CONNECTED VEHICLE PILOT
Deployment Program

ICF/Wyoming Concept of Operations

Kate Hartman, CVP Deployment Program Mgr., ICF/Wyoming Site COR
Deepak Gopalakrishna, ICF/Wyoming Project Manager

ITS Joint Program Office

TODAY'S AGENDA

- Purpose of this Webinar
  - To share the Concept Development Activities from the ICF/Wyoming Pilot site with the stakeholders of connected vehicle technologies.

- Webinar Content
  - Connected Vehicle Pilot Deployment Program Overview (*Kate Hartman*)
  - ICF/Wyoming Concept of Operations (*Deepak Gopalakrishna, Vince Garcia and Ali Ragan*)
  - Stakeholder Q&A (*Kate Hartman & Deepak Gopalakrishna*)
  - How to Stay Connected (*Kate Hartman)*

- Webinar Protocol
  - We have muted all participant lines during the webinar in order to reduce background noise
  - You are welcome to ask questions via chatbox at the Q&A Section
  - The webinar recording and the presentation material will be posted on the CV Pilots website

CONNECTED VEHICLE PILOT DEPLOYMENT PROGRAM

PROGRAM GOALS

STAY CONNECTED

- Participate in Concept Development Phase Webinars for the three Pilot Sites (see website for exact dates and times)

Feb 2016	Mar 2016	Apr 2016	May 2016	Jun 2016	Jul 2016	Aug 2016
◆◆	◆		◆◆◆			◆ ◆ ◆

Concept of Operations Webinars — **Performance Measurement Webinars** — **Comprehensive Deployment Plan Webinars**

- Visit Program Website for Updates: http://www.its.dot.gov/pilots
- Contact: Kate Hartman, Program Manager, Kate.hartman@dot.gov

PILOT SITES

ICF/Wyoming DOT

NYCDOT

Tampa (THEA)

ICF/Wyoming

Presentation Overview

Deepak Gopalakrishna, ICF/Wyoming Project Manager

ICF/Wyoming Team

Phase 1

Led By ICF

Partners
- Wyoming DOT
- Trihydro
- NCAR
- Univ of Wyoming
- CATT Lab
- McFarland Mgmt

Phase 2

Led By Wyoming DOT

Partners
- Wyoming DOT
- Trihydro
- NCAR
- Univ of Wyoming
- CATT Lab
- McFarland Mgmt

New Partners
- DSRC Radio Vendors
- On-board equipment vendors
- Data providers
- Weather Sensor Developers
- Fleet Operators

Phase 3

Led By Wyoming DOT

Partners
- Wyoming DOT
- Trihydro
- NCAR
- Univ of Wyoming
- CATT Lab
- McFarland Mgmt

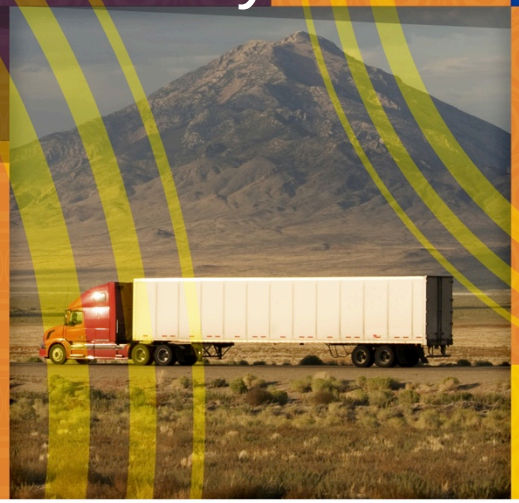
New Partners
- Fleet Operators

Stakeholders Engaged throughout Pilot

- Wyoming Trucking Association
- Wyoming Highway Patrol
- Wyoming Workforce Development
- Wyoming Chamber of Commerce
- Freight Operators
- Oil and Gas Industry Representatives

Presentation Overview

- WYDOT Opening Remarks – Ken Schultz, WYDOT
- Site Orientation and Key Issues – Vince Garcia, WYDOT
- Deployment Concept Overview –Deepak Gopalakrishna, ICF
- Stakeholder Engagement – Ali Ragan, WYDOT
- Next Steps – Deepak Gopalakrishna, ICF



