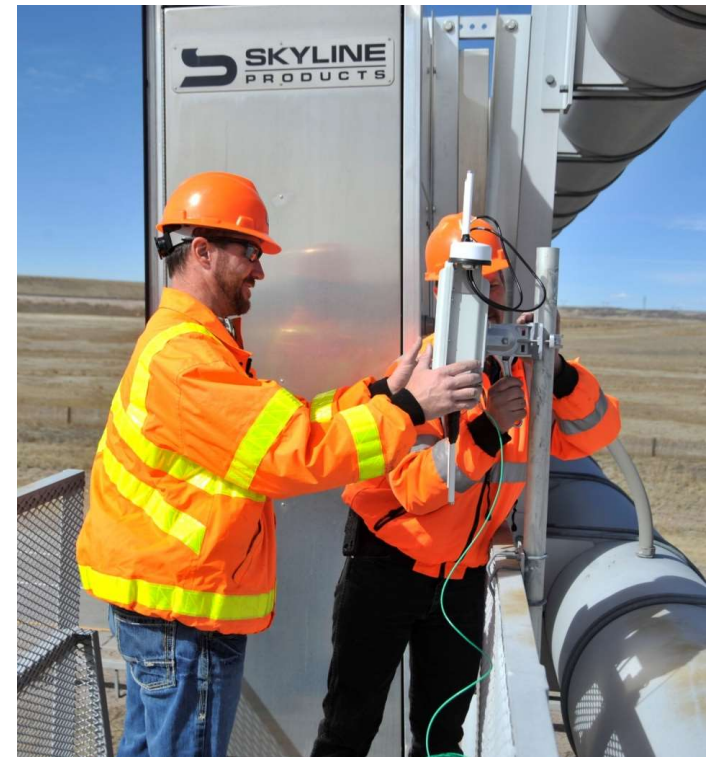
Connected Vehicle Overview



DSRC BASED

➤ Vehicle to Infrastructure (V2I)

- Vehicles send out basic messages to roadside infrastructure
 - basic vehicle metrics
 - windshield wipers on?
 - data about interactions with other CVs
- Vehicles receive Traveler Information Messages (TIM) from roadside infrastructure
 - Supplemented by satellite



Connected Vehicle Overview



DSRC BASED

- Wyoming's telecommunication infrastructure - there's not fiber everywhere
 - Use of radio based networks
- Configured for native IPv4 and IPv6
 - IPv4 admin and device monitoring
 - IPv6 send/receive CV data



Freight-focused



FREIGHT
FOCUSED

- ~150-200 are large trucks
- ~ 100 are small/medium trucks

CV Trucks



- Trucking Companies of various sizes
 - Dooley Oil
 - Double D Distribution
 - Sinclair Oil
 - Others...

Fleet
Partners



- CVOP Users (800 firms)
- Wyoming Trucking Association
- Third Party Intermediaries

