MDOT STATEWIDE RWIS EVALUATION

August 2015

National Rural ITS Conference

PARSONS BRINCKERHOFF

ITERIS Innovation for better mobility

MDOT Michigan Department of Transportation

Agenda

- Project Overview
- Existing System Evaluation
- Best Practice/Literature Review
- Technology Assessment
- Strategic Deployment Guide
- Current State of Michigan’s RWIS

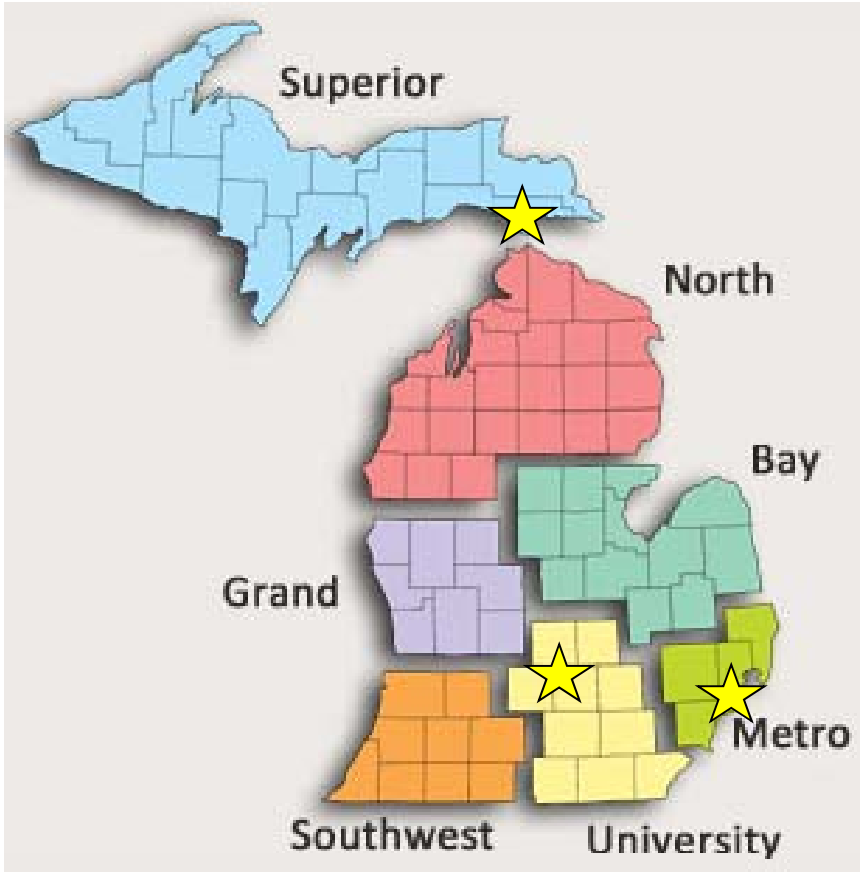
PROJECT OVERVIEW - MDOT RWIS EVALUATION

Purpose: To take a comprehensive statewide look at the future of the RWIS program

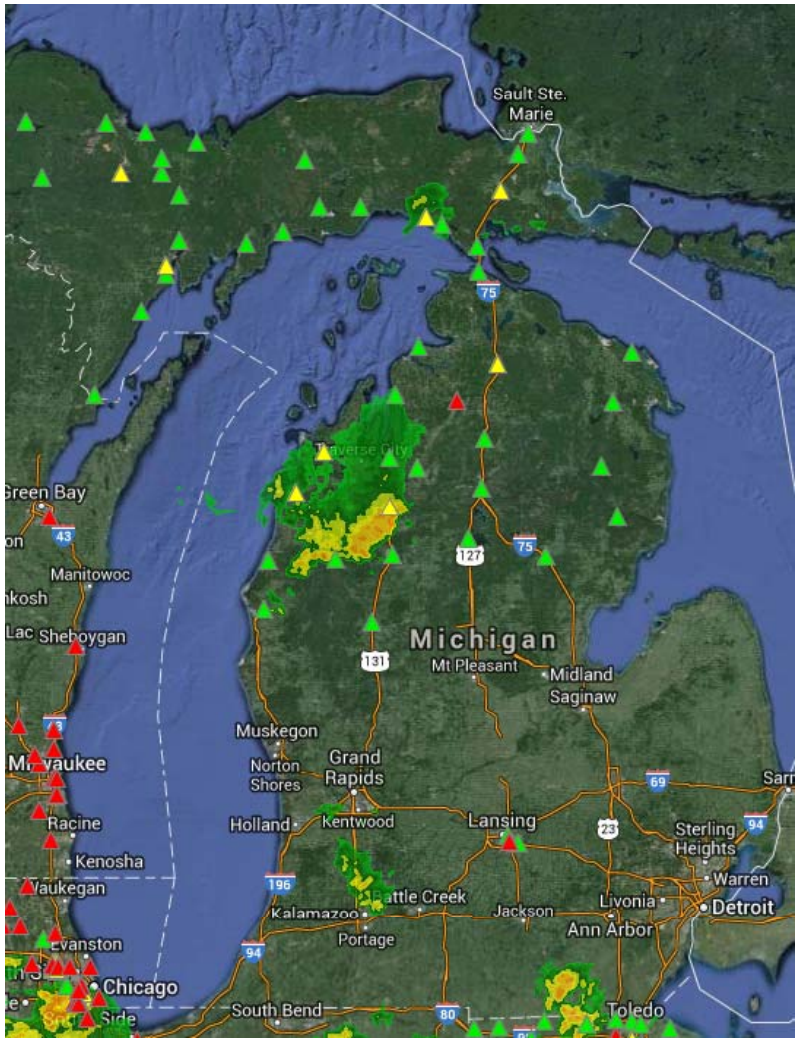
- Determined “best” practices through practitioner interviews and literature review
- Conduced an existing system evaluation
- Conducted a broad technology review and assessment.
- Developed, evaluated, and Recommended deployment strategies for MDOT’s Next Generation RWIS Program

Existing System Evaluation

- Stakeholder workshops over a 3-day period
- Each day the workshop was hosted in a different geographic region
  - Varying needs/practices in Rural and Urban environments
- Three (3) focus groups within each Region
  - Road Maintenance and Operations
  - MDOT Planning Staff and Management
  - Weather Sharing Partners