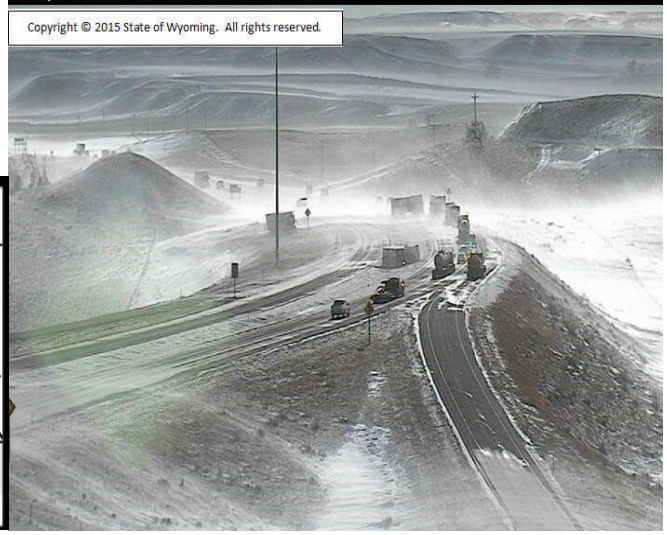
ICF/Wyoming

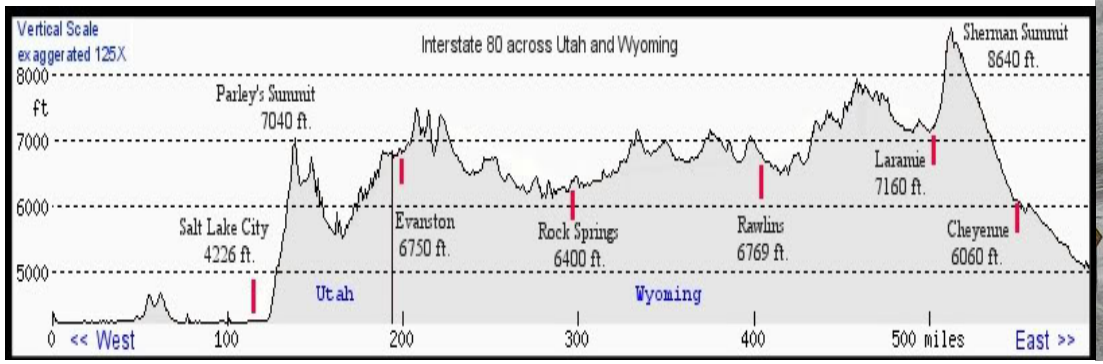
Site Orientation and Key Issues

Vince Garcia, Wyoming DOT

I-80 in Wyoming

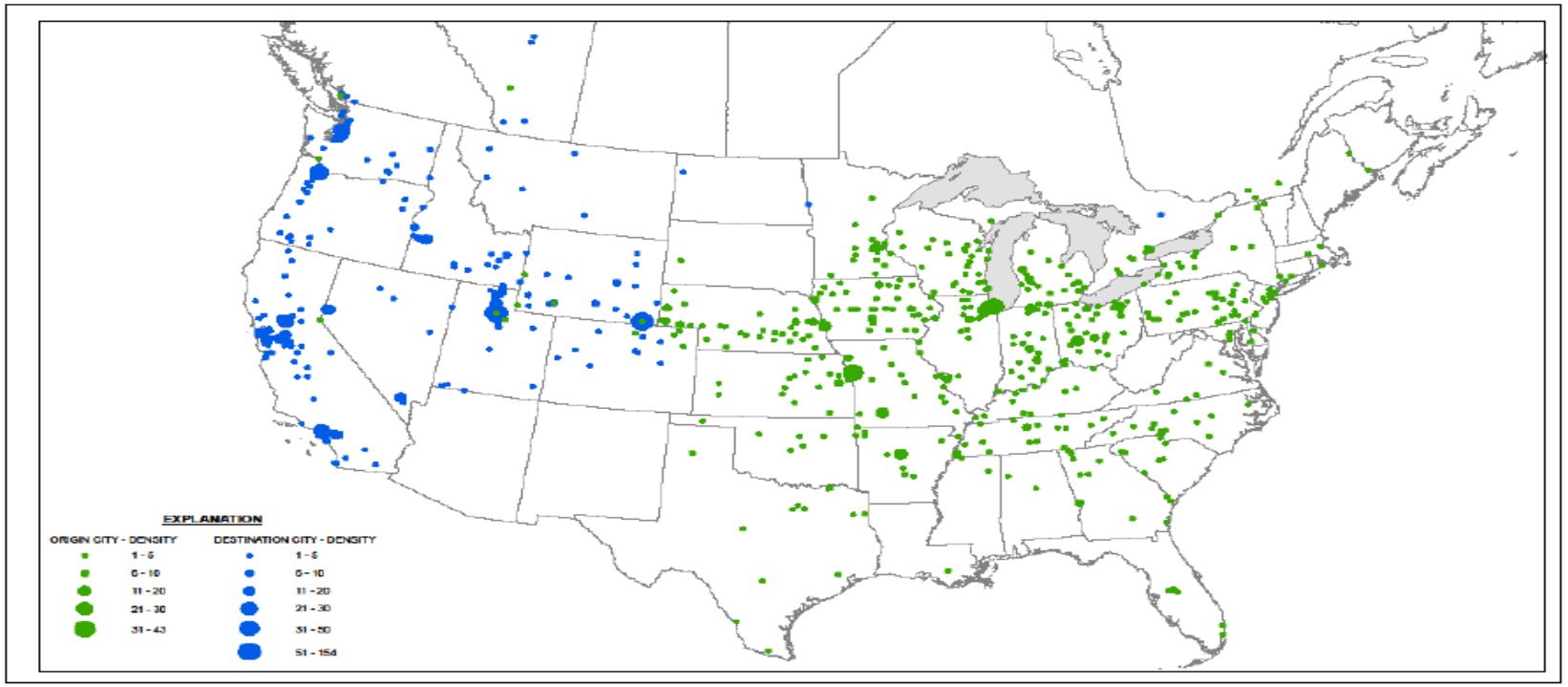
- Major corridor for east/west freight in the northwest part of the country
- 402 miles long from Utah to Nebraska
- More than 32 million tons of freight per year (at 16 tons per truck).
- Truck volume is 30 to 55% of the total traffic stream on an annual basis
  - can make up as much as 70% of the traffic stream on a seasonal basis
- Elevation all above 6,000 feet, with the highest point reaching 8,640 feet (2,633 m) above sea level at Sherman Summit