Freight
Partners



Integrated with the TMC



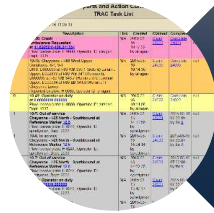
INTEGRATED
WITH TMC



Supports I-80 Traveler Information



Supports VSL and other traffic management strategies



Integrated with TMC Management Systems

Integrated with WYDOT Fleets



INTEGRATED
WITH WYDOT
FLEETS



~100 DSRC-
enabled snow
plows and
highway patrol
vehicles



Environmental
Probe Data
Collection



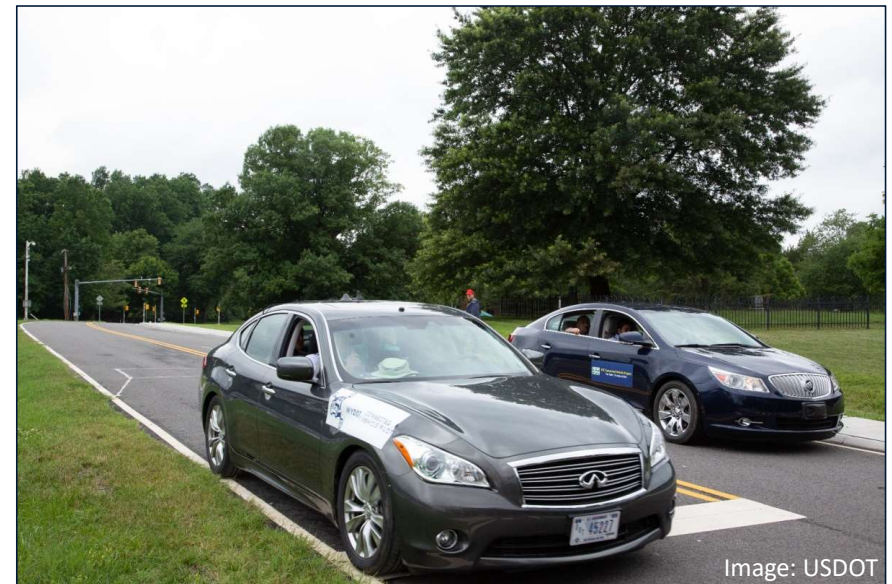
Leverage existing
technology

Forward Facing



FORWARD
LOOKING

- Interoperability is a major component
- Project built to standards
- Everything documented along the way
- Successful interoperability testing with New York and Tampa





Connected Vehicle Pilot

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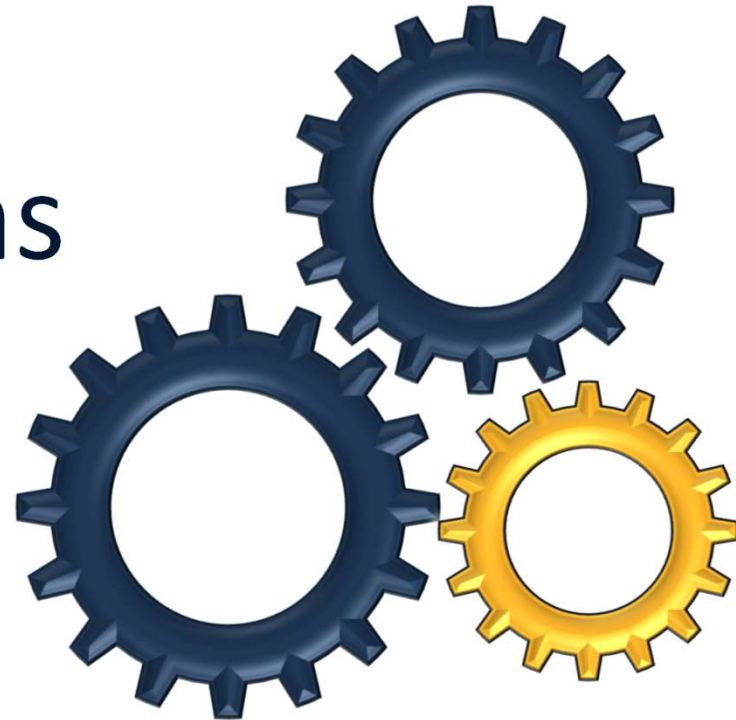
visit the Wyoming Connected Vehicle Pilot website
<https://wydotcwp.wyroad.info>

email
dot-cvpilot@wyo.gov

How does it all work?