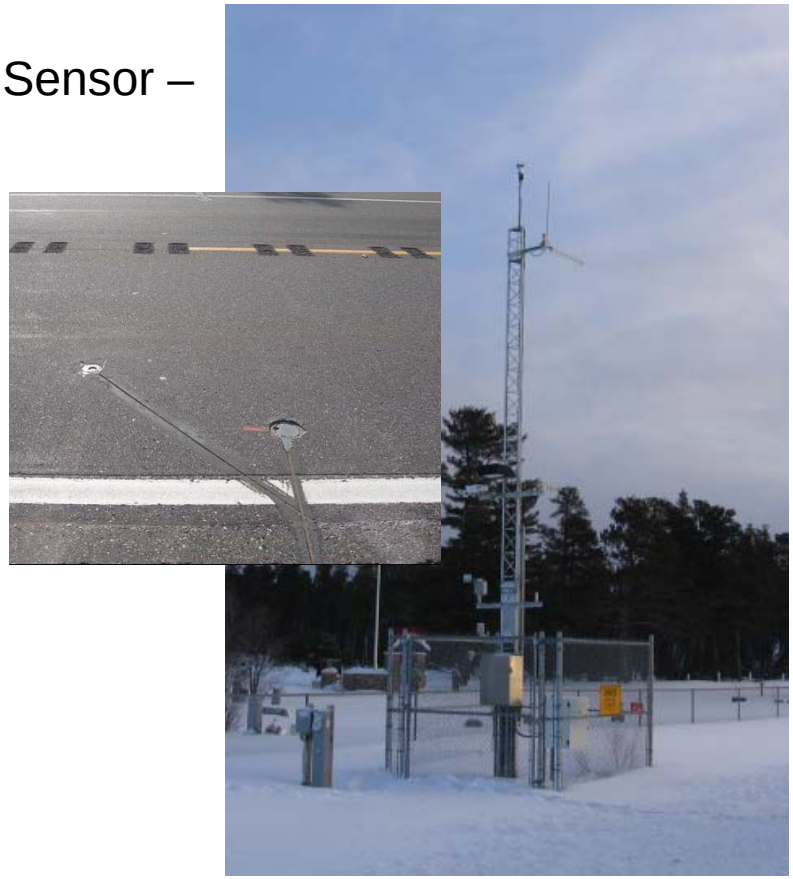
Existing System – MDOT Statewide RWIS



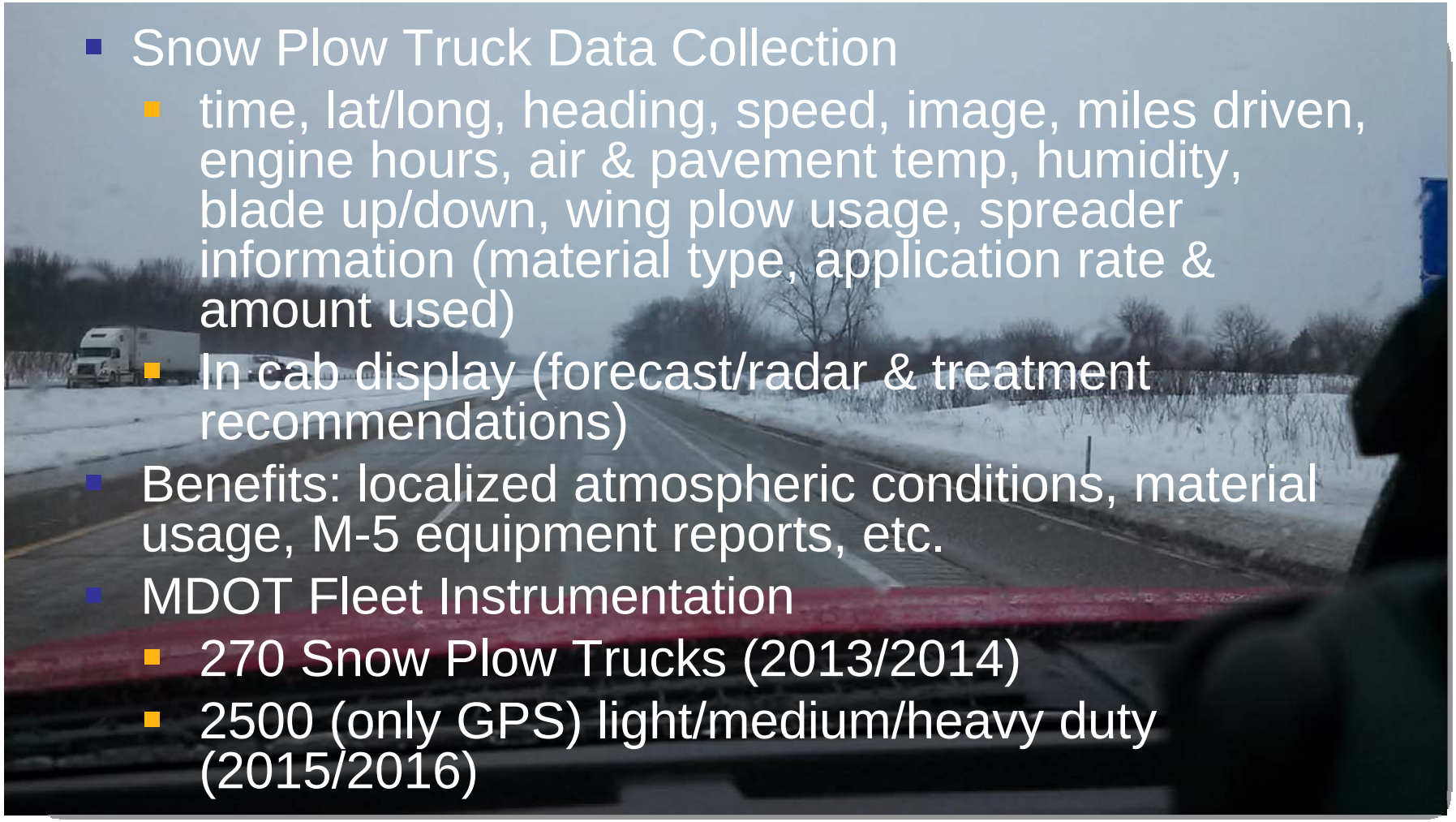
- MDOT has 73 ESS
  - Pavement temperature (in-pavement and non-invasive)
  - Atmospheric weather parameters
  - MVDS traffic counts
  - Camera images
- Connected Vehicle Implementations
  - AVL/GPS/MDSS
  - Wx-TINFO
- Multi-RWIS Vendor Approach
  - Effective for location
  - Cost efficient
  - NTCIP required
- Performance-based Contract
  - High level of data availability
  - Relatively low cost

