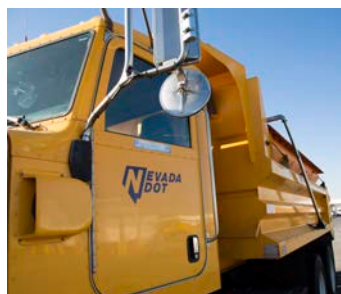


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Weather-Responsive Management Strategies

Orientation Webinar
September 10, 2018

Poll #1

Agenda

- Welcome and Overview:
Weather-Responsive Management Strategies (WRMS)
- WRMS Examples
- WRMS Deployment
- Closing Thoughts and Next Steps
- Q&A



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Welcome and Overview

Today's Presenters

Roemer Alfelor

FHWA Road Weather
Management Program

Paul Pisano

FHWA Road Weather
Management Program



Roemer



Paul

Steve Cook, Michigan
Department of Transportation

Bret Hodne, City of West
Des Moines, Iowa



Steve



Bret

What is “Every Day Counts”(EDC)?

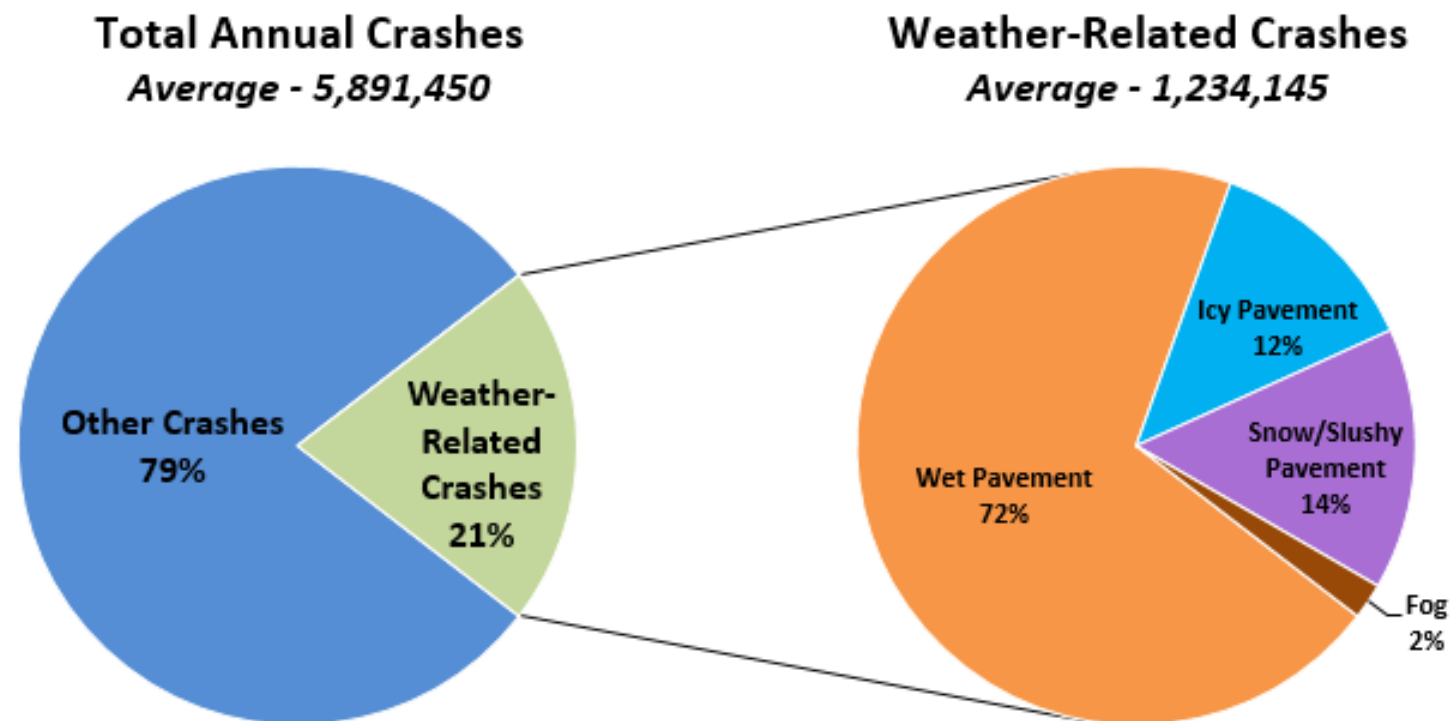
- State-based model to identify and rapidly deploy proven but underutilized innovations to:
 - shorten the project delivery process
 - enhance roadway safety
 - reduce congestion
 - improve environmental sustainability
- EDC Rounds: two-year cycles
- Initiating 5th Round (2019-2020) - 10 innovations
- To date: 4 Rounds, over 40 innovations

For more information: <https://www.fhwa.dot.gov/innovation/>

FAST Act, Sec.1444



Weather Impacts on Highway Safety



Source: NHTSA crash databases (<https://www.nhtsa.gov/research-data>).

Other Weather Impacts on Transportation

- **Mobility**
 - About 25% of non-recurring delays are due to weather
 - Congestion costs about \$9.5B/yr. in 85 urban areas*
- **Productivity**
 - Weather-related delays add about \$3.4B/yr. to freight costs
- **Environment**
 - Chemicals used for anti-icing and de-icing affect watersheds, air quality and infrastructure



*Source: 2015 Urban Mobility Scorecard (<http://mobility.tamu.edu/ums/>).

Photos – Flood in the Desert (Nevada DOT)



Source: Nevada DOT YouTube (<https://www.youtube.com/watch?v=xbsLI5fdPFE>).

What is WRMS?

EDC-5 Weather-Responsive Management Strategies

- Weather-Responsive Traffic Management (WRTM)
- Weather-Responsive Maintenance Management (WRMM)

Using Mobile and Connected Vehicle Data

to increase the effectiveness of traffic operations and reduce costs associated with maintenance during adverse road weather conditions.