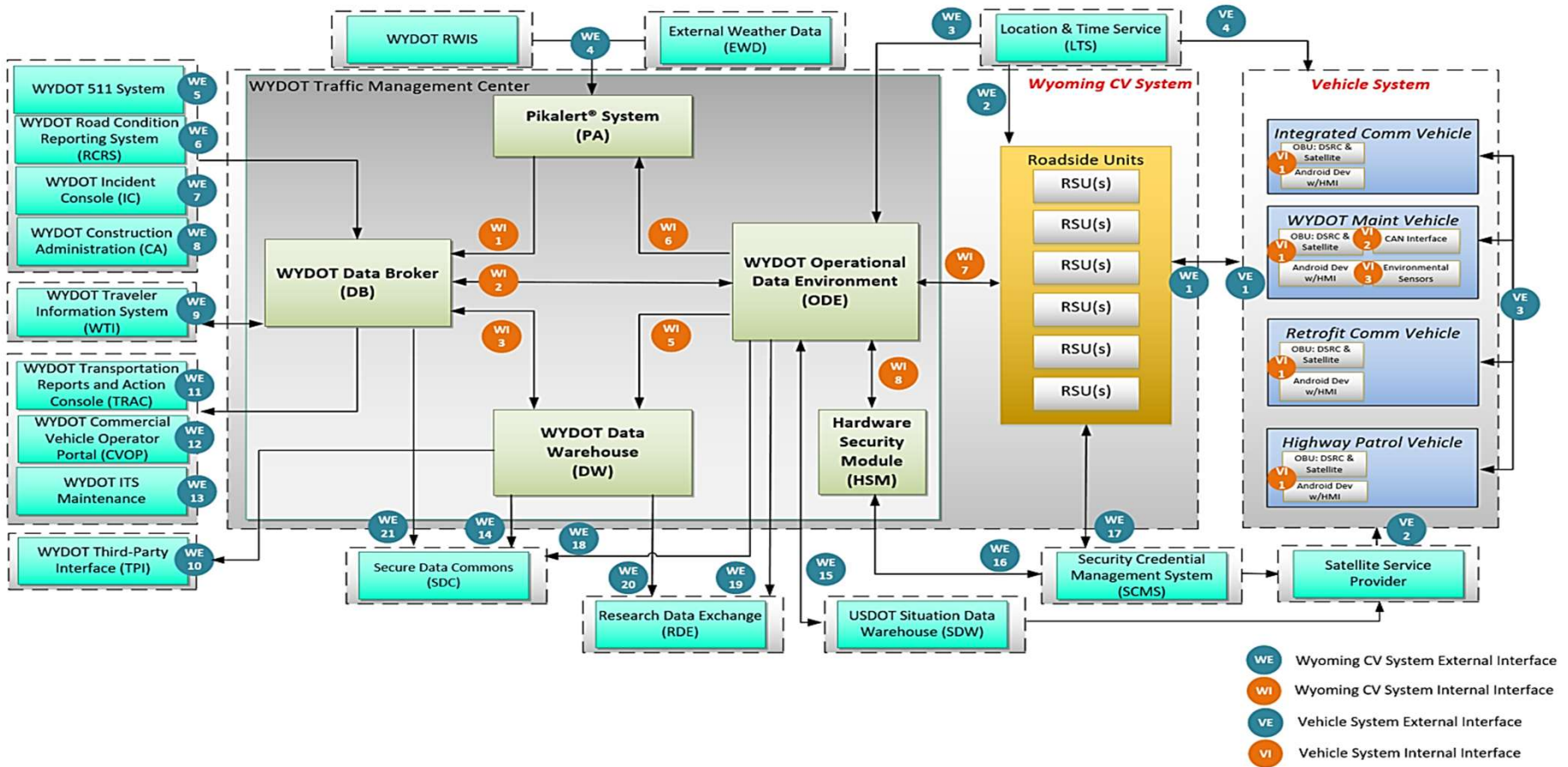


Back end Systems





Backend Systems



Connected Vehicle Pilot: Security

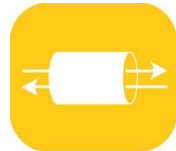
SECURITY BY DESIGN



HSM
On-board
units



HSM
Road-side
units



SSL VPN

VPN
Protect
data in
transit



HSM &
Background
Checks
For TMC



Database
Encryption