Existing System Evaluation - Fixed ESS

- Fixed Environmental Sensor Stations (ESS)
  - Visibility Sensor
  - Air Temperature/Relative Humidity Sensor –
  - Barometric Pressure Sensor
  - Wind Sensor
  - Precipitation Sensor
  - Pavement Condition Sensor
  - Subsurface Sensor (12 readings)
  - Remote Processing unit
  - IP Surveillance System (CCTV)
  - Traffic Sensor (MVDS)



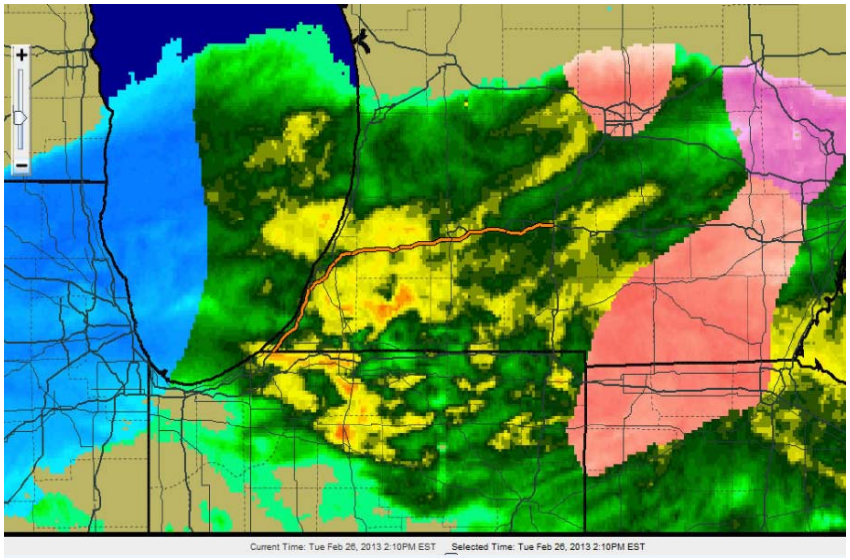
Snow Plow AVL/GPS/MDSS

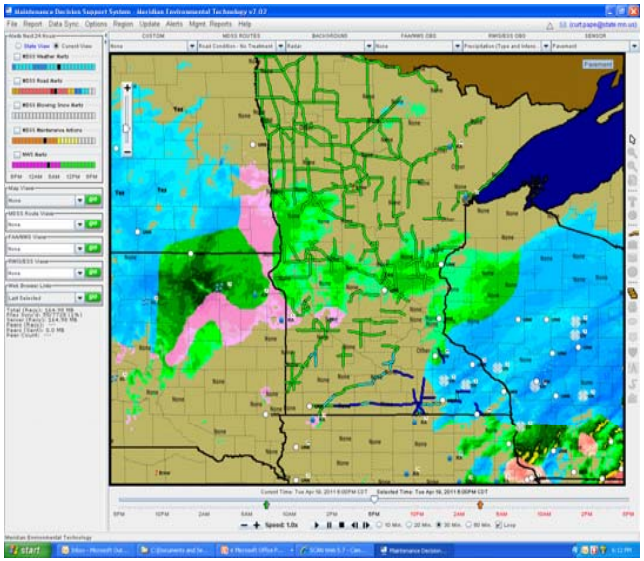


- Snow Plow Truck Data Collection
  - time, lat/long, heading, speed, image, miles driven, engine hours, air & pavement temp, humidity, blade up/down, wing plow usage, spreader information (material type, application rate & amount used)
  - In cab display (forecast/radar & treatment recommendations)
- Benefits: localized atmospheric conditions, material usage, M-5 equipment reports, etc.
- MDOT Fleet Instrumentation
  - 270 Snow Plow Trucks (2013/2014)
  - 2500 (only GPS) light/medium/heavy duty (2015/2016)

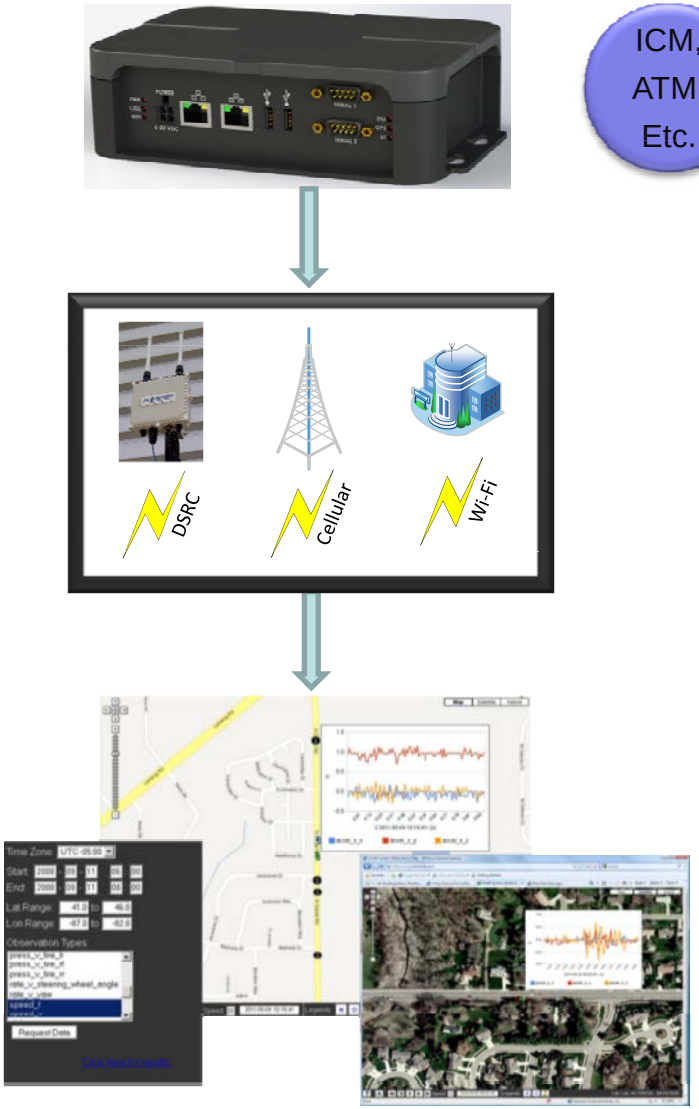
Maintenance Decision Support System (MDSS)