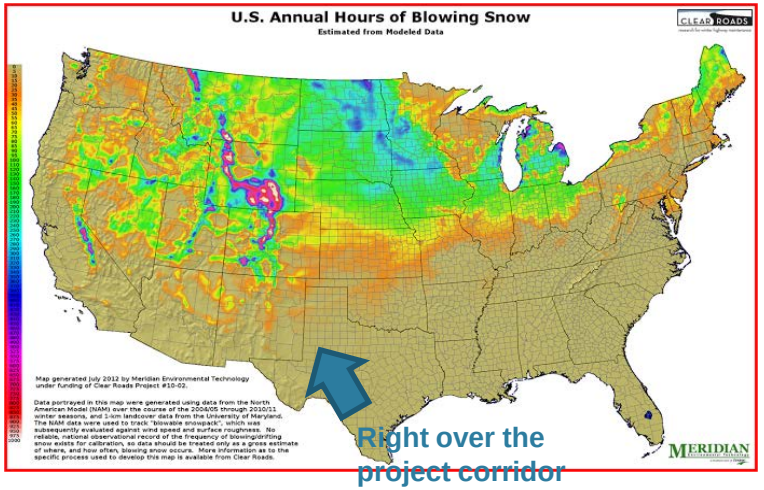
National Impacts

- Origins and Destinations of Westbound Freight on I-80



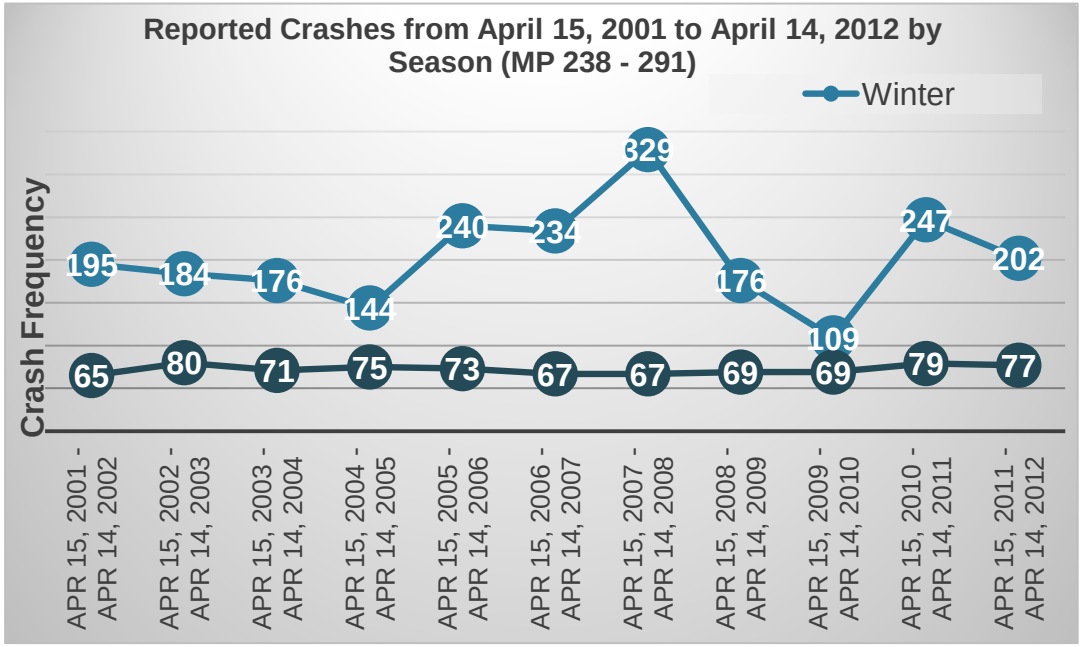
(Source: FHWA-WY- 09/09F Interstate 80 Freight Corridor Analysis)

Challenging Road Conditions



High Crash Rates

- Winter crash rate (October to April) has been found to be 3 to 5 times as high as the summer crash rates
- Speed management is critical



4/13/2014 - Between Laramie and Rawlins - Speeds reduced to 45 mph in VSL zone – **0 Fatalities - 70+ vehicles**

4/15/2015 - Between Cheyenne and Laramie - Speeds reduced to 45 mph in VSL zone – **0 Fatalities - 65+ vehicles**

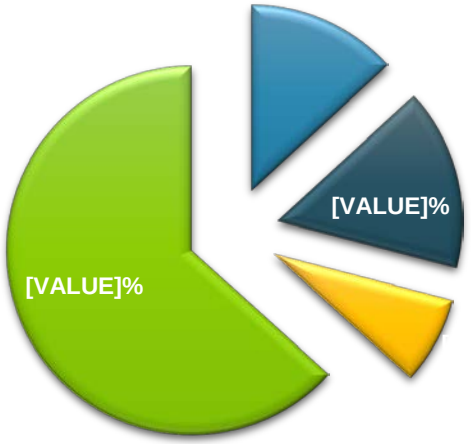
4/20/2015 - Between Laramie and Rawlins - Speeds 75 mph (no VSL available) – **2 Fatalities - 65+ vehicles**

Video of a Multi-Vehicle Crash

- Show video

Road Closures

- For the three years from 2010 to 2012, there were 172 road closures
- Average duration of the closures was over 8 hours long.
- At conservative value of $370 per truck per hour of closure, there is an economic impact of around $11.7 million per closure.



Limited Parking

- Extremely rural corridor
- Distances between towns along the I-80 corridor range from 60 to 115 miles
- No services between towns .
- 3,037 spaces with 18% of those locations being public facilities (e.g., rest areas, truck parking lots, and truck parking turnouts) and the remainder being at private truck service locations.

Lack of Alternatives

- During extended road closures two-lane highways are also typically closed, along with I-80, to prevent large-scale diversion of freight traffic.
- Alternate routes are not always built to the same geometric standards as the interstate, increasing the hazards during severe weather events.
- (I-90), approximately 250 miles to the north,
- Interstate 70 (I-70), approximately 100 miles to the south, both of which have their own challenges of mountainous terrain and severe weather events.

WHAT DO I-80 USERS WANT?

DOT	• Improve road condition monitoring for operations and maintenance • Improve communication with on-road vehicles • Improve interaction with fleet managers • Improve emergency response times
Truckers	• Spot-specific information of road conditions • Parking guidance • Customized advisories and alerts • Information on stopped vehicles ahead • Work Zone Alerts
Fleet Managers	• Forecast conditions on I-80 • Closure information and parking guidance • Return to normal conditions • Construction information
Drivers	• Forecast conditions • Stopped vehicles • Road closures

ICF/Wyoming

Deployment Concept Overview

Deepak Gopalakrishna, ICF/Wyoming Project Manager

Five Focus Areas

- Manage following speed and distance between vehicles by alerting trucks to slowing traffic ahead to prevent multiple-vehicle crashes.
- Provide custom alerts and advisories for vehicles that are at risk due to their weight, profile or traveling speeds due to high-winds, near work zones, include alerting drivers if their vehicles are too tall for bridges.
- Provide location-based parking information with a focus on directing drivers to safe parking areas in the event of a road closure.
- Allow first responders to be notified of a crash automatically based on vehicle metrics, such as airbag deployment.
- Use data collected from vehicle's weather sensors such as the status of windshield wipers and if anti-lock brake systems are activated. This information will be used to develop advisories and forecasts for travel to fleet management centers and the general public.