Tables w/
Potential
PII

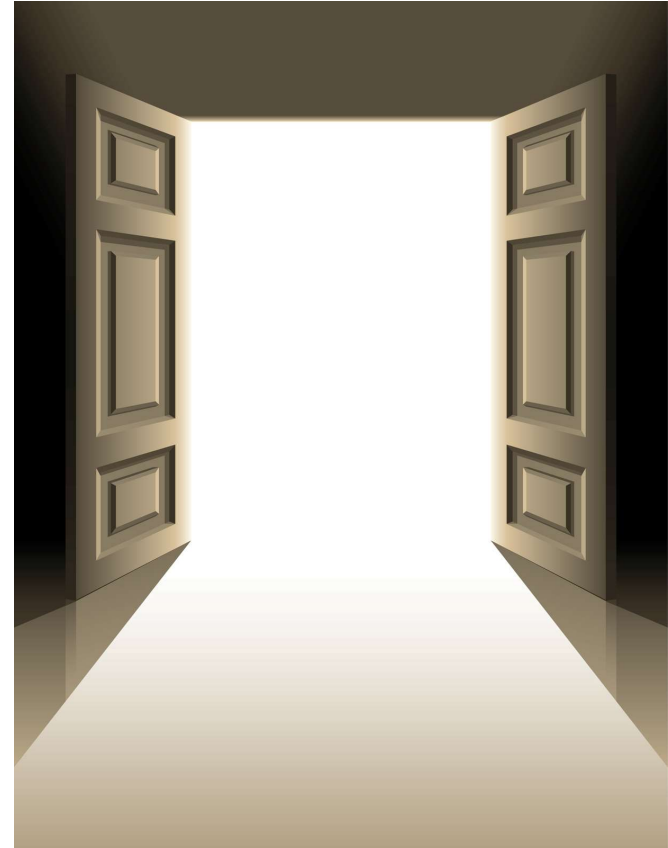


SCMS
Certificates
and
Validation



Firewalls
IPv4 and
IPv6

Open Source Software





Open Source: TMDD Data Feed

- WYDOT wants all consumers of our information to benefit from improved data

WYDOT
Systems

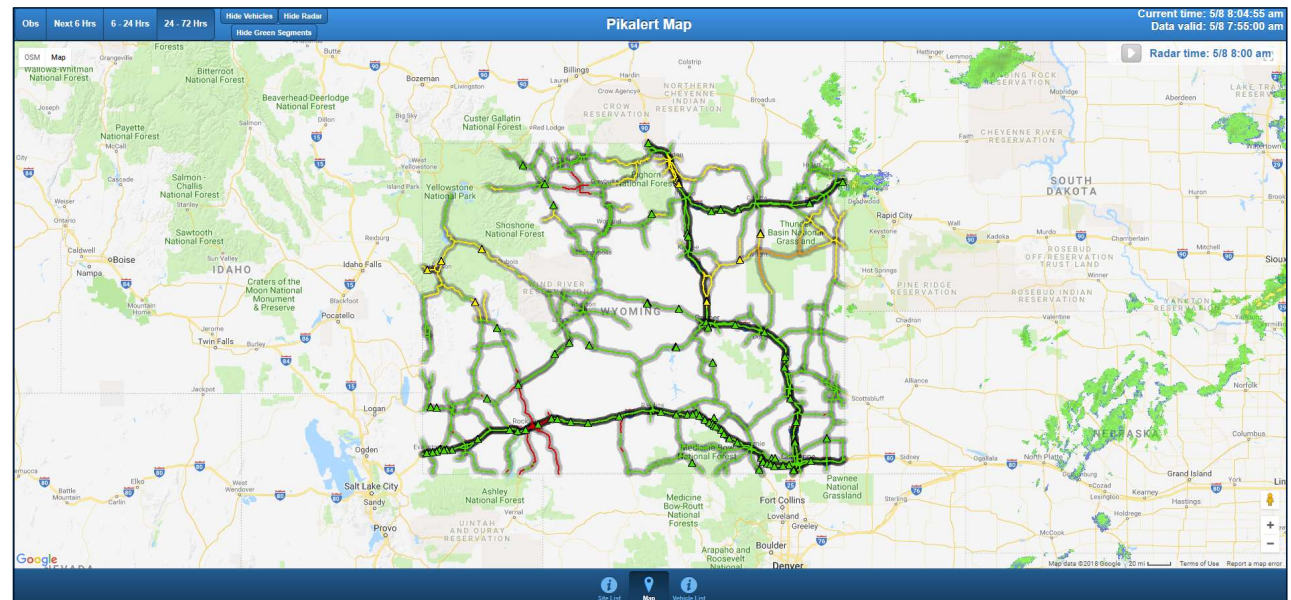