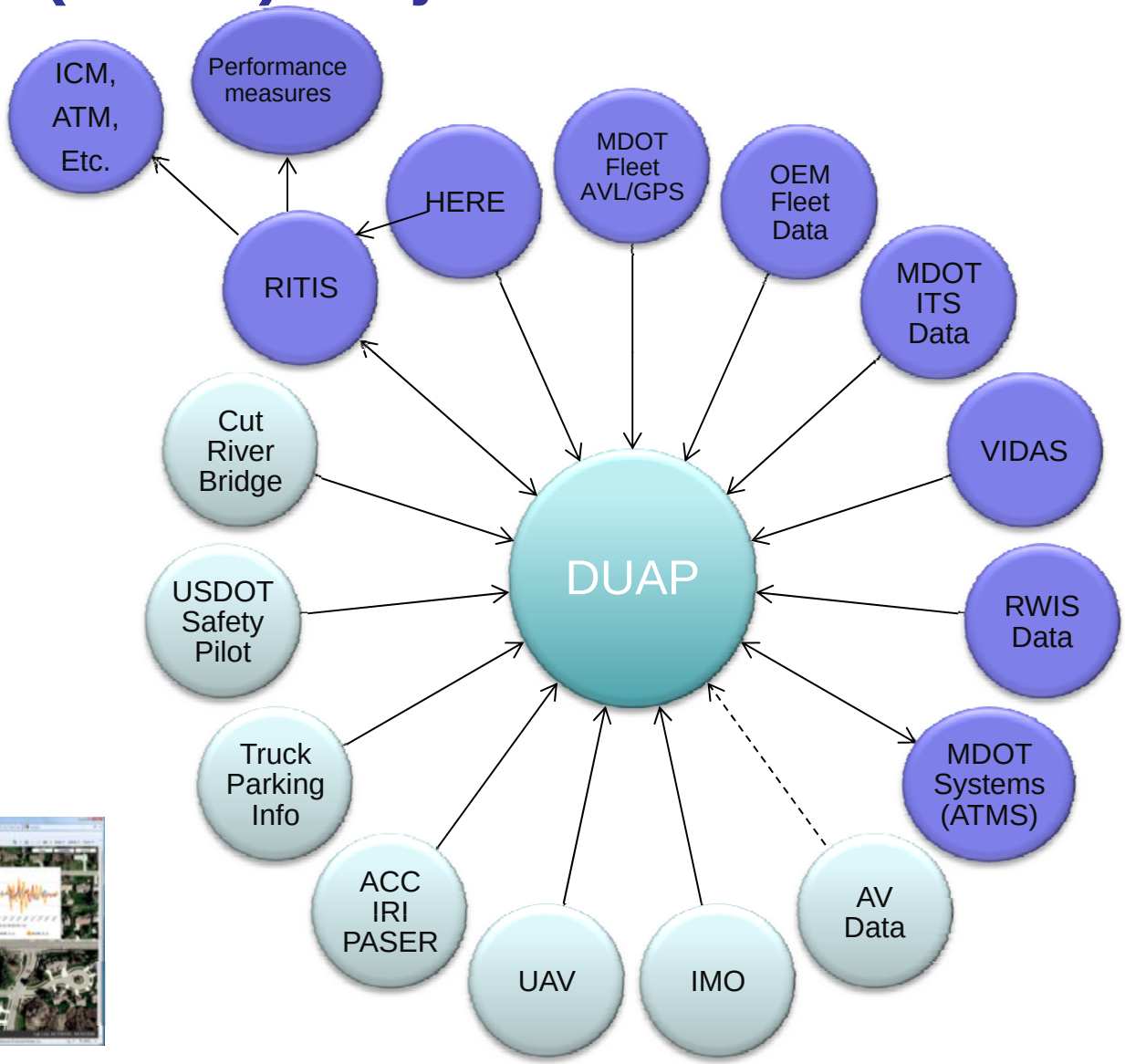
- MDSS
  - Weather forecast catered to DOT needs
  - Roadway treatment recommendations based on historical and current weather conditions
  - AVL vehicles and HERE data (travel times & performance measures) Maintenance Decision Support System (MDSS)



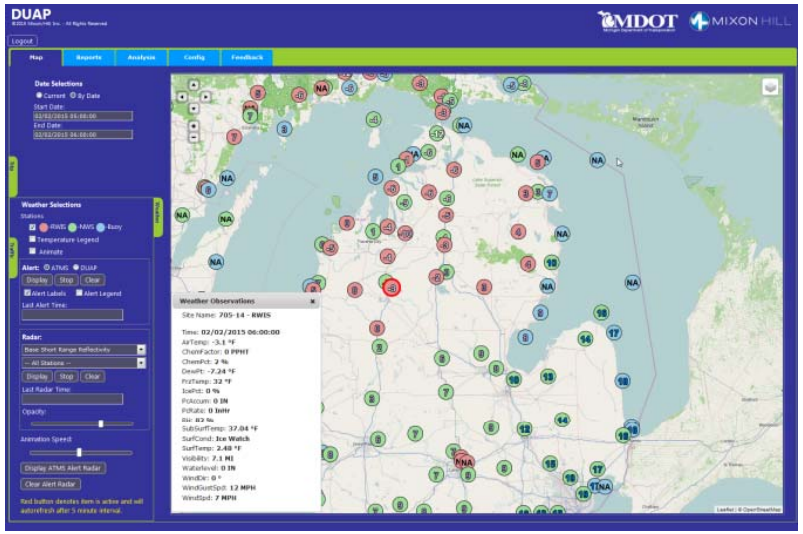


MDOT Data, Use, Analysis & Processing (DUAP) Project





WxTINFO


DUAP
MDOT
MIXON HILL
Logout
Map
Reports
Analysis
Config
Feedback
Weather Observations