Source: FHWA

Goals of EDC-5: Weather-Responsive Management Strategies

- Maximize the use of mobile road weather data to support DOTs and local transportation agencies in implementing traffic and maintenance management strategies during inclement weather
- Improve safety and reliability, and minimize environmental impacts of weather, on the transportation system

Types of Weather-Responsive Management Strategies

Traffic Management Strategies

- Motorist Advisory and Warning System (i.e. 511, Highway Advisory Radio, Variable/Dynamic Message Sign, Website, Kiosk, In-vehicle application, Smartphone Application)
- Signal Timing and Ramp Metering
- Variable Speed Limit
- Road/Lane Closure
- Traffic Diversion
- Vehicle Restriction



Source: Minnesota DOT

Maintenance Management Strategies

- Anti-icing and De-icing
- Plowing and Snow Removal
- Route Optimization/Vehicle Tracking
- Debris Removal
- Water Drainage Maintenance
- Vegetation Control



Source: Michigan DOT

Mobile and Connected Vehicle Road Weather Data Sources

- Vehicle-based Road Weather Sensors
 - Friction, Temperature, Precipitation, Snow Depth, etc.
- On-board cameras
- Electronic tablets
- Cell Phones and Personal Digital Assistants (PDA)
- Global Positioning System receivers/AVL Systems
- Vehicle Controller Area Network (CAN) Bus



Source: Nevada DOT



Source: Wyoming DOT



Source: Utah DOT



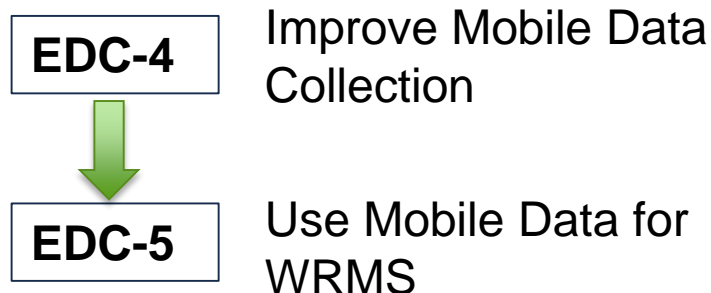
Source: City of West Des Moines, IA

EDC-4 Initiative: Integrating Mobile Observations (IMO)

- **Weather and road condition data collection** from fleet vehicles for a more comprehensive view of network conditions
- Advanced, vehicle-based technologies are deployed to **collect, transmit, and use** weather, road condition, and related vehicle data

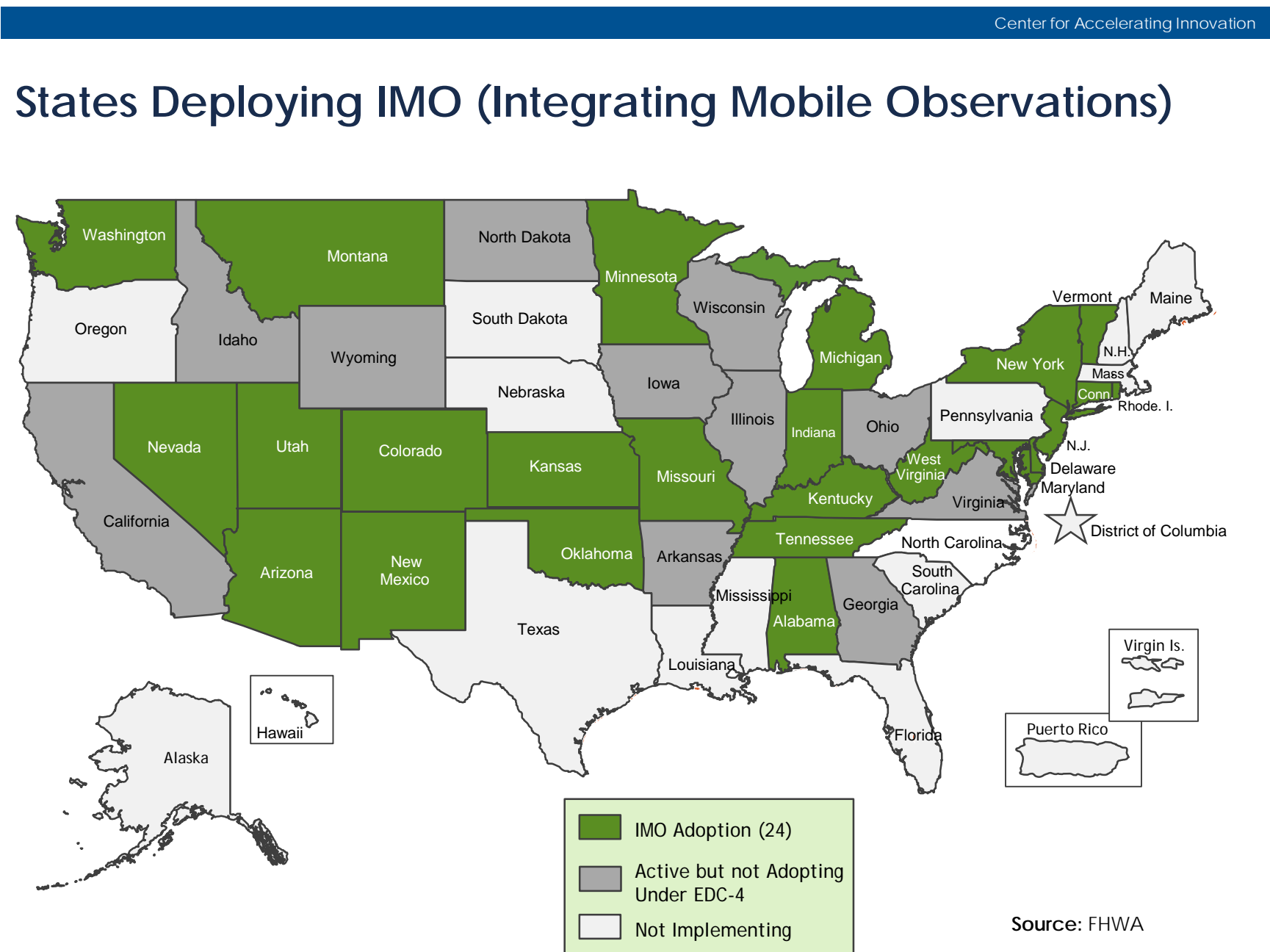


Source: Wyoming DOT



Poll #2

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States Deploying IMO (Integrating Mobile Observations)

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States Deploying IMO (Integrating Mobile Observations)

Legend:

- IMO Adoption (24)
- Active but not Adopting Under EDC-4
- Not Implementing

Source: FHWA

Transportation Agencies using Mobile or CV Data for WRMS

States	Local Agencies
Michigan	West Des Moines, IA
Minnesota	Fargo, ND
Nevada	Denver, CO
South Dakota	Hennepin County, MN
Utah	McHenry County, IL
Wyoming	Dakota County, MN