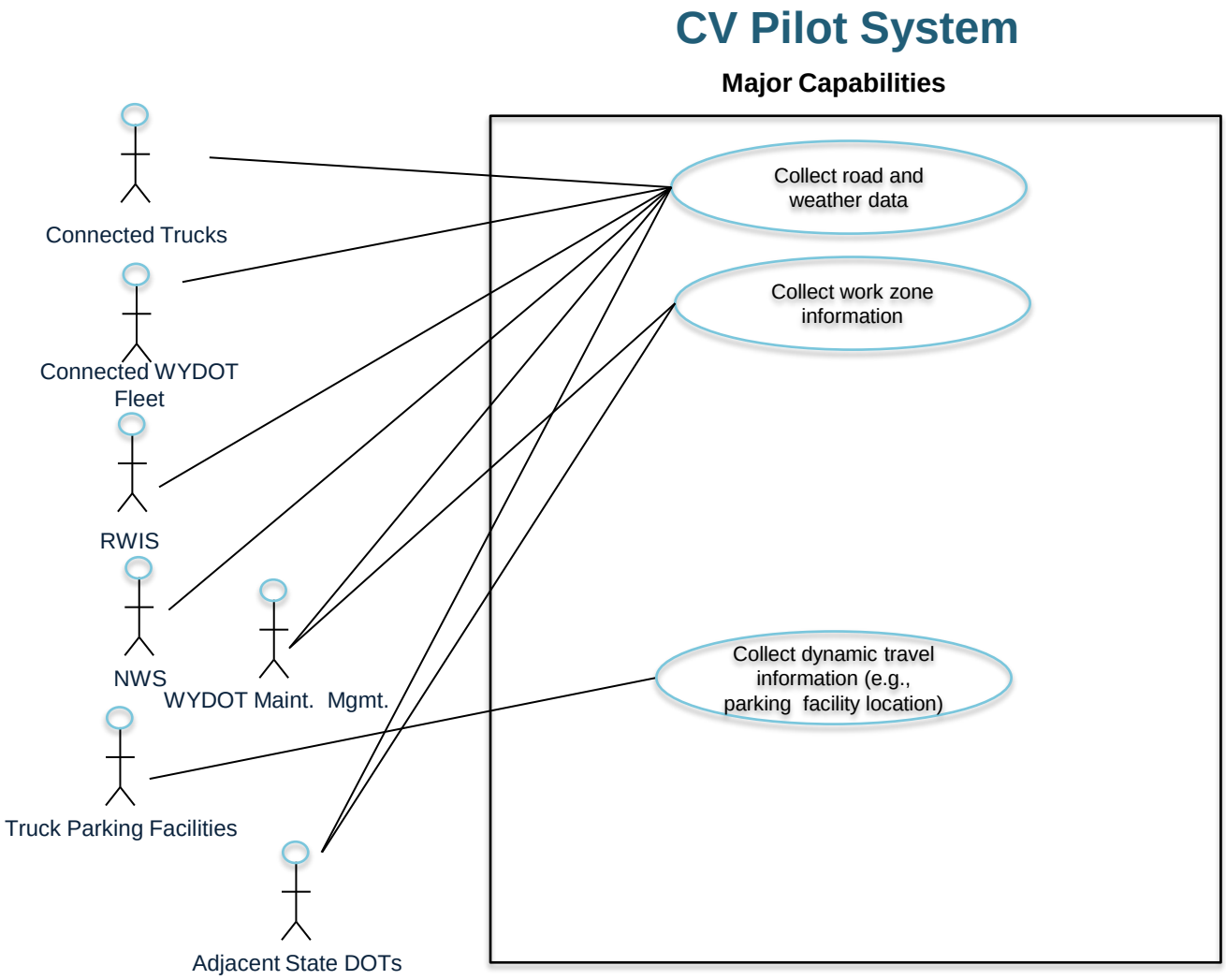
Goals for WYDOT

Operational	• Not an R&D effort. To be used by WYDOT Operations for immediate needs
Scalable and Sustainable	• Ability to incorporate new fleets and applications
Evolutionary	• Ability to start with a few applications/services but grow to an eco-system of services
Replicable	• Be a model deployment for rural freight-heavy corridors
Leveraged	• Maximize use of already created federal investments and state initiatives. Do not recreate the wheel

