

**TRB 2016 International Conference & Workshop  
on Winter Maintenance and Surface  
Transportation Weather**

**Connected Vehicle Winter Weather Maintenance  
Advanced Technologies/Management for  
Motorist Advisories and Warnings**

**Michigan Department of Transportation**

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Engineer of Operations and Maintenance

# Learning Outcomes

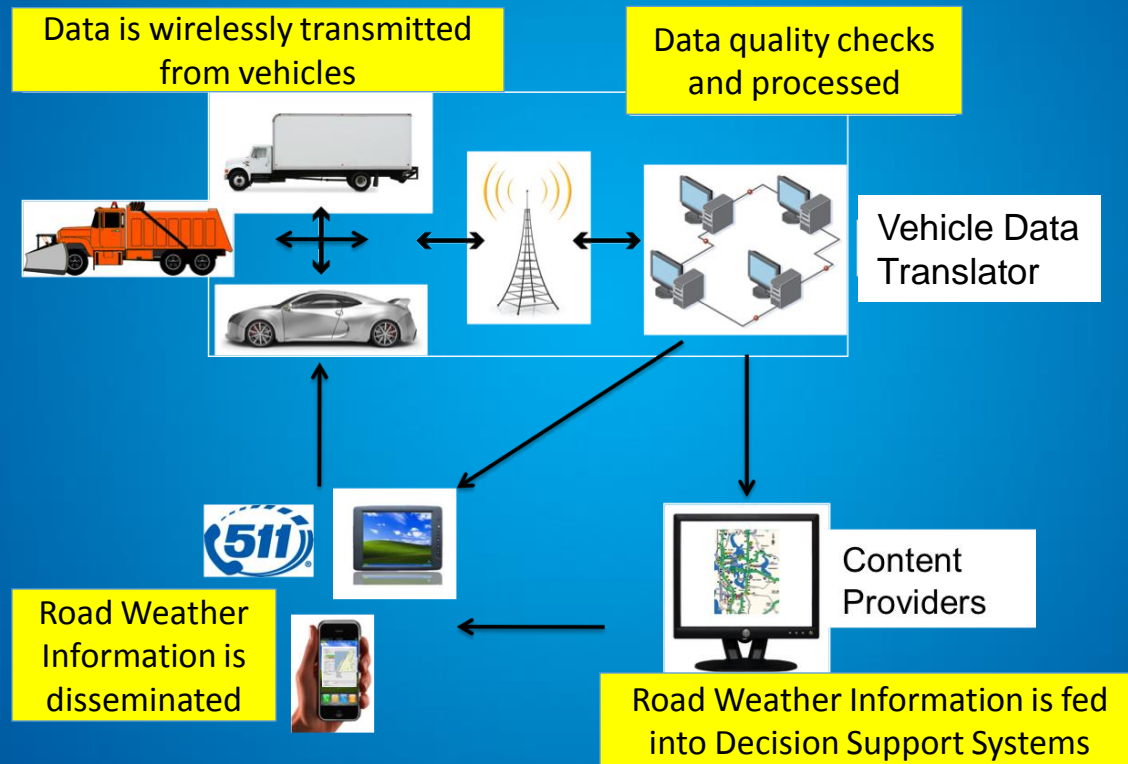
- Traveling Public Benefits
- Operations Users Benefits
- Maintenance Users Benefits

# Federal Highway Administration (FHWA) Integrated Mobile Observations (IMO) Objectives

FHWA established several IMO objectives:

- Better understand how to capture, communicate, and process data from the vehicle's internal and external road weather sensors
- Identify uses for and incorporation of the data in new and existing applications
- Assess the impact and results of utilizing the data in applications
- Establish a sustainable infrastructure that can be an integrated with operational assets that will support an agencies data collection needs

# FHWA Roadway Weather Management Project Description



# FHWA IMO Project Partner DOTs

Goal: Exploring the feasibility of using vehicle-based data to improve transportation safety & mobility



## **Vehicles Used:**

**DOT Snow Plows**

**DOT Supervisor Trucks**

**DOT Safety Trucks**

**DOT seasonal high mileage vehicles**

## **Minnesota DOT**

- ~550 Vehicles
- Data
  - GPS
  - Air Temperature
  - Relative Humidity
  - Surface Temperature
  - Wiper Status
  - Brake Status
- DSRC & Cellular