Benefits of Weather-Responsive Management Strategies

- Increased safety for travelers and maintenance staff from more timely, accurate, and location-specific traveler information, alerts, and warnings
- Improved transportation system performance (reduced delays, increased goods movement, etc.)
- Enhanced traffic management operations
- Increased efficiency of road treatment and maintenance management strategies (cost savings)
- Reduced negative environmental impacts through the more efficient use of materials



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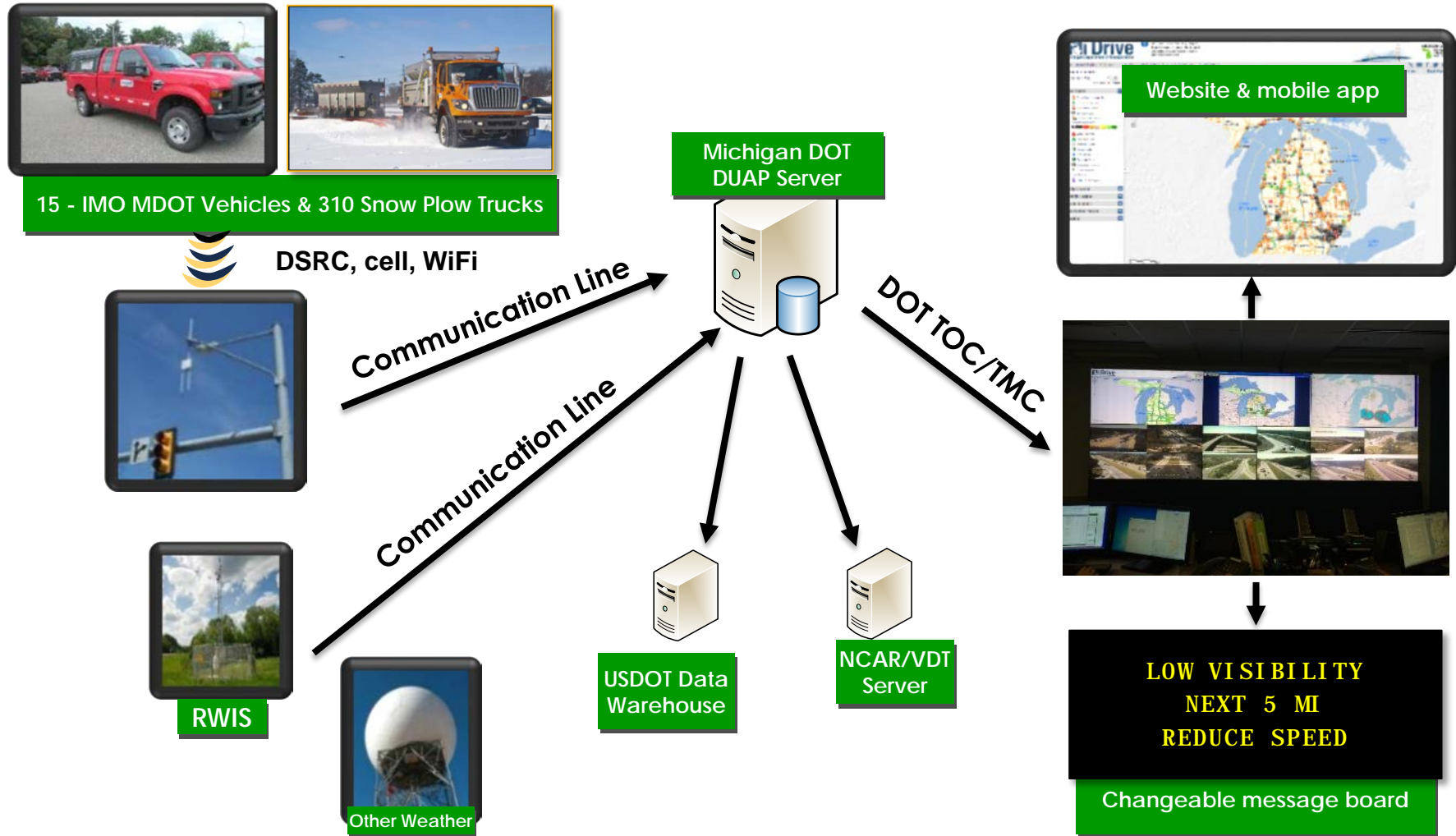
WRMS Examples