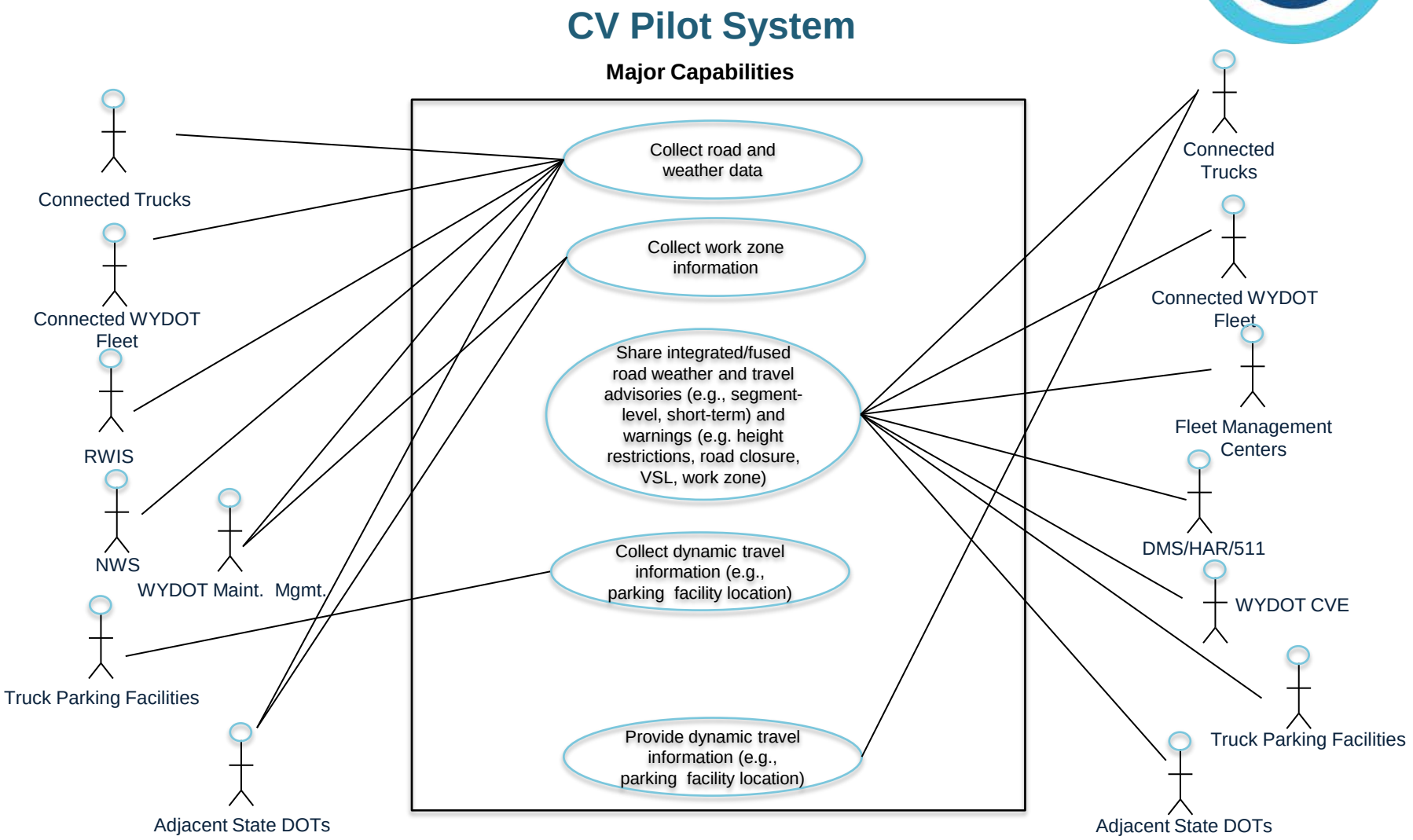
System Capabilities

- CV Pilot System (Center)
  - Collect road and weather data
  - Collect work zone information
  - Share integrated/fused road weather and travel advisories (e.g., segment-level, short-term) and warnings (e.g. height restrictions, road closure, VSL, work zone)
  - Collect dynamic travel information (e.g., parking facility location)
  - Provide dynamic travel information (e.g., parking facility location)
- CV Mobile Distribution (Field)
  - Collect safety messages (e.g., road advisories, road warnings)
  - Share safety and road condition messages)
  - Generate emergency message
  - Collect road conditions from other connected vehicles

Context Diagram (1/2)

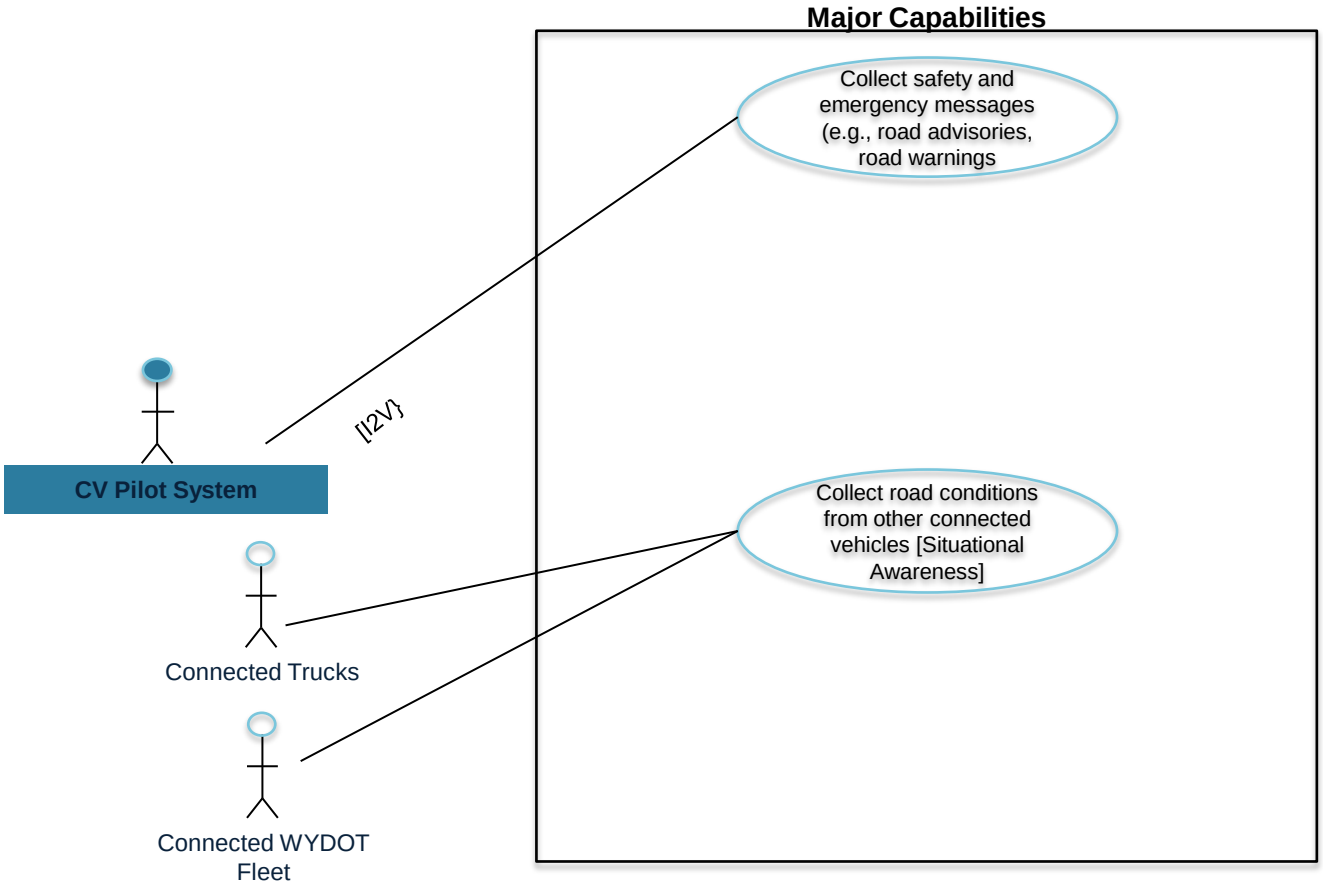


Context Diagram (1/2)