## **Nevada DOT**

- ~30 Vehicles
- Data
  - GPS
  - Air Temperature
  - Relative Humidity
  - Surface Temperature
  - Wiper Status
  - Maintenance Status
- DSRC, Radio & Cellular

## **Michigan DOT**

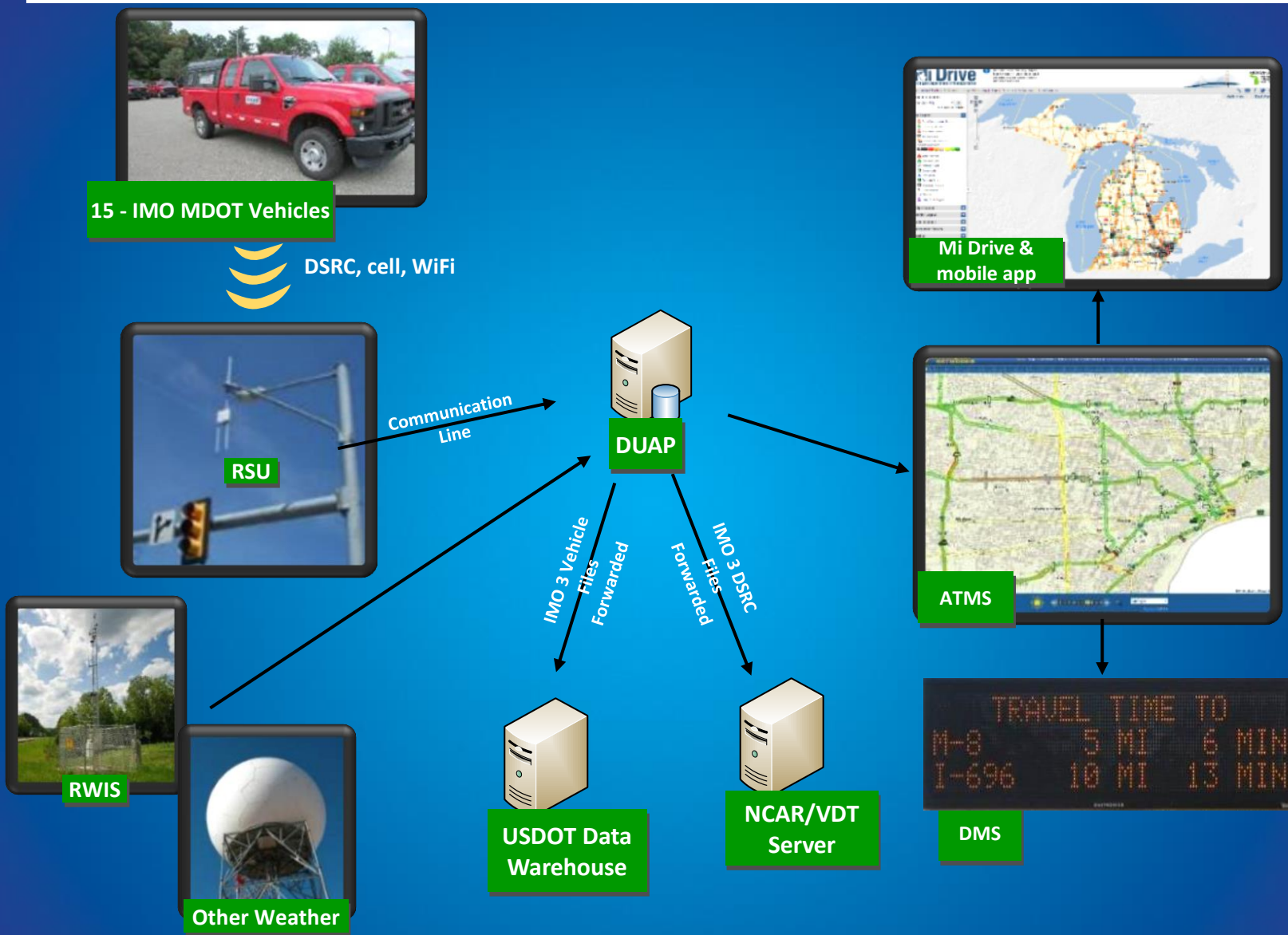
- 15 - Vehicles
- Data
  - GPS
  - Air Temperature
  - Relative Humidity
  - Surface Temperature
  - Wiper Status
  - Camera image
  - Differential wheel speed
- DSRC, Cellular & WiFi