TMDD
Web
Service

Third
Party
Systems



Open Source: Pikalert

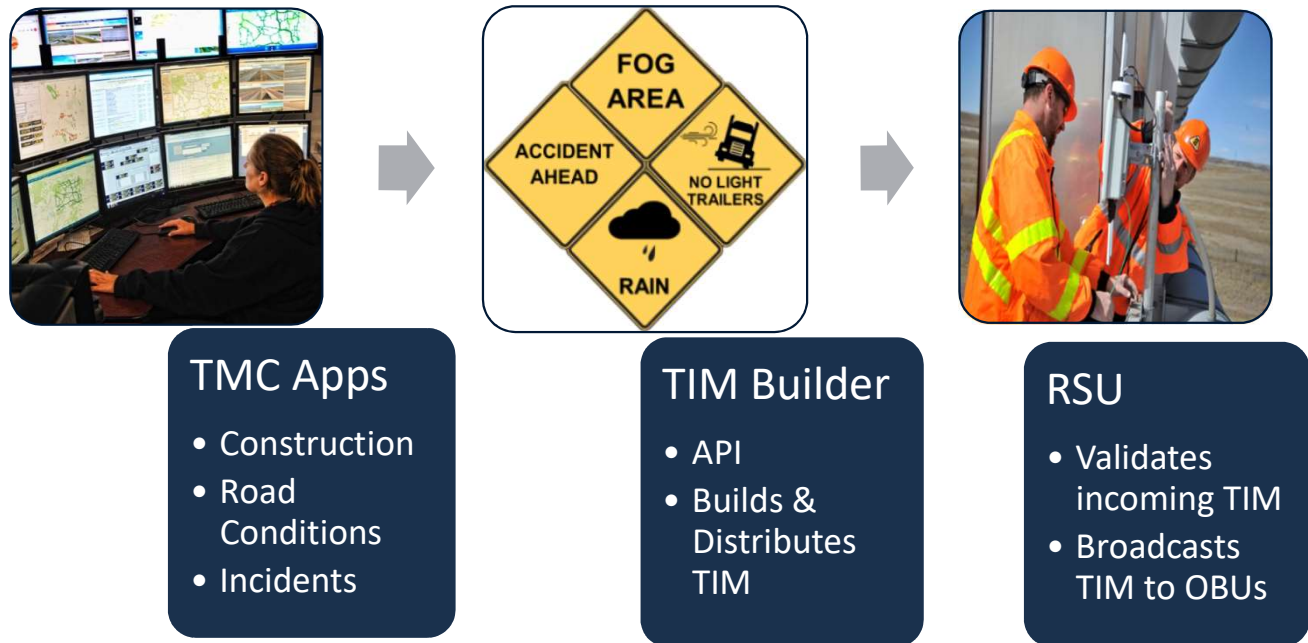
- Using the Pikalert system developed by the National Center for Atmospheric Research to process CV data
- Provides actionable alerts to TMC operators
- Provides forecast weather and “now-cast” surface conditions