Michigan DOT Wx-TINFO

Wx-TINFO: Weather-Responsive Traveler Information System

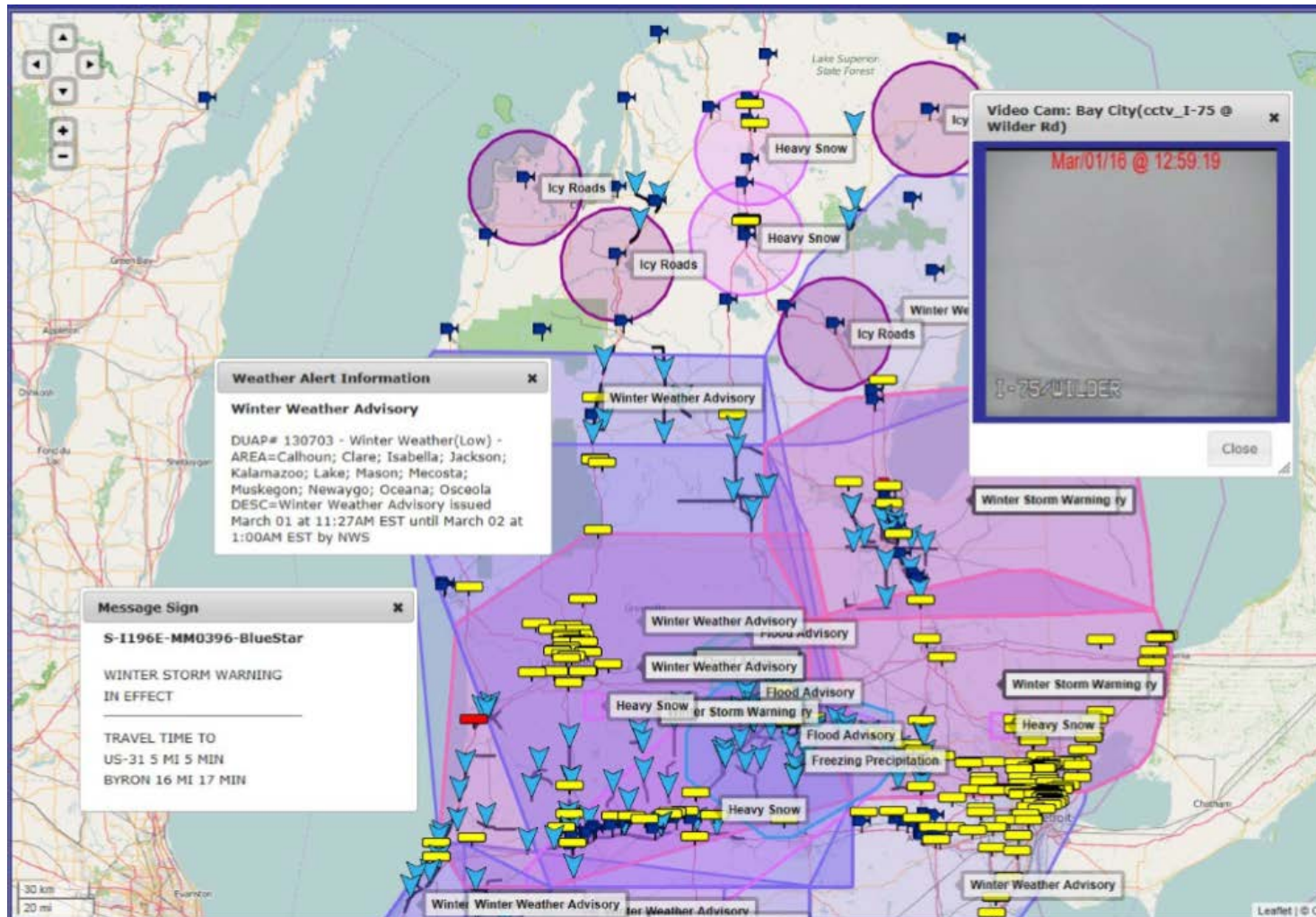
- A system that brings together near-real time environmental and weather-related data collected from both fixed and mobile data sources (IMO). The data is used to trigger motorist advisories and warnings
- The information is made available to the traveling public via roadside dynamic message signs (DMS) and the Michigan traveler information website (Mi-Drive)

Michigan DOT Wx-TINFO Framework



Source: Michigan DOT

Michigan DOT Wx-TINFO Weather Alerts



Source: Michigan DOT

Wx-TINFO Dynamic Message Signs

**WHITE OUT CONDITIONS
ON I - 94
REDUCE SPEED**

**SLIPPERY ROADS
WB I - 94
REDUCE SPEED**

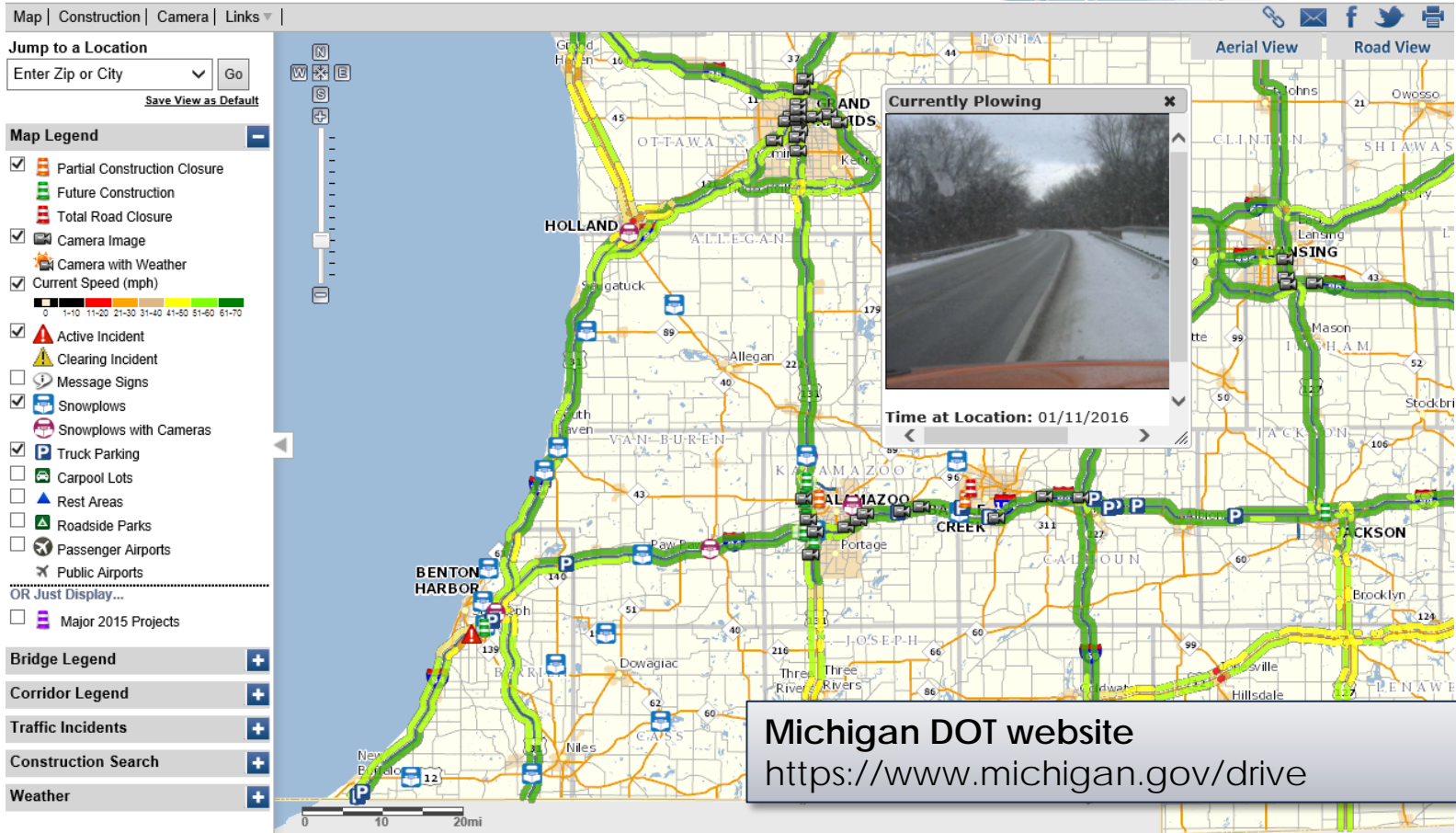
**TORNADO WARNING
INGHAM COUNTY
8:00 – 10:00 AM**

**LOW VISIBILITY
NEXT 5 MI
REDUCE SPEED**

Michigan DOT website



[Michigan.gov Home](#) | [MDOT Home](#) | [Contact Us](#) | [Disclaimer](#) | [Requirements](#)



Michigan DOT website
<https://www.michigan.gov/drive>

Source: Michigan DOT

Wx-TINFO Benefits

- Provides traveling public with more timely/valuable information allowing them to make safer pre-trip and en-route decisions during inclement weather conditions.
- Provides better roadway coverage and localized messaging for TOC/TMCs thereby increasing motorist awareness as to the safest trip alternative.
- Provides the ability to utilize an alert system to advise maintenance staff of necessary winter maintenance locations, including unsafe pavement/roadway conditions, and enhances response times.
- Optimizes the use of maintenance resources through data driven performance metrics (tracking material usage, time on roadway/overtime, automates completing vehicle logs & reports, reduced fuel consumption/emissions, etc.)