# Winter Maintenance Operations

- Transportation Operations Centers (TOCs) & Messaging for Weather Information
- Traditional weather information (NWS, ASOS, AWOS, etc.)
- Roadway Weather Information System (RWIS)
- AVL/Maintenance Decision Support System
- IMO & WxTINFO Connected Vehicle for Weather Data
- Data Usage, Mapping and Messaging



# MDOT/FHWA Integrated Mobile Observations (IMO) Project



# MDOT/FHWA Integrated Mobile Observations (IMO)

## Project - Data Collection

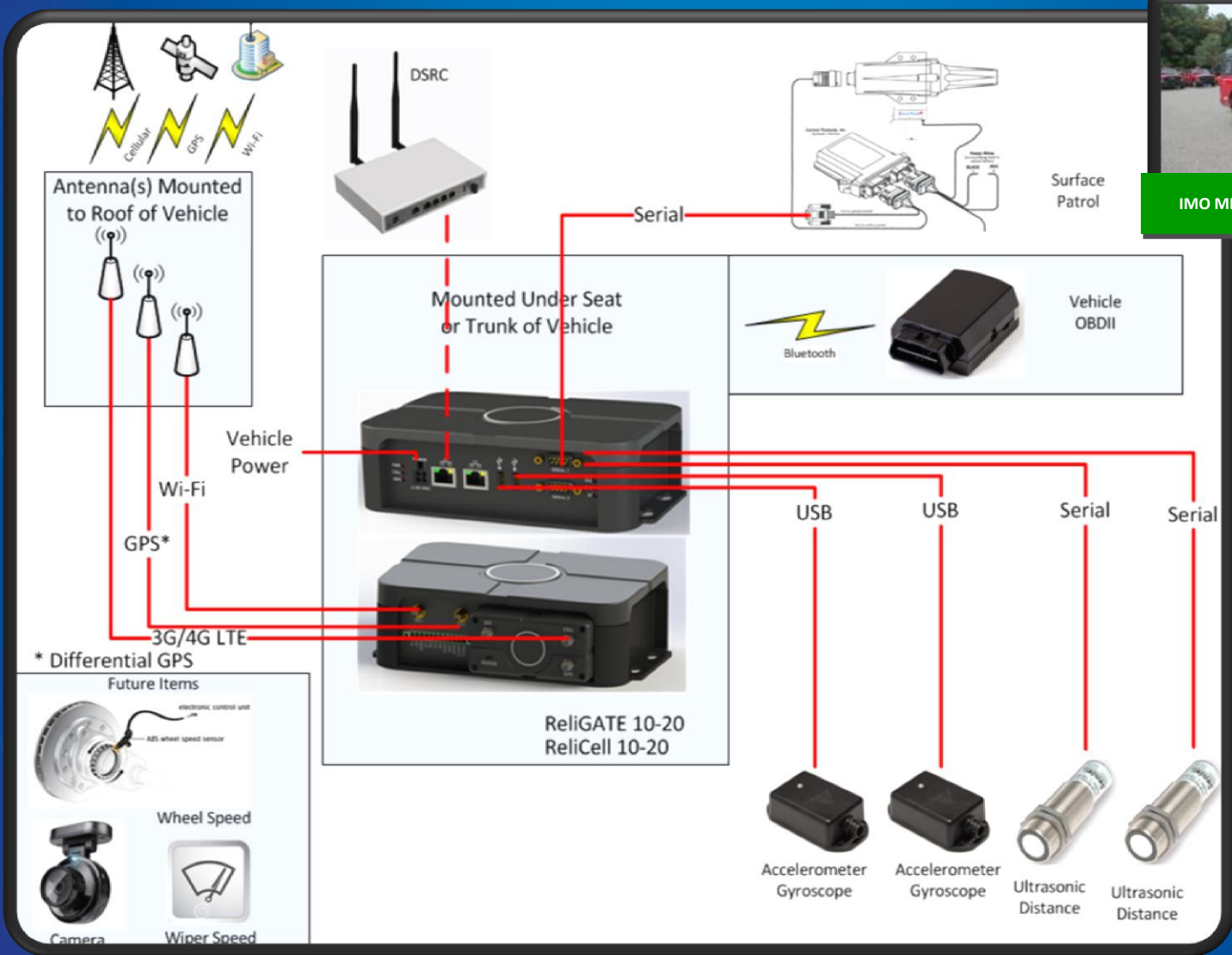
- 15- MDOT vehicles (Ford F150) equipped with a mobile data acquisition platform
- Data collected
  - Accelerometer readings
  - Latitude
  - Longitude
  - Altitude
  - GPS Speed
  - Surface temperature
  - Ambient temperature
  - Humidity
  - Dew point
  - Images
  - Wheel speed (x4)
  - CANBus