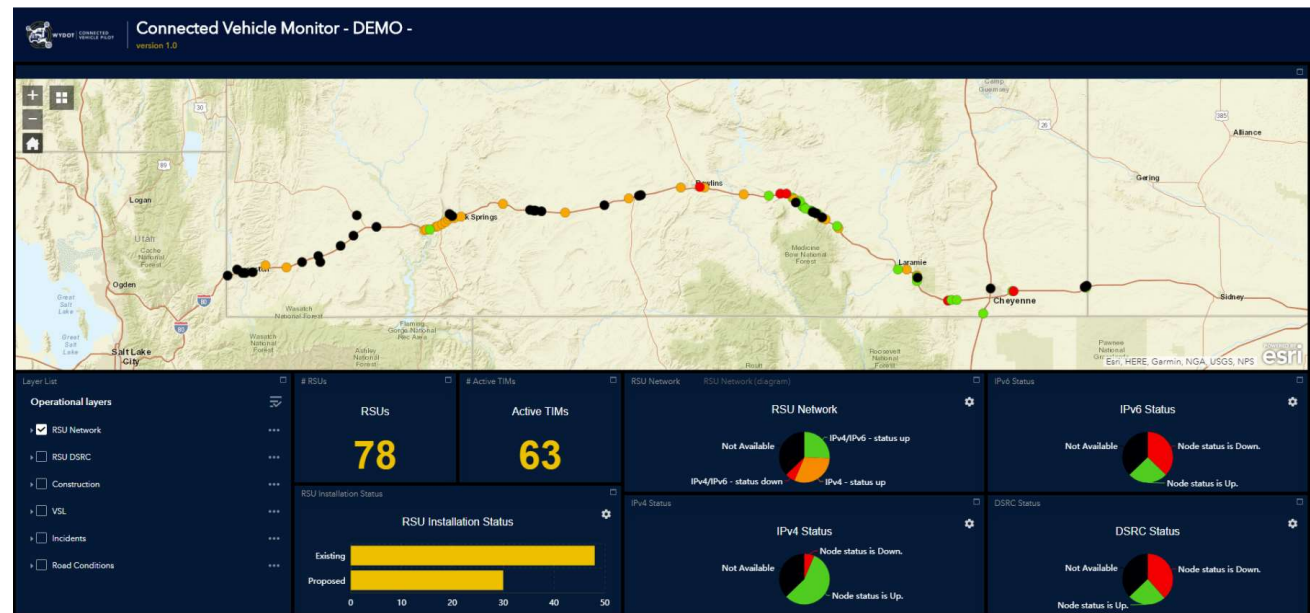
Open Source: TIM Builder

- RSUs will be updated with the same application used for updating WYDOT's website, phone system, text/email alerts and Highway Advisory Radios
- This integration means no additional work for operators



Open Source: CV Monitor

- The CV monitor is used to monitor RSUs in real-time
- Provides the status of communication, vehicle counts, posted TIMs and other information
- A specialized version with an enhancement allows authorized people to apply firmware updates to RSUs

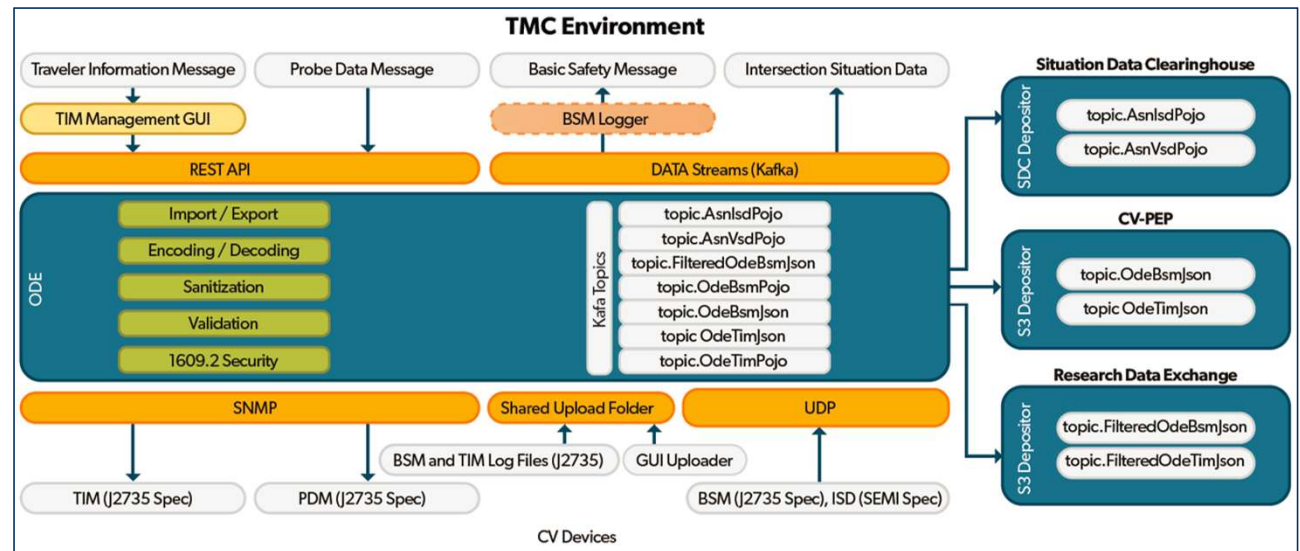


Open Source: ODE

- Through the Operational Data Environment, information is sent from the CV to the TMC and then to a central repository



➤ <https://github.com/usdot-jpo-ode/jpo-ode>





More open source

- Situational Data Warehouse
- Sirius XM is able to pick up messages from the SDW and broadcast them using its satellite network