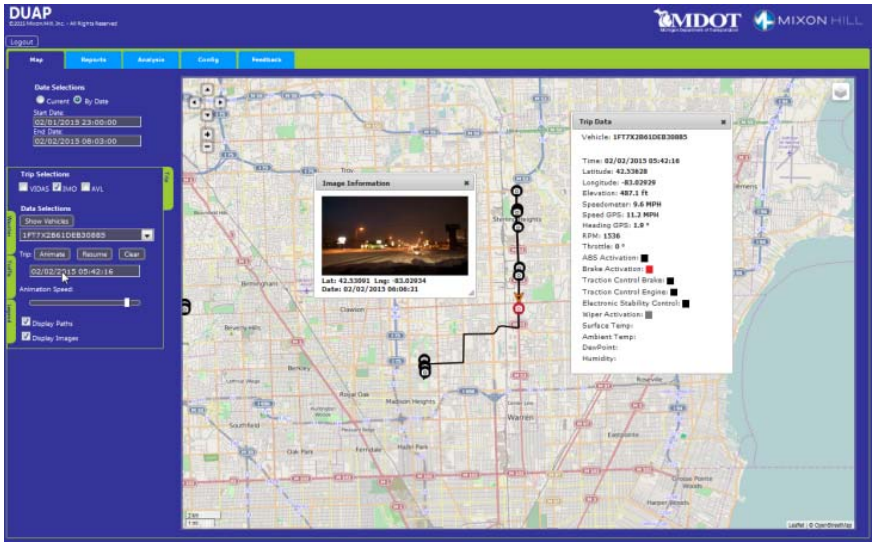

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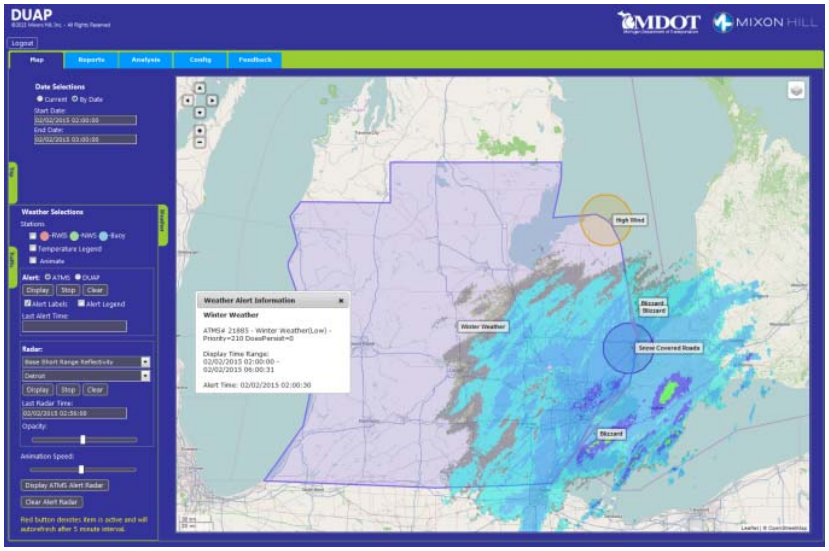
Image Information


DUAP
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Logout
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Reports
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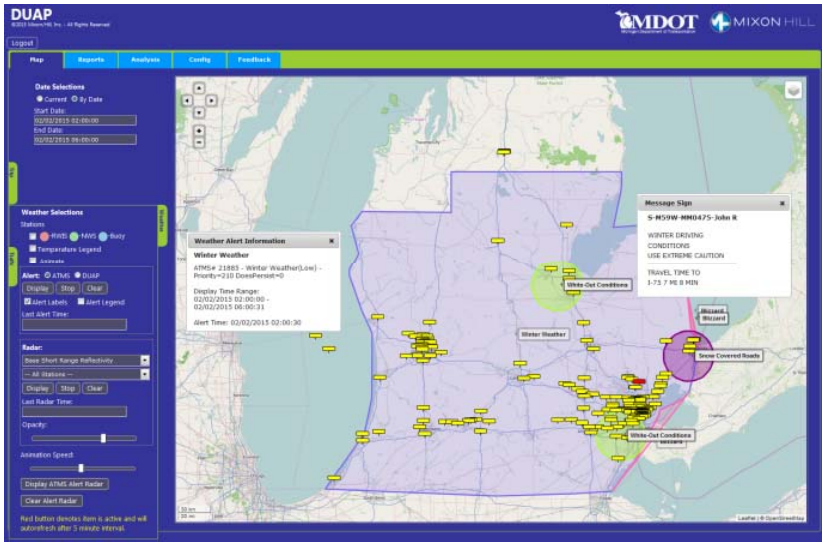
Config
Feedback
Weather Alert Information
Winter Weather
Blizzard
Snow Covered Roads


DUAP
MDOT
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Logout
Map
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Config
Feedback
Weather Alert Information
Message Sign
White-Out Conditions
Winter Weather
Blizzard
Snow Covered Roads