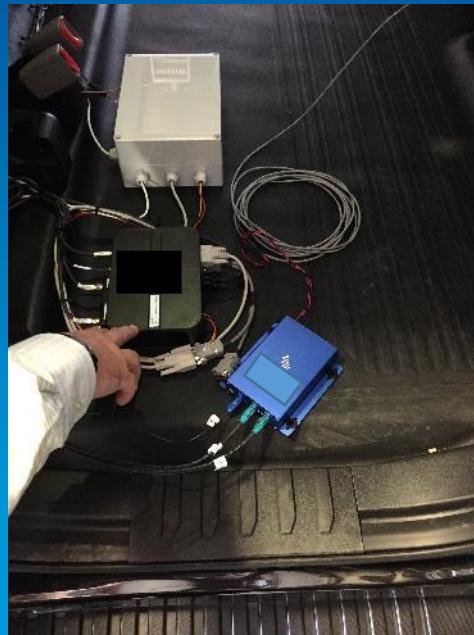


# MDOT Vehicle Data Collection Description



IMO MDOT Vehicles

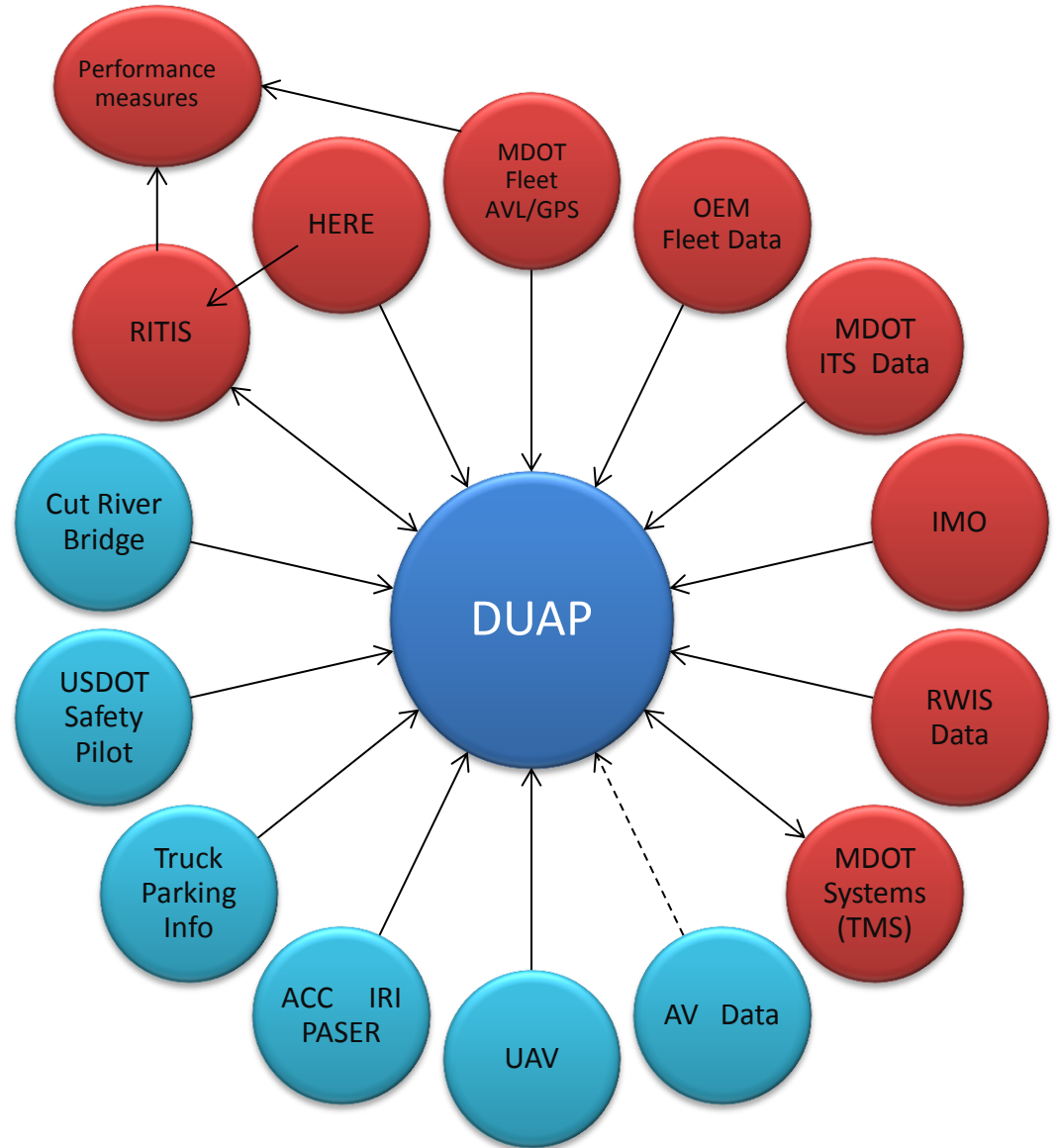
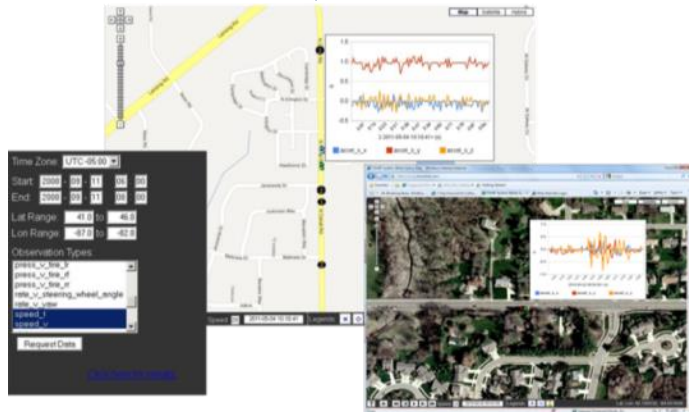
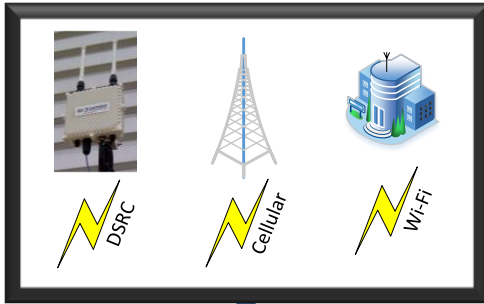