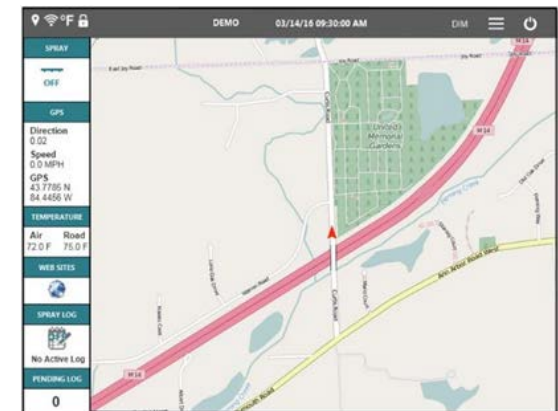
Michigan DOT WRMS – Herbicide Spraying

Features:

- 30 statewide trucks instrumented with AVL
- In-Truck touch screen monitor
- Electronic spray log
- Flow meter recording (on/off)
- GPS location on Map
- Invasive and Endangered Species locations display on monitor

Benefits:

- Reduced electronics
- i-Pad
- Handheld GPS – writing down Lat/Long
- Laptop
- Paper logs – lost em, penmanship, accuracy, completed, adding totals
- Manages incomplete record-keeping (expensive spray controllers)
- Mapping - records any shape file – alerts, invasive weeds, endangered, etc.
- Weather advisories & warnings before you go
 - Tying into an MDSS for hour by hour precipitation, wind, etc.



Photos Source: Michigan DOT

West Des Moines, Iowa - WRMS Deployment

- 150,000 daytime population
- ~70,000 residents
- 800 lane miles of pavement
- Three major interstate roadways
- High public expectations



Source: Bret Hodne, West Des Moines Public Services

Technologies and Data Used for WRMS

Road Weather Sensors

- Stationary
- Mobile

Cameras

Data Collected:

- Road friction
- Pavement/sub-surface temperatures
- Relative humidity
- Dew point
- Air temperature
- Snow/Ice depth
- Wind speed
- Pictorial history of road conditions



Infrared Stationary RWIS



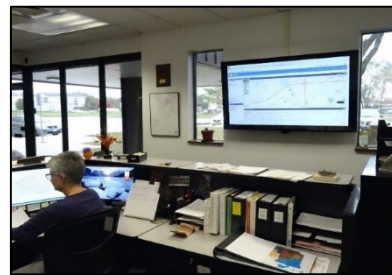
Infrared Pavement Temperature Sensor



Sensors/Controllers



Mobile RWIS Unit



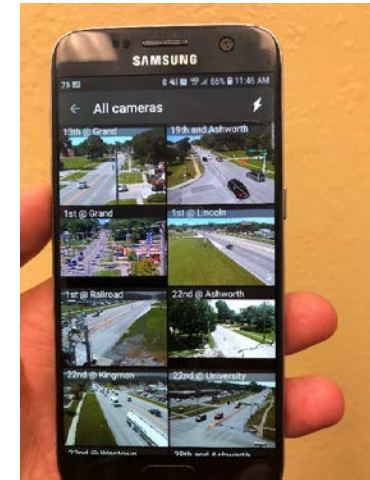
Real-Time Information



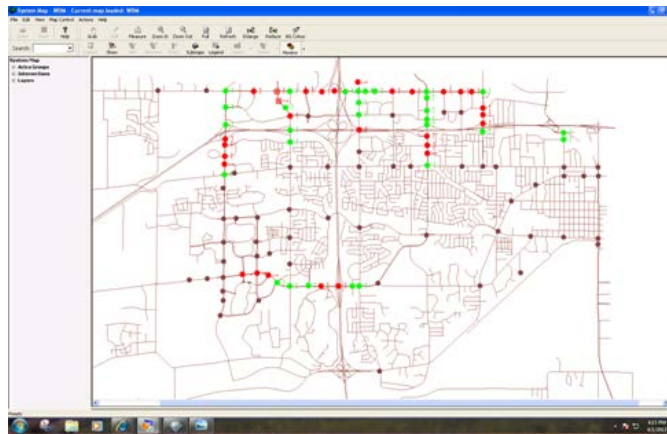
Live/Recorded Road Data

City Traffic Safety Network

- Cameras around entire city
- TMC operators able to pull up varying road conditions
- Information also available on smartphones and tablets
- Information can be used by the public



Smartphone Info



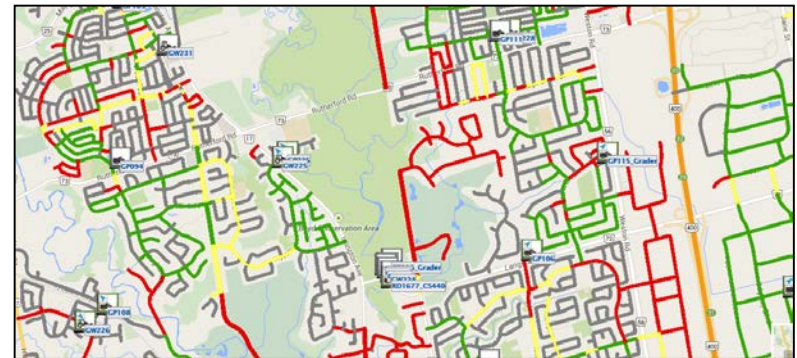
Live Network Data Feed



Traffic Camera Network

Automated Vehicle Location (AVL)