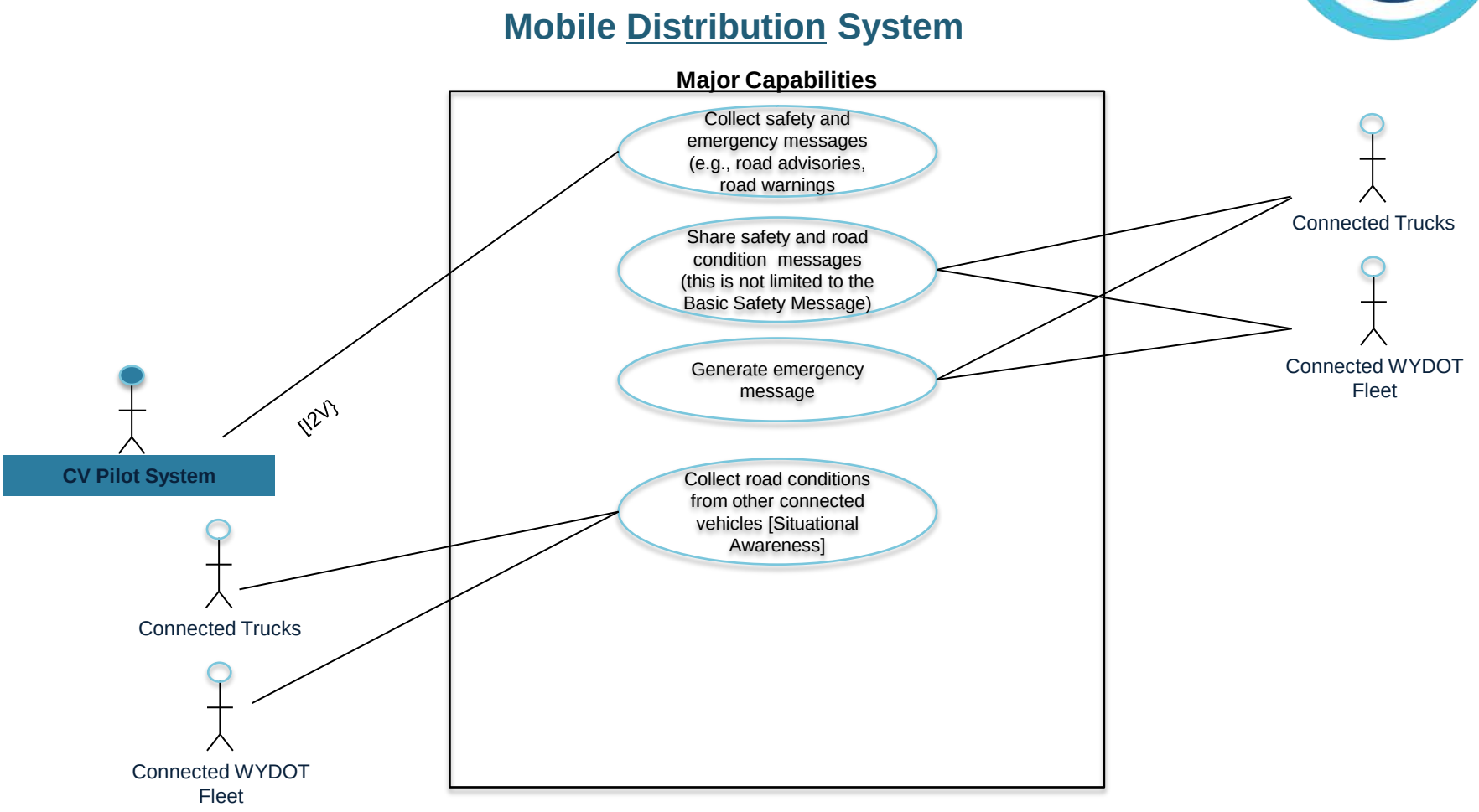


Context Diagram (2/2)