➤ <https://webapp.cvmvp.com/whtools/>

System Name	<input type="text" value="SDW 2.3"/>			
Dialog ID	<input type="text" value="156 (travelerInformation)"/>			
Start Date	<input type="text" value="2018-10-11T21:20:52"/>	<input type="button" value="X"/>	<input type="button" value="Calendar"/>	<input type="text" value=">="/> <input type="text" value="v"/>
End Date	<input type="text" value="2018-10-18T21:22:16"/>	<input type="button" value="X"/>	<input type="button" value="Calendar"/>	<input type="text" value="<="/> <input type="text" value="v"/>
NW Corner Lat/Lng	<input type="text" value="42.30270602152241"/>	<input type="text" value="-108.5349655151367"/>	<input type="button" value="Globe"/>	

Map showing location in Wyoming near the border of Idaho, South Dakota, and Nebraska. A red pin is placed on the Wyoming map, labeled 'OMING'.

Application code sharing: OSADP

- All applications developed as part of this pilot are considered open source and made publicly available
- The repository includes code and release notes

➤ Open Source Application Development Portable

- Public repository for code base and application notes
- Applications like the ODE and SDW are discoverable through the OSADP, but available for pull requests, development in the open integration, documentation, and installation through GitHub





Data sharing: USDOT Public Data Hub

➤ Data from the pilot is shared via the USDOT

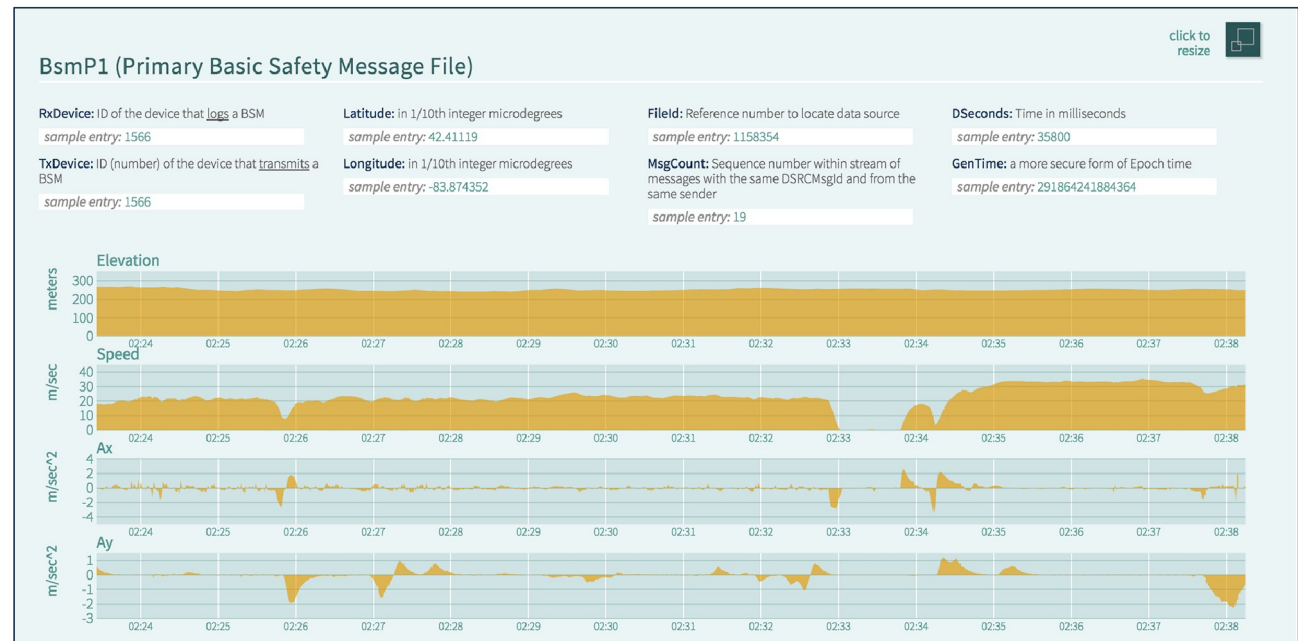


Image: USDOT