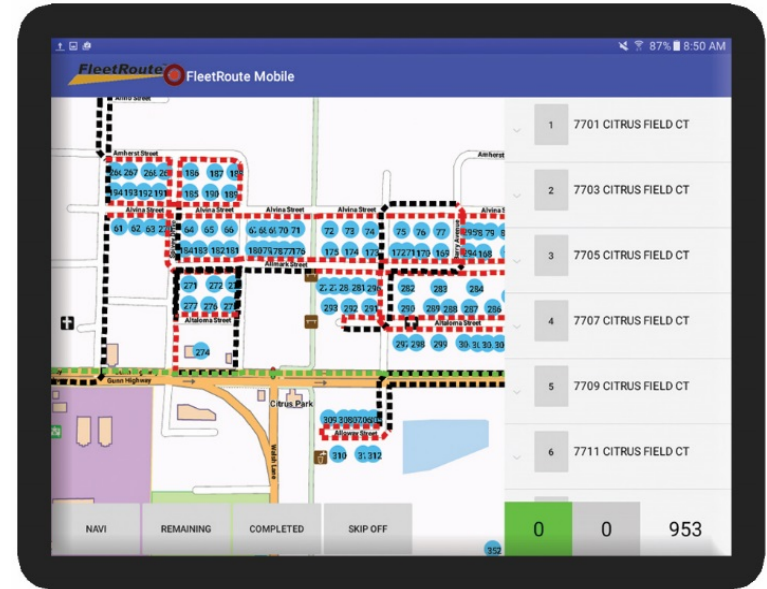
- Connected to fleet vehicles
 - Operator training
- Material management tool
 - Captures amount of material spread in real time
- Transmits real-time data
- Customer support
 - Provides residents information on when roadway was plowed
- Contractor management



Near real-time operational information

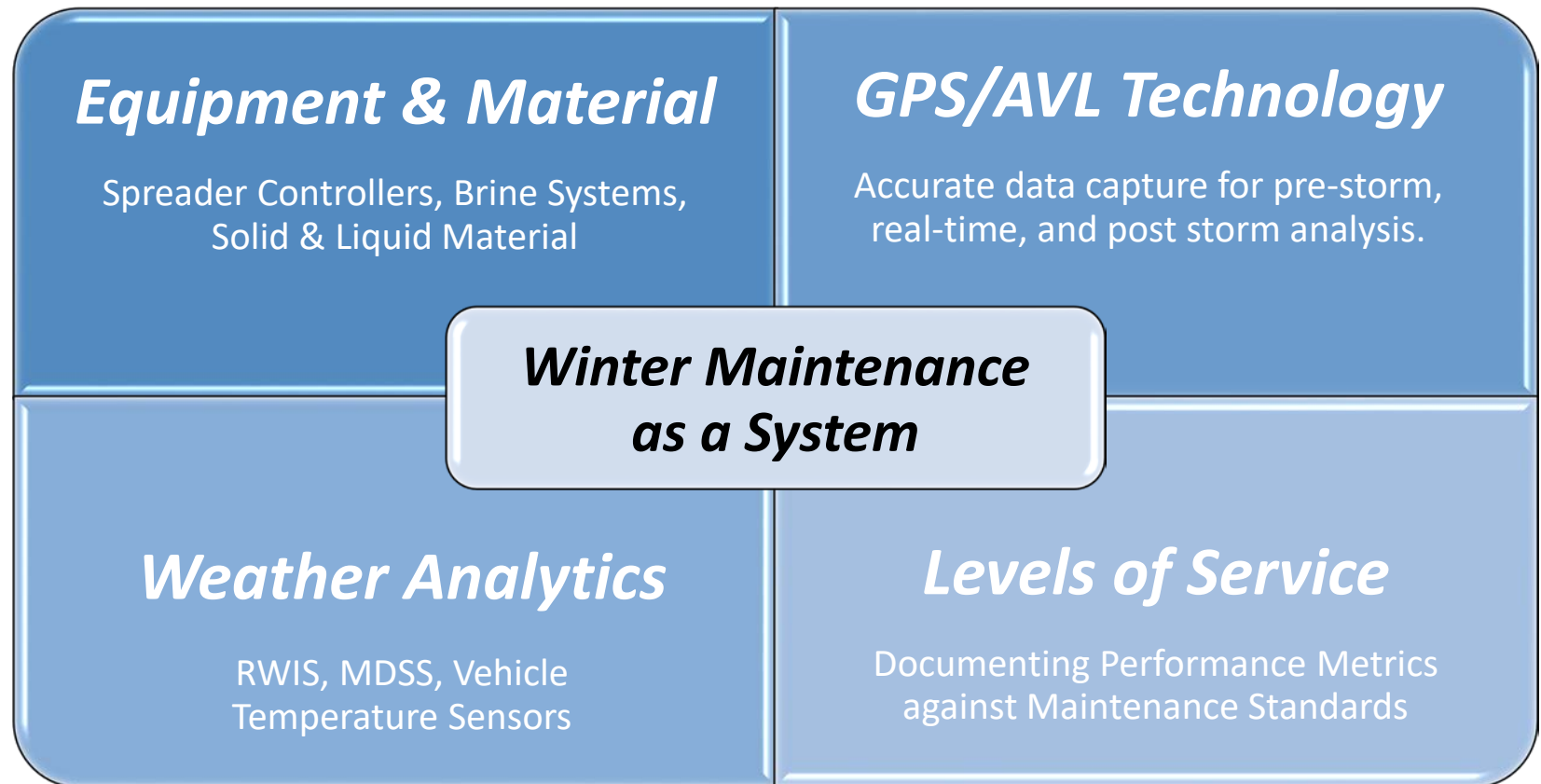
Snow Plow Route Optimization

- Turn-by-turn routing for operations
- Leading to the “next level” of customer service – exact time snow plow will be there
- Challenge – fleet will have to break off onto arterials during route



Snow Plow Routes

West Des Moines Winter Maintenance Management Framework



Other State DOT Implementations

- Wyoming DOT
 - Road Condition Reporting
 - Dynamic Message Signs
 - Variable Speed Limit
- Minnesota DOT
 - Web-Maintenance Decision-Support System (WebMDSS)
 - Motorist Advisory Warning
 - 511 Traveler Information
 - Fleet Management and Vehicle Maintenance Info
- Nevada DOT
 - Winter Maintenance Treatment Recommendations
 - Material Usage Tracking
 - Traveler Information
- Utah DOT
 - Road Condition Reporting using Mobile App (Crowdsourcing)
 - Traveler Information