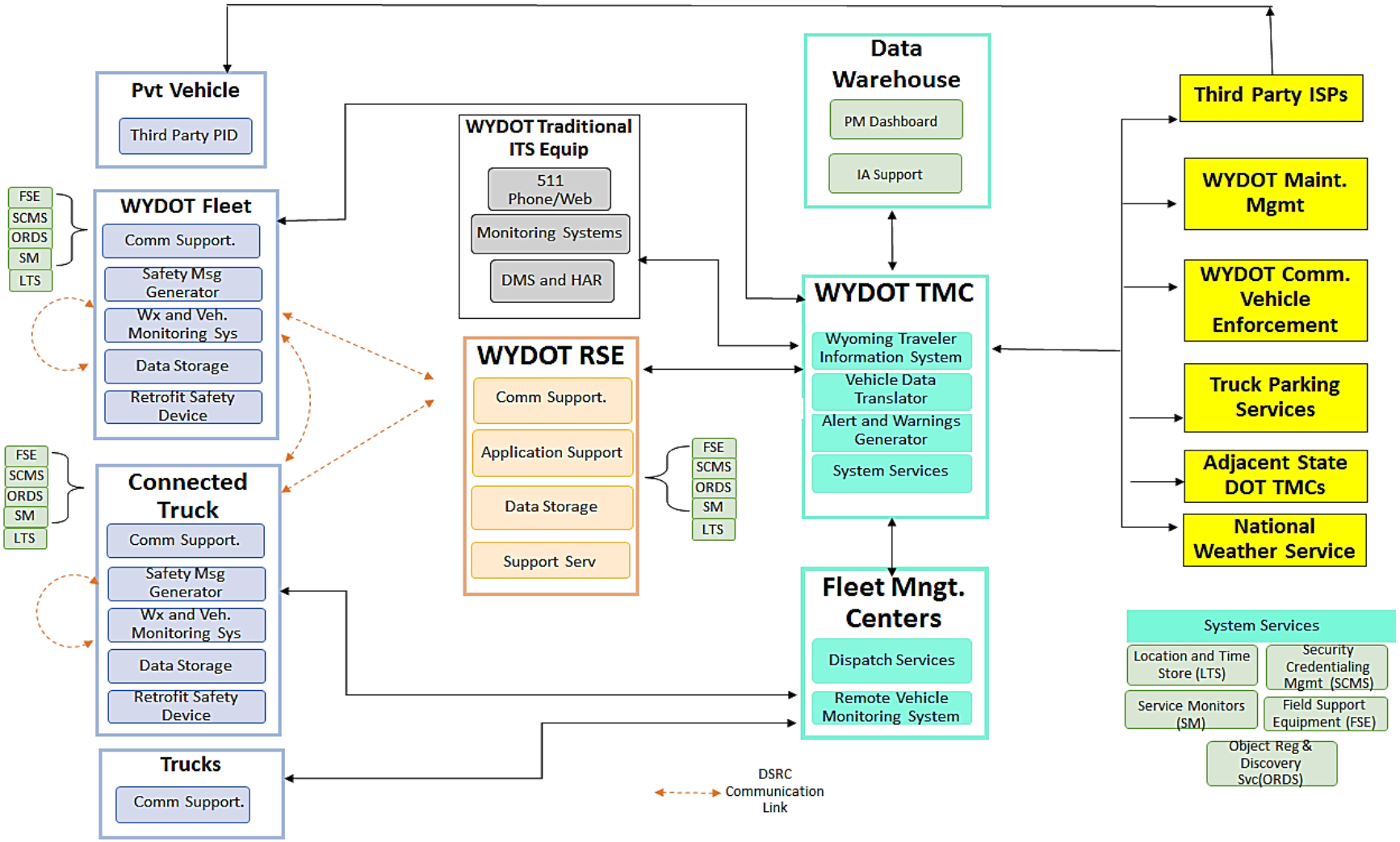
Mobile Distribution System



Context Diagram (2/2)



Physical Elements



Defined Scenarios

- Six scenarios and 16 use-cases are defined to demonstrate the capabilities and desired functionality of the proposed system:
  - Corridor Monitoring and Operations Support (4 use-cases)
  - Truck Advisories (3 use-cases)
  - Truck Warning (3 use-cases)
  - Incident Notification (2 use-cases)
  - Dynamic Travel Planning Support (2 use-cases)
  - Performance Management (2 use-cases)

Corridor Monitoring & Operations Support

- WYDOT will leverage data collected from mobile platforms, fuse them with existing data sources and develop segment level advisories and warnings.

- WYDOT will also initiate several actions that improve the operations of the corridor based on the information received from the field.

- Four specific use-cases are identified:

V2I Road Weather Data Collection	• Identifies how weather and road weather data collection occurs during the pilot using both connected vehicles, existing road weather infrastructure, and atmospheric weather models.
Data Fusion and Segment Advisories	• Defines how WYDOT TMC personnel, WYDOT TMC Weather providers and the vehicle data translator system fuses various sources of atmospheric and road weather data, quality-checks the data and develops segment level advisories and forecasts of conditions.
Weather Responsive Traffic Management	• Defines how the WYDOT TMC proactively manages traffic conditions by a combination of advisory, control and treatment strategies.
Adjacent State DOT Coordination	• Describes how closure and road condition information is communicated from the WYDOT TMC to similar operating partners in Colorado, Nebraska and Utah.

Truck Advisories

- Proposed system alerts truck drivers on I-80 about affected area or segments of the highway so they can optimize their route selection and overall travel time.
- It should be noted that the advisories do not demand immediate action from drivers.
- Three use cases are identified under this scenario:

I2V Advisory	• Represents advisories provided by RSE to connected vehicles as they pass by specific locations on the corridor.
Wide Area Advisory	• Defines the wide-area advisories generated by the WYDOT TMC to support operations during adverse weather in the corridor
V2V Advisory	• Provides a V2V advisory between equipped trucks and WYDOT fleet vehicles especially between vehicles traveling in opposite directions.

Truck Warning

- Mitigate the effects of incidents by warning drivers approaching an affected area or segment of the highway.
- In contrast to advisories, warnings entail immediate action in order to optimize the driver's route selection and avoid a potential incident.
- Three specific use-cases are identified under this scenario:

I2V Warning - General	• A RSE communicates with equipped vehicles about immediate threats to driving conditions. Warnings are not customized to vehicles and all equipped vehicles will receive the same message.
V2I Warning-Custom	• A RSE communicates with equipped vehicles about immediate threats to driving conditions. Warnings are generated based on the vehicle type or traveling speeds of the receiving vehicle.
V2V Warning	• V2V communications alert drivers of deteriorating conditions in front of the lead vehicle. Warnings provided by the lead vehicle are relayed backward in the traffic stream to other equipped vehicles.

Incidents Notification

- Improves notification of incidents to appropriate agencies within Wyoming.
- Where communications are not present, connected vehicles also serve as a relay to collect and distribute emergency notification.
- Two use-cases are identified under this scenario:

Incident Notification	• WYDOT TMC receives a location-based notification, generated by an equipped vehicle involved in a crash in the corridor. The WYDOT TMC will then notify emergency response personnel based on location.
Emergency Relay	• Relay of emergency and crash information occurs between equipped vehicles to ultimately notify WYDOT TMC when communication is available.

Dynamic Travel Planning Support

- Provides travel planning support to third parties including freight management centers and third party application developers.