Existing Evaluation - Needs Analysis Example

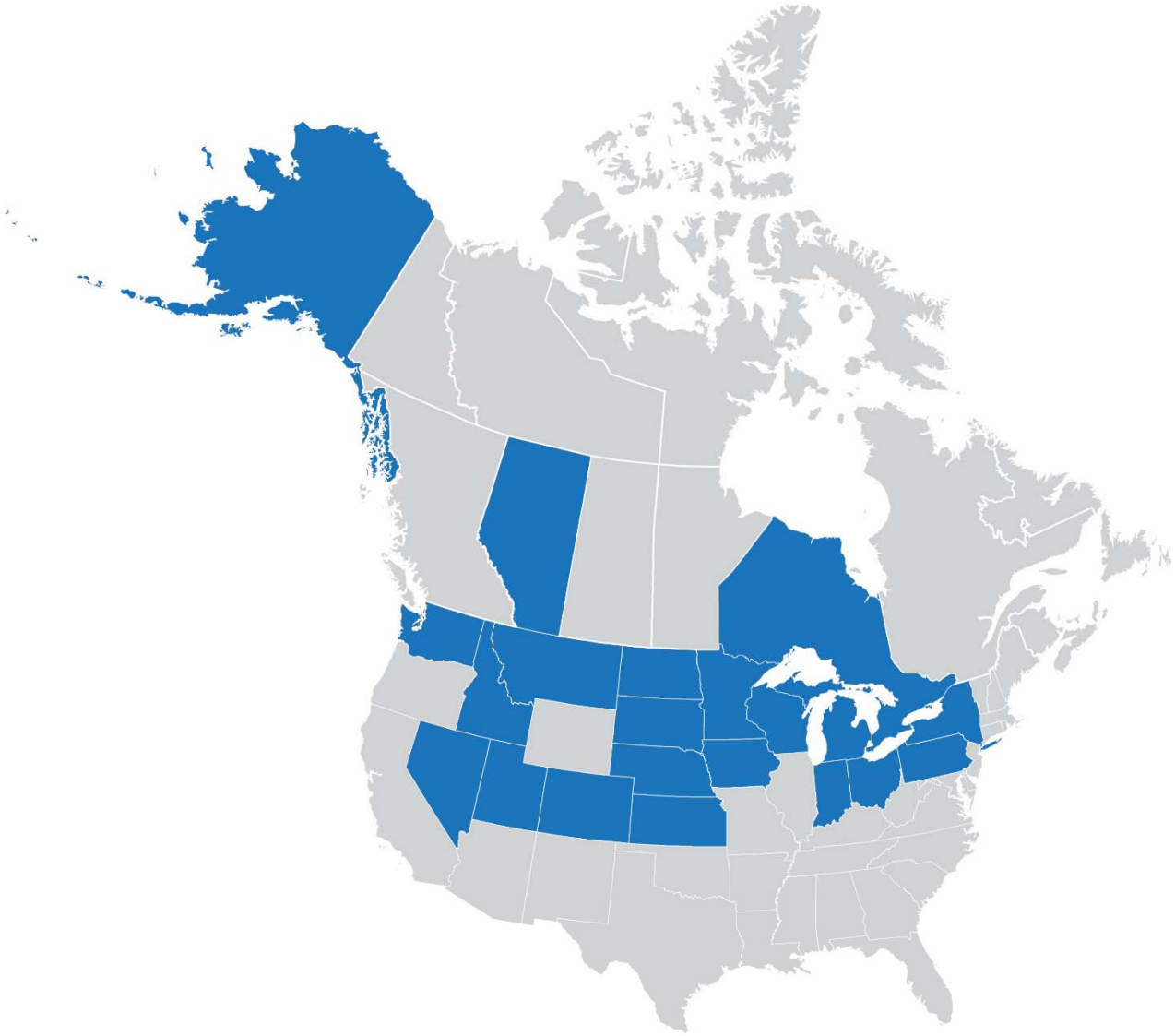
Table 4-1: Maintenance and Operations User Needs

USER NEEDS	*Region**	*Overall Priority (High, Medium, Low)*	*How Existing System Performs (Very Good, Average, Poor)*	
Maintenance personnel need improved visibility on conditions near the edge of their area of responsibility to help in allocating resources efficiently.	Superior, North, Southwest, Metro	High	Average	This downr areas have
General need for real-time RWIS reporting from the hosted web application.	All	High	Very Good	Real-
General need clear camera images for decision making. Images include clear night images with the use of infrared technology.	All	High	Very Good	Cam well i incre came light.
MDOT personnel need to receive forecasts to determine when and where a storm will take place.	All	High	Average	Syste portic and t storn
General need information to determine if maintenance should treat the roadway, how they should treat, and if the treatment was accurate.	Metro, North, Superior	High	Average	This syste RWIS obtai
Maintenance personnel need better forecast and/or detection of lake effect snow bands, and squall of snow. Expanded, enhanced, or improved RWIS data made available to weather forecasters will lead to improved forecasts.	All	High	Poor	
	Superior, North	Medium	Average	This

Existing System - Gap Analysis and Conclusions

- Define Region MDOT Champions
- Better Lake Effect Snow Reporting
- Integrate with ATMS
- Determine Frost Depth Measurement Sensor Locations
- Define Performance Measurements
- Provide Training and Awareness
- Defined High Priority Areas
- Determine Grip Value Calculations
- Better Storm Forecasting
- Improve Mobile Observations
- Mobile Access to ESS Data

Best Practice/Literature Review



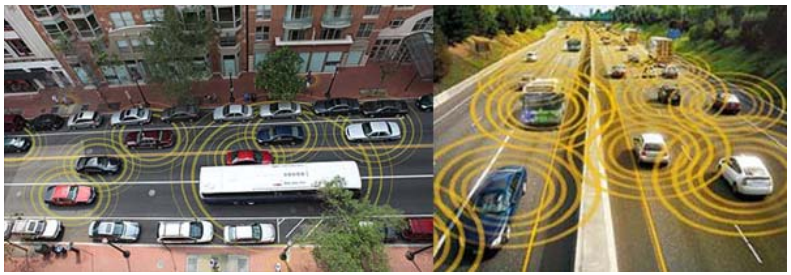
- Phone Interview with 20 States/Provinces
- Literature Review yielded areas that have important influence on the direction of the RWIS program.

Best Practice - Summary

- Most accurate and cost effective solution to measure **Pavement Conditions:** non-invasive condition, and simple thermister
- **ESS Siting** to provide representative road weather conditions.
- **Weather Instrumentation Package** should include sensing devices to measure
  - air temperature/RH,
  - horizontal wind information,
  - precipitation type and rate, and
  - visibility
- Consider measurement at **Maintenance Trouble Spots**
- ESS sites should include **Cameras**
- **Performance-based contracts** improves quality of the system output and performance of the system
- **Mobile Data Collection** augments RWIS information and MDSS
- DOTs are integrating **Traffic Monitoring Devices** for performance metrics

Best Practice – Notable Trends

- Additional emphasis on resource considerations to support traveler information requirements



- DOT's and agencies using MDC/AVL technologies to support operations and management

- Use of Performance measures to assess level of service, maintenance performance are affecting the instrumentation requirements at ESS sites

Technology Evaluation

- Investigate new sensors and technologies to support the RWIS program
- Investigate new ways to utilize road weather data
- Assess how well technologies and techniques will MDOT RWIS needs and gaps.