Poll #3



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WRMS Deployment

Innovation Deployment Team

Role	Name/Agency
EDC Leads	Roemer Alfelor (FHWA HQ – RWM Program) Paul Pisano (FHWA HQ - RWM Program)
FHWA Team	Gabriel Guevara (FHWA HQ - RWM Program) Ray Murphy (FHWA Resource Center) Kevin Moody (FHWA Resource Center) Sharon Gordon (FHWA Center for Local Aid Support)
AASHTO	Rick Nelson (AASHTO)
State DOT	Steve Cook (Michigan DOT) Vince Garcia (Wyoming DOT) Rodney Schilling/Ambere Angel (Nevada DOT) Joe Huneke (Minnesota DOT)
Local Agency	Bret Hodne (West Des Moines, IA)

Innovation Implementation Stages

Not Implementing	Agency is not implementing WRMS due to lack of resources, management support or interest, or road weather impacts not significant
Development Stage	<p>Agency is developing WRMS implementation plans and:</p> <ul style="list-style-type: none"> - Collecting guidance and best practices - Identifying data requirements - Building support stakeholders/management - Identifying or acquiring internal and external resources
Demonstration Stage	<p>Agency is testing, piloting and documenting their WRMS implementation for at least a 3 month time period over an inclement weather season, and developing:</p> <ul style="list-style-type: none"> - The criteria to gauge how well WRMS is working - The performance measures to evaluate the effectiveness of the WRMS
Assessment Stage	<p>Agency has adopted WRMS and is adjusting current processes for full deployment, including:</p> <ul style="list-style-type: none"> - Developing a timeline for deployment - Identifying and securing funding to support deployment - Considering agency-specific training and sharing of informational materials
Institutionalized	<p>Agency has adopted WRMS and uses it regularly:</p> <ul style="list-style-type: none"> - WRMS is accepted as standard business process - Regularly monitors the effectiveness of WRMS and makes appropriate adjustments - Communicates WRMS benefits to stakeholders and the public

Poll #4

Innovation Deployment Resources

- Existing Documents/Resources
 - FHWA Pubs (i.e. CV-WRTM Deployment Guidelines)
 - AASHTO SICOP Podcasts
 - IMO Toolkit
- Implementation Plan: In-Person Activities
 - Webinars and Conference Presentations
 - Stakeholder Meetings
 - Peer Exchange Workshops
 - Demonstration Site Visits
 - Training
- Implementation Plan: Technical Resources
 - Case Studies and Fact Sheets
 - Website
 - Social Media
 - Articles in Journals/Newsletters
 - Educational and Promotional Videos

EDC-5 Funding Opportunities

- ❑ ***State Transportation Innovation Council (STIC) Incentive***
 - ✓ Up to \$100,000 per STIC per year to standardize an innovation
 - ✓ <https://www.fhwa.dot.gov/innovation/stic/>

- ❑ ***Accelerated Innovation Deployment (AID) Demonstration***
 - ✓ Up to \$1 million available per year to deploy an innovation not routinely used
 - ✓ <https://www.fhwa.dot.gov/innovation/grants/>

Closing Thoughts and Next Steps

- Weather-Responsive Management Strategies apply to all weather conditions
 - Non-winter
 - Winter
- There are two types of WRMS – Traffic and Maintenance. Agencies can implement one or both under EDC-5.
- The EDC-5 initiative focuses on WRMS that utilize mobile or CV data
- Significant benefits have resulted from implementing WRMS at the State and local levels
- Next step is to develop implementation plan for WRMS deployment

Contacts

EDC-5 Coordinators & STIC Network

<http://www.fhwa.dot.gov/innovation/stic/stic-contacts.cfm>

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Innovation Deployment News



Weekly newsletter



Bi-monthly magazine

To Subscribe:

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Text: Send "FHWA Innovation" to 468311





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Q&A



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Appendix

Minnesota DOT Weather-Responsive Management Strategies

- MnDOT has been involved with IMO for several years.
- Approximately 650 plow trucks, 20 light duty supervisor vehicles and 32 mower tractors equipped with AVL
- Mobile Data collected:
 - Air Temperature
 - Relative Humidity
 - Surface Temperature
 - Wiper Status
 - Brake Status
 - Camera Images
- Data communicated through AVL, Cellular, and DSRC
- WRMS Applications:
 - Web-Maintenance Decision-Support System (WebMDSS)
 - Motorist Advisory Warning
 - 511 Traveler Information
 - Fleet Management and Vehicle Maintenance Info

Minnesota DOT Weather-Responsive Maintenance Management Strategy

WebMDSS:

- Web-based form of the client-side Maintenance Decision Support System used by state DOTs
- Provides detailed, hour-by-hour weather and pavement forecasts at the maintenance route level
- Provides live, real-time map of what's going on in the network
- Users can click on specific trucks and see their latest images and sensor data.

Winter Maintenance Reports:

- Salt usage by operators vs. recommended
- Vehicle speed while applying chemicals
- Average precipitation
- End of shift report
- Material usage by route
- AVL status report
- Sander status