- Two specific use-cases are identified under this scenario:

Freight Travel Planning Guidance	• WYDOT TMC and fleet management centers exchange information about travel conditions and forecasts on I-80 through the CVOP and other connections enabled by the proposed system.
Third Party Application Developer Support	• WYDOT TMC supports access to CV data feeds to third-party application developers to use segment alerts and advisories generated by the proposed system in their user-facing applications.

Performance Management

- Monitoring of daily operations and improved day-to-day performance of the proposed system.
- Develops a post-hoc assessments of outcomes and impacts due to the proposed system.
- Two specific use-cases are identified under this scenario:

Performance Management Support	• Continuously monitor the performance of the system both from measuring the outputs of the system (what is the system supposed to do) as well outcomes (what is the system achieving).
Impact Evaluation Support	• Activities necessary to establish the overall safety and mobility impacts of the proposed system.

Application Summary

Road Weather Advisories for Trucks and Vehicles

Spot Weather Impact Warning

CV-enabled Weather-Responsive Variable Speed Limits

Situational Awareness

Automated Notification of Emergency Responders

Work Zone Warnings

Truck Parking Availability for Freight Carriers

Freight-Specific Dynamic Travel Planning

Connected Vehicle Applications

CV Application	WYDOT Snow Plows	WYDOT Maintenance Fleet Vehicles	Emergency Vehicles	Private Trucks/ Commercial Vehicles
1. Road Weather Advisories for Trucks and Vehicles	✔	✔	✔	✔
2. Automatic Alerts for Emergency Responders			✔	
3. CV-enabled Weather-Responsive Variable Speed Limits	✔	✔	✔	✔
4. Spot Weather Impact Warning	✔	✔	✔	✔
5. Work Zone Warnings	✔	✔	✔	✔
6. Situational Awareness	✔	✔	✔	✔
7. Truck Parking Availability for Freight Carriers				✔
8. Freight-Specific Dynamic Travel Planning				✔

ICF/Wyoming

Stakeholder Engagement Summary

Ali Ragan, Outreach Lead

Who we talked to

- Stakeholders Engaged in ConOps Development
  - U.S Department of Transportation
  - WYDOT
    - Traffic, Construction, Maintenance, GIS/ITS, IT, Telecom Programs, Purchasing, Public Affairs, and Planning.
  - Wyoming Highway Patrol
  - Fleet Managers
    - UPS, Crete Carrier, Werner ENT, Walmart Trans, Sage Truck Driving Schools, Lowes Burgner/Transpro Trucking, Ram Trucking, Savage Trucking.
  - Wyoming Trucking Association
  - City managers and local traffic and law enforcement officials
    - Rawlins, Laramie, Cheyenne, Green River, Rock Springs, Evanston.
  - National Weather Service
  - County Emergency Management
  - Private Truck Parking Services
  - Wyoming Government

What we heard

- Specific system concerns and needs
  - **Pass information to other states so drivers can plan ahead**
  - **Need greater situational awareness of upstream conditions**
  - **Truck parking is a real issue**
  - **When necessary, take the TMC out of the loop.**
  - **Be aware of distracted driving**
  - **Keep in mind level of driver experience, as a driver in general and in Wyoming in particular**
  - **Be aware of possible concerns with data sent from vehicles (privacy and security)**
  - **Communicate with drivers on the other side of the road -- northbound drivers know what southbound drivers need to know**
  - **Keep in mind cell phone dead zones**
- Overall
  - Great interest and support
  - Unfamiliarity with systems engineering language and process
  - Want it now!

What we learned

- Letting the user needs drive the process
- Need different levels for engagement in the pilot for the freight community.
  - Diversity of freight and trucking operations.
- Leveraging resources, existing initiatives and examples.
- Performance management – Think early and often.
- Look for applications that do not depend on critical mass of vehicles.
- Set expectations.
- Language barriers.
- Simplicity of system.

ICF/Wyoming

Next Steps

Deepak Gopalakrishna, ICF/Wyoming Project Management Lead

Next Steps

- Phase I Tasks:
  - Task 1: Program Management
  - Task 2: Pilot Deployment Concept of Operations (ConOps)
  - Task 3: Security Management Operating Concept
  - Task 4: Safety Management Plan
  - Task 5: Performance Measurement and Evaluation Support Plan
  - Task 6: Pilot Deployment System Requirements
  - Task 7: Application Deployment Plan
  - Task 8: Human Use Approval
  - Task 9: Participant Training and Stakeholder Education Plan
  - Task 10: Partnership Coordination and Finalization
  - Task 11: Outreach Plan
  - Task 12: Comprehensive Pilot Deployment Plan
  - Task 13: Deployment Readiness Summary

Ongoing Activities

- Security Management Plan
- Safety Management Plan
- Performance Management and Evaluation Plan
- Partnership development

- **And most importantly, Vendor Engagement Activities**

- **Please reach out to Ali Ragan, WYDOT (ali.ragan@wyo.gov), if you are a vendor with interest in this project**
  - **Setting up a 30 minute webinar in February to talk about your product and our needs**
  - **Engaging with vendors for On-Board Equipment, Roadside Equipment, Application Developers, Weather Telematics, Fleet Data Providers**

Stakeholder Q&A

- Please keep your phone muted
- Please use chatbox to ask questions
- Questions will be answered in the order in which they were received

STAY CONNECTED

Join us for the *Getting Ready for Deployment* Series

- Discover more about the 2015 CV Pilot Sites
- Learn the Essential Steps to CV Deployment
- Engage in Technical Discussion

Website: http://www.its.dot.gov/pilots

Twitter: @ITSJPODirector

Facebook: https://www.facebook.com/DOTRITA

Contact for CV Pilots Program:

Kate Hartman, Program Manager
Kate.hartman@dot.gov

Public ConOps Webinars:

- ICF/Wyoming Pilot Site

  2/5/2016, 1:00 – 2:00 pm EST

- Tampa (THEA) Pilot Site

  2/8/2016, 2:00 – 3:00 pm EST

- NYC Pilot Site

  TBD

Please visit the CV pilots website for the recording and the briefing material of the previous webinars.