Technology Evaluation – Evolving NextGen RWIS Approaches

Technologies

- Connected Vehicle Data
  - MDC/AVL
- Virtual RWIS
- IR & Thermal Cameras
- Vehicle Detection with Camera
- FAST

Techniques

- Automated Road Condition Assessment
- Forecasting and Lake Effect Snow Reporting
- Performance Management
- RWIS Applications for Arterial Management
- RWIS Data for ATM Applications

Technology Evaluation – Address Stakeholder Needs/Gaps

- Match gaps identified in the existing system evaluation with newer technologies and techniques (as applicable)
- Example: *Determine Grip Value Calculations*
  - Deploy non-invasive on existing ITS infrastructure such as camera and detector poles.
  - Extract data from MDC units (fleet vehicles)
  - Deploy temporary or permanent leased options where power/communications is difficult
  - Integrate camera imagery as a confirmation or correction tool for road conditions

Deployment Strategy

What is our Vision?

What is the challenge we are trying to address and what are the steps to develop the vision?

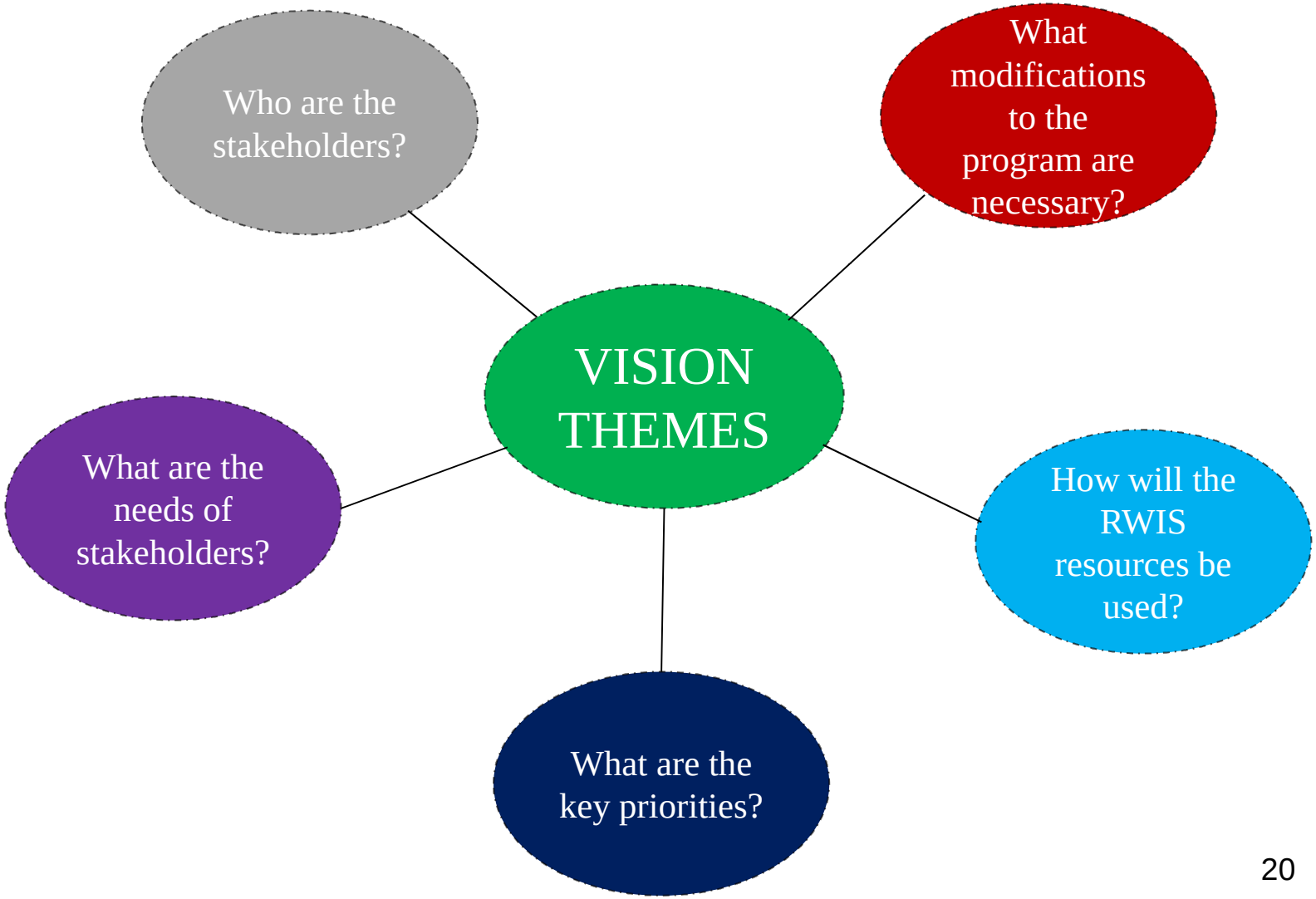
Where have we been and where are we Going?

Which needs are not satisfied by the existing system and which strategies will successfully fill those gaps?

Which Strategies are critical for success?

Which statewide strategies will allow MDOT to succeed with their RWIS vision in the near and long-term?