Source: Minnesota DOT

Nevada DOT WRMS

Instrumented Maintenance Vehicles

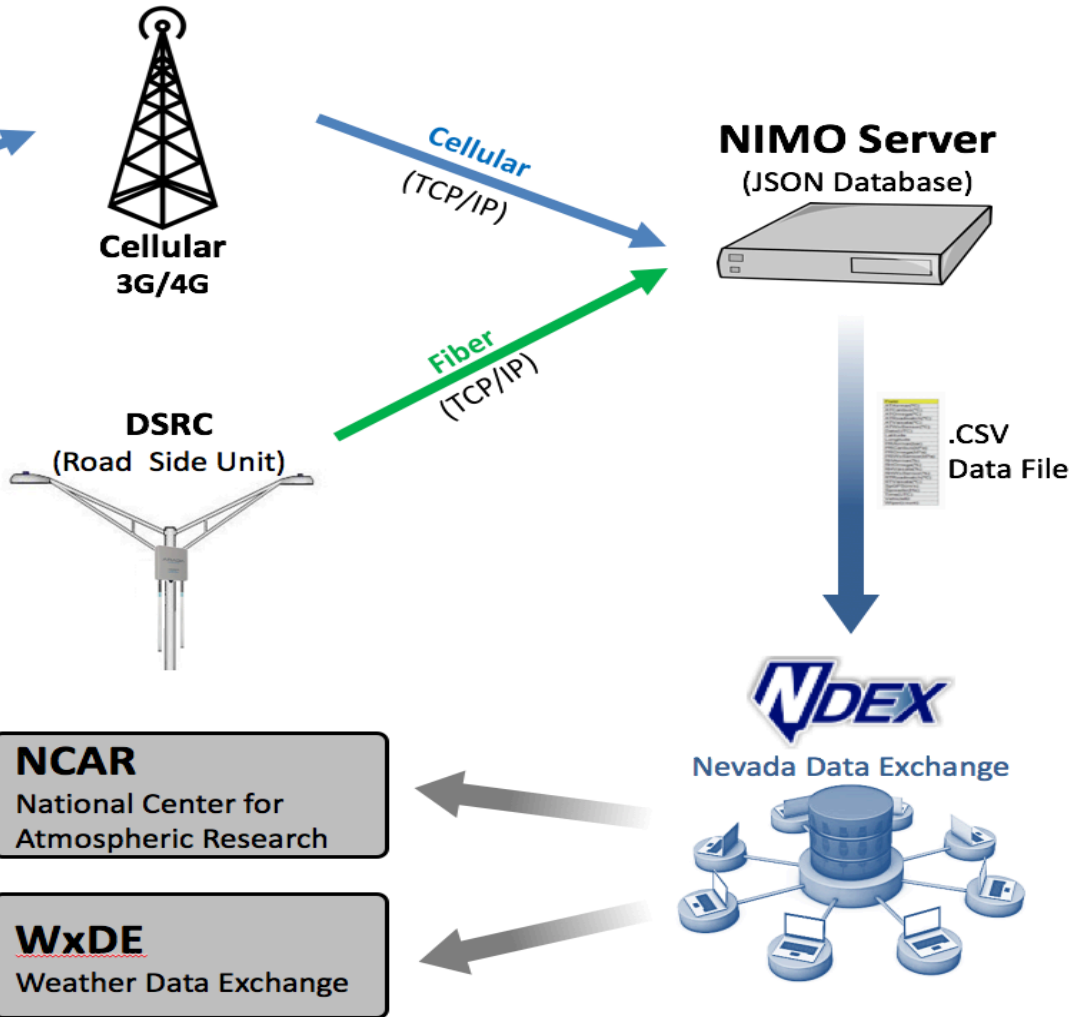


In-Vehicle Equipment:

- Weather Sensors
- Vehicle Sensors (OBU, CANBus)
- Equipment Sensors (Spreader)
- Location Sensor (GPS)
- Radio

Applications and MMS:

- Winter Maintenance
 - Treatment Recommendations
 - Material Usage Tracking
- Traffic Management
 - Traveler Information
- Data Management Systems
 - WxDE, NCAR, etc



Source: Nevada DOT

Nevada DOT WRMS

Enhanced Maintenance Mgmt. Decision-Support System (E-MDSS)

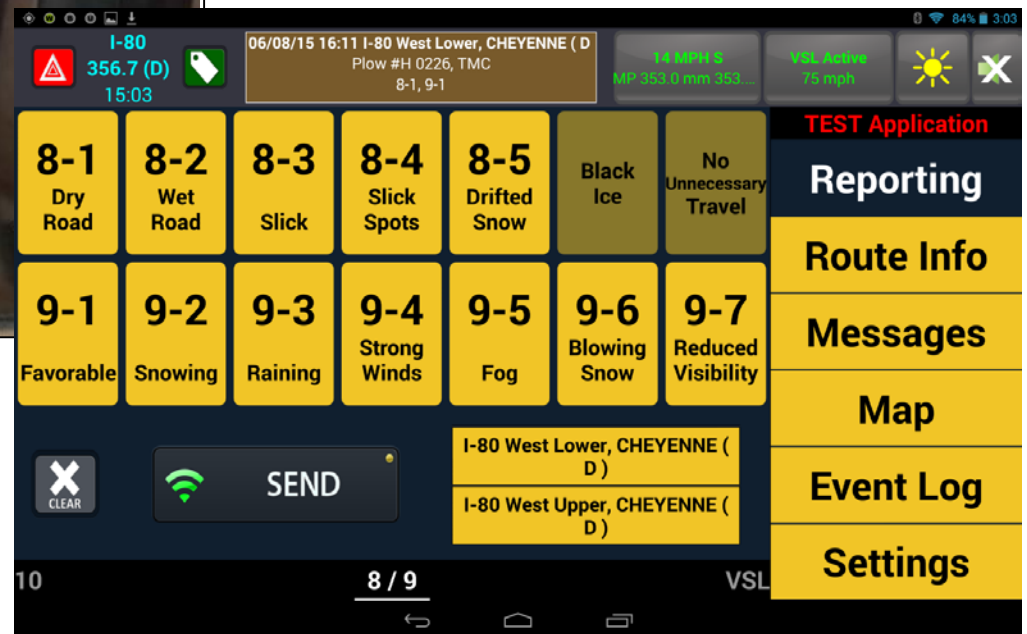
- NDOT and Univ. of Nevada Reno (UNR) have been involved with IMO for 6 years and over three different phases (radio, cellular and DSRC)
- Approx. 60 vehicles equipped to receive mobile data
 - Air Temperature
 - Surface Temperature
 - Relative Humidity
 - Atmospheric Pressure
 - Wiper Status
 - Spreader Rate
- Nevada Data Exchange (NDEX)
 - RWIS Data
 - IMO Data
- WRMS Applications (Web based Pikalert/VDT System with NCAR)
 - Enhanced Maintenance Decision Support System (eMDSS)
 - Motorist Advisory and Warning
 - Blow Over Capability

Wyoming DOT Road Condition Reporting and Traffic Management

- Mobile Road Condition Reporting app – developed for electronic tablets which are installed on maintenance vehicles to allow field crews to report information and update database remotely, free radio traffic, save employee time and provide information to the public quickly
- Traffic/maintenance management functions previously done over the radio:
 - Make road condition reports
 - Report incidents
 - Get weather data
 - See what's posted on DMS
 - Recommend changes to Variable Speed Limits



Wyoming DOT Mobile Tablet Installation and Interface



Source: Wyoming DOT



WyDOT WRMS Benefits

- More efficient road and traffic condition reporting by maintenance employees and TMC operators.
- Improved traffic management capabilities during weather events:
 - More DMS changes
 - More accurate DMS and VSL recommendations
- More timely condition reporting updates to the public
- Increased situational awareness of maintenance employees