# FHWA/MDOT Weather Response Traveler Information System (Wx-TINFO) Project Objectives

- Wx-TINFO project designs a system that brings together near-real time environmental/weather related data collected from both fixed and mobile data sources and develops motorist advisories and warnings
- The information is made available to the traveling public via roadside dynamic message signs (DMS) and a traveler information website

# MDOT Data, Use, Analysis & Processing (DUAP) Project



# MDOT DUAP/ATMS Weather Map

Map Reports Analysis Feedback

Date Selections  
 Current  By Date  
 Start Date: 02/02/2016 09:00:00  
 End Date: 02/02/2016 21:00:00

Weather Selections  
 Stations  
 RWS  HWS  
 Temperature Legend  
 Animate

Alert:  ATMS  DUAP  
 Display Stop Clear  
 Alert Labels  Alert Legend  
 Last Alert Time: 02/02/2016 13:13:37

Radar:  
 Base Short Range Reflectivity  
 All Stations  
 Display Stop Clear  
 Last Radar Time: 02/02/2016 13:11:00  
 Overlay  
 Animation Speed

ATMS Alert/Radar: Display Clear  
 Red button denotes item is active and will autohide after 5 minute interval.

Map Reports Analysis Feedback

Date Selections  
 Current  By Date  
 Start Date: 02/02/2016 04:00:00  
 End Date: 02/02/2016 20:00:00

Data Selections  
 VIDAS  IMO  
 AVL  BSM  
 Signals

Viewing Selections  
 Show Vehicles  
 All Vehicles  
 Animate Pause Clear  
 Animation Time: 02/02/2016 06:54:48  