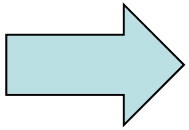
Deployment Strategy - Developing the RWIS Vision



Modifications to the Program to meet MDOT Needs

MDOT NEEDS

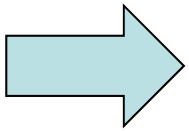
1. Better Information for Lake Effect Snow Patterns and Timing



POTENTIAL APPROACHES

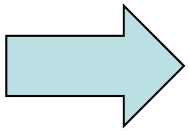
- Denser ESS network
- High resolution forecast model
- Collage of camera images
- Mobile & crowd sourcing data

2. Improved Information on Conditions in Outlying Areas



- Fixed and virtual locations to fill voids
- Integrate CV program options into fixed observation network
- Trade-offs between camera imagery and full ESS configuration

3. Improved Mobile Observations



- Establish MDOT vision for the CV program
- Establish QC plan to assure quality CV data

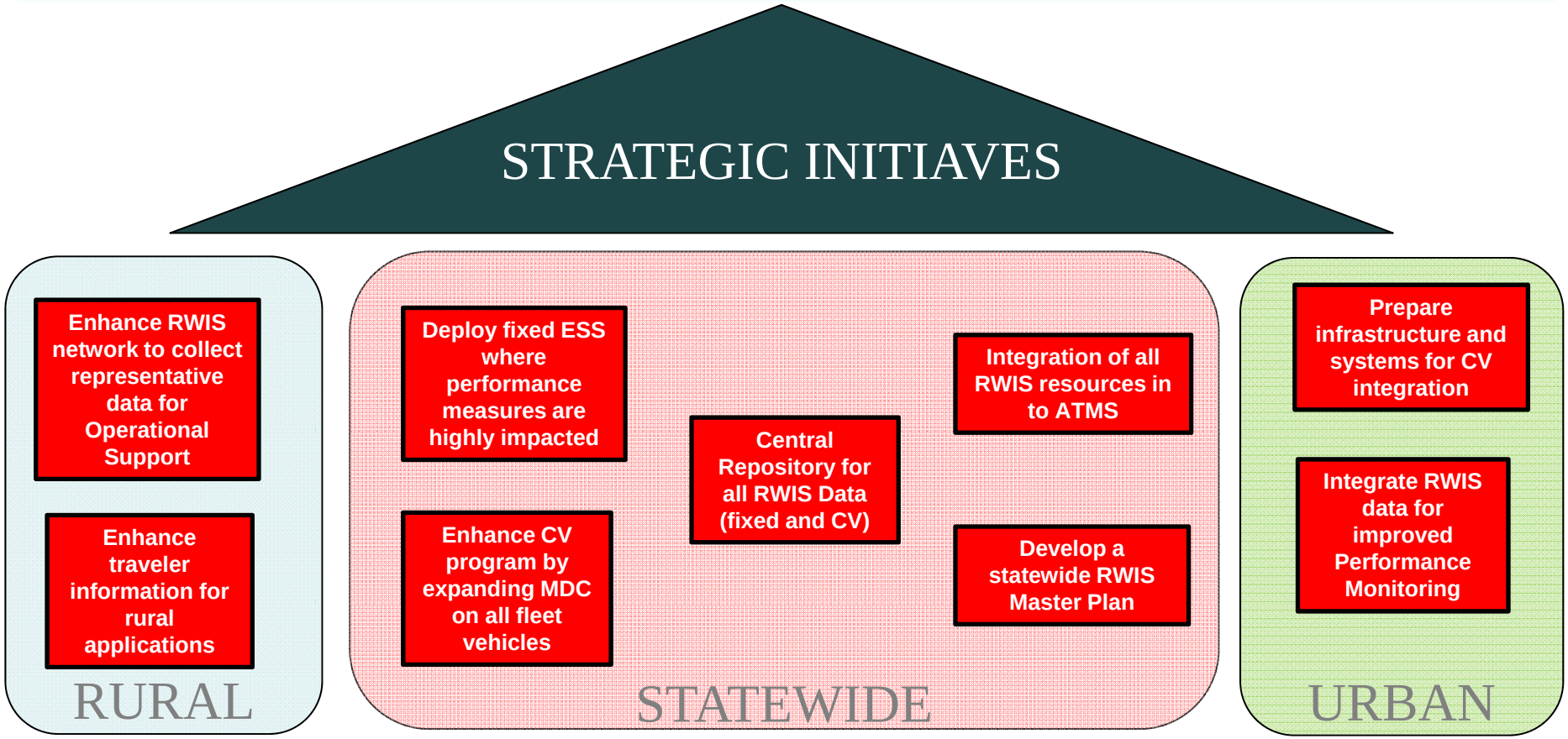
Vision for Road Weather Resources

Source Information	Vision
Fixed Environmental Sensor Station (ESS)	Provide network of "gridded" information on a continuous 7X24 basis
Portable ESS	Address unique challenges/requirements Address short-term problems (future resources may solve problem)
Connected Vehicle – Fleet Vehicle Data	Further expansion of connected vehicle resources on fleet vehicles (MDOT and partner agency) to complement ESS
Connected Vehicle – Consumer Vehicle Data	Statewide resource to provide near real-time roadway conditions Augment data collected from fleet vehicles and fixed/portable ESS. Leverage traffic management strategies for safety, mobility, awareness.
CCTV	Camera resource to cover all state trunk lines, critical state routes and key signalized interchanges
Vehicle Detection	Provide volume/speed information on all state routes to enhance internal and external information reporting. Especially for data sets not available from crowd sourcing assets.

DEPLOYMENT STRATEGY

VISION

To have a robust system that provides stakeholders useful information about road weather conditions around the entire state of Michigan using an array of existing and next generation technologies.



Final Recommendations Summary - Key Priorities to Meet MDOT Needs

- Develop a performance based **Data Management Program and Contract Option**
  - Similar to approach used for ESS data.
- Continue **RWIS ESS Expansion**
- Enhance system with **Network of Present Weather Sensors** to collect precipitation data
- **Integration of all CCTV Cameras** in to a single resource
- Leverage the **Connected Vehicle Network** to augment road weather information data set
- Continue to develop the "**System of Systems**" that supports RWIS applications

Michigan DOT
Future initiatives/The future is now

- New ESS in Southern Regions
  - Southwest and Grand
- Final ESS deployments in Northern Regions
  - North and Superior
- Bridge and Curve Warning Systems
- Concept of Operations Development and Updates
- Mobile methods of data acquisition
  - Snow Plows and CV
- Co-location with other ITS devices

Michigan DOT
Overall Impact of RWIS System to ITS in Michigan

- **Benefits**
  - Actual observations to initialize forecasts
  - Allows for more accurate and location-specific forecasts
  - Drive more effective and resource-conserving road maintenance operations
  - The result is a higher level of service and safety
  - More efficient and environmentally responsible allocation of equipment, labour and chemicals.
  - Culminating in applications that further benefit the traveling public.

Questions/Comments?

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