 Animation Speed:

Vehicle Paths  
 Photos  
 Road Defects  
 Road Segments  
 Latitude: 42.42345531 Longitude: -84.77097082

Trip Data  
 Vehicle: J.N\_1FTEW1E1F4FFB25757  
 Time: 02/02/2016 06:54:48  
 Latitude: 42.284822  
 Longitude: -84.385223  
 Elevation: 961 ft  
 Speedometer:  
 Speed GPS: 0 MPH  
 Heading GPS: 0 °  
 RPM:  
 Throttle:  
 ABS Activation:  
 Brake Activation:  
 Traction Control Brake:  
 Traction Control Engine:  
 Electronic Stability Control:  
 Wiper Activation:  
 Surface Temp: 26 ° F  
 Ambient Temp: 24 ° F  
 DewPoint: 19.6 ° F  
 Humidity: 83 %  
 Front Plow:  
 Belly Plow:  
 Left Plow:  
 Right Plow:

Map Reports Analysis Feedback

Date Selections  
 Current  By Date  
 Start Date: 02/04/2016 04:00:00  
 End Date: 02/04/2016 20:00:00

Data Selections  
 VIDAS  IMO  
 AVL  BSM  
 Signals

Viewing Selections  
 Show Vehicles  
 02-8045--C-B\_1FTFW1EF7EKD83152  
 Animate Resume Clear  
 Animation Time: 02/04/2016 09:41:42  
 Animation Speed:

Vehicle Paths  
 Photos  
 Road Defects  
 Road Segments  
 Latitude: 42.42345531 Longitude: -84.77097082

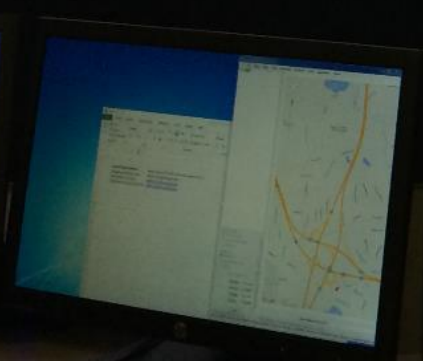
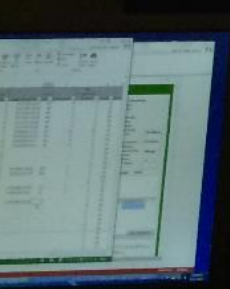
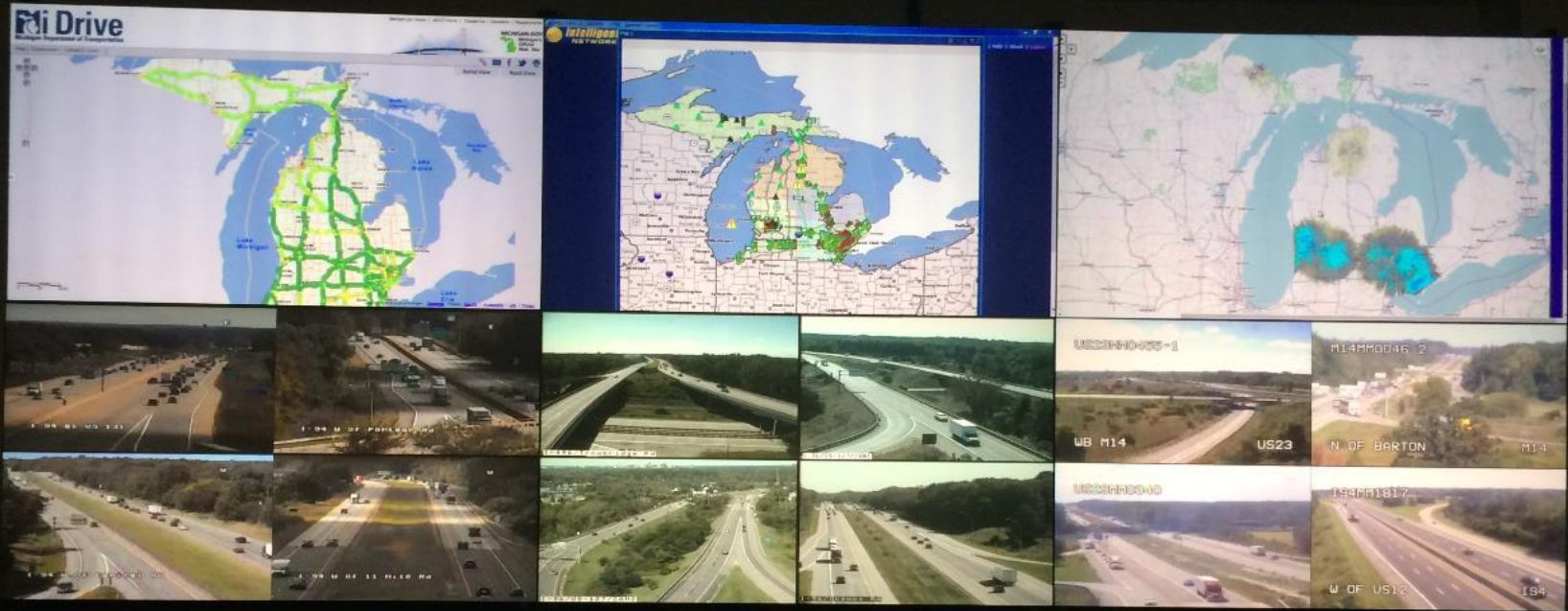
Road Defect  
 Defect Type: Map Cracking  
 Defect Time: 02/03/2016 12:00:04  
 Latitude: 38.96421  
 Longitude: -94.495564  
 Pavement Type: Hot Melt Asphalt  
 Graph

March 1, 2016, winter storm

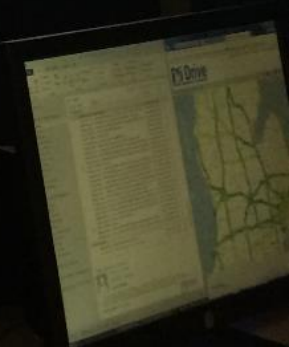
Weather Alert Information  
 Winter Weather Advisory  
 DUAP# 130703 - Winter Weather(Low) - AREA=Calthoun; Clara; Isabella; Jackson; Kalamazoo; Lake; Mason; Mecosta; Muskegon; Newaygo; Oceana; Osceola  
 DESC=Winter Weather Advisory issued March 01 at 11:27AM EST until March 02 at 1:00AM EST by NWS.

Message Sign  
 S-1196E-MM0396-BlueStar  
 WINTER STORM WARNING IN EFFECT  
 TRAVEL TIME TO US-31 5 MI 5 MIN  
 BYRON 16 MI 17 MIN

Video Cam: Bay City(cctv\_1-75 @ Wilder Rd) Mar01/16 @ 12:59:19



CONSTRUCTION  
SAFETY REGIONAL PLAYBOOK



Map | Construction | Camera | Links |

### Jump to a Location

Enter Zip or City

### Map Legend

- Partial Construction Closure
- Future Construction
- Total Road Closure
- Camera Image
- Camera with Weather
- Current Speed (mph)
- Active Incident
- Clearing Incident
- Message Signs
- Snowplows
- Snowplows with Cameras
- Truck Parking
- Carpool Lots
- Rest Areas
- Roadside Parks
- Passenger Airports
- Public Airports

### OR Just Display...

- Major 2015 Projects

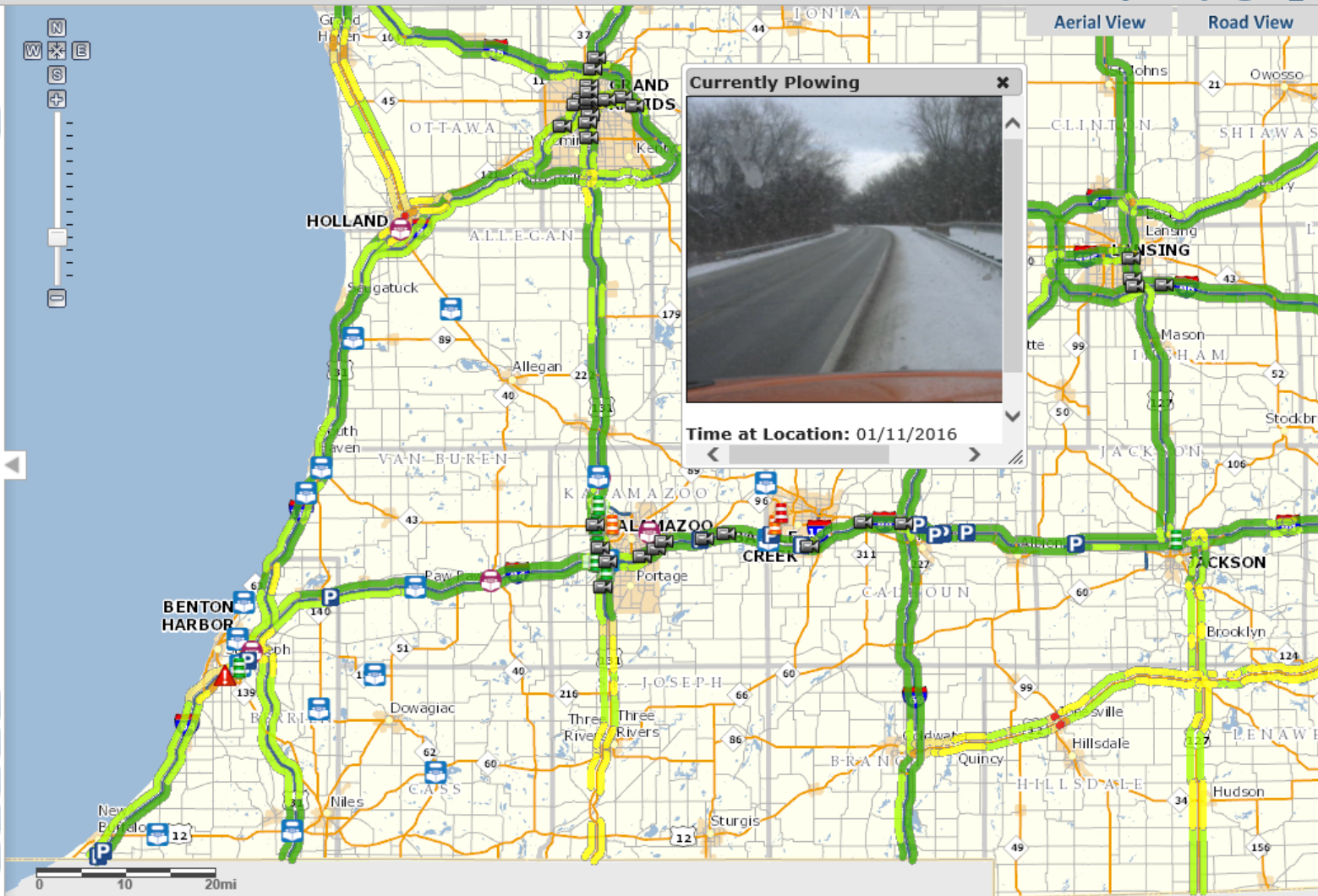
### Bridge Legend

### Corridor Legend

### Traffic Incidents

### Construction Search

### Weather



**Currently Plowing**

Time at Location: 01/11/2016

# DMS Motorist Advisory/Warning Messages

- White Out Conditions

WHITE OUT CONDITIONS  
ON I-94  
REDUCE SPEED

- Icy Roads

SLIPPERY ROADS  
WB I-94  
REDUCE SPEED

- Tornado Warning

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

- Low Visibility

LOW VISIBILITY  
NEXT 5 MI  
REDUCE SPEED



# Examples of Motorist Advisory and Warnings



**Variable Speed  
Limit Sign**



**Severe Weather  
Warning Sign**



**Dynamic Message Sign**



**Smart Truck  
Parking**

# Learning Outcomes

- **Traveling Public Benefits:** demonstrated how providing motorists with more timely/valuable information allows them to make safer decisions both pre-trip and en-route in relation to traveling the road network in inclement weather conditions.
- **Operations Users Benefits:** DOT operations are critical in providing motorists with valuable information during winter weather events. TOC/TMCs can become overwhelmed with incidents that occur during winter weather events. Having the ability to utilize an alert system to advise TOCs of necessary weather related advisory or specific alert locations increases near real-time knowledge of roadway conditions, thereby increasing the motorist decision and safety.
- **Maintenance Users Benefits:** DOT maintenance activities are critical in providing motorists with safe driving conditions during winter weather events. DOT maintenance staff manages multiple maintenance activities (plowing, salting, etc.) during winter weather events. Having the ability to utilize an alert system to advise maintenance staff of necessary winter maintenance locations, including near real-time unsafe pavement/roadway conditions, enhances response times and improves the use of maintenance resources.

**THANK YOU**

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