Integrating Mobile Observations in Maintenance and Operations Management Tools

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Road Weather Management Program Stakeholder Meeting
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Content

- ## What are we doing?
  - Project background
  - Goals of the project
- ## Why?
  - Connected Vehicle efforts /Goals
  - RWMP Roadmaps / Tracks 3 & 4
- ## How / With who?
  - Vehicle Data Translator
  - Partnership with State Dots
- ## What next?

What are we doing?

The IMO Project
- Our hypothesis:
  - Weather has a significant impact on operations and maintenance activities for every agency from a staffing, equipment and budget perspective.
  - Connected Vehicle promises new data and information on all roads in real or near real-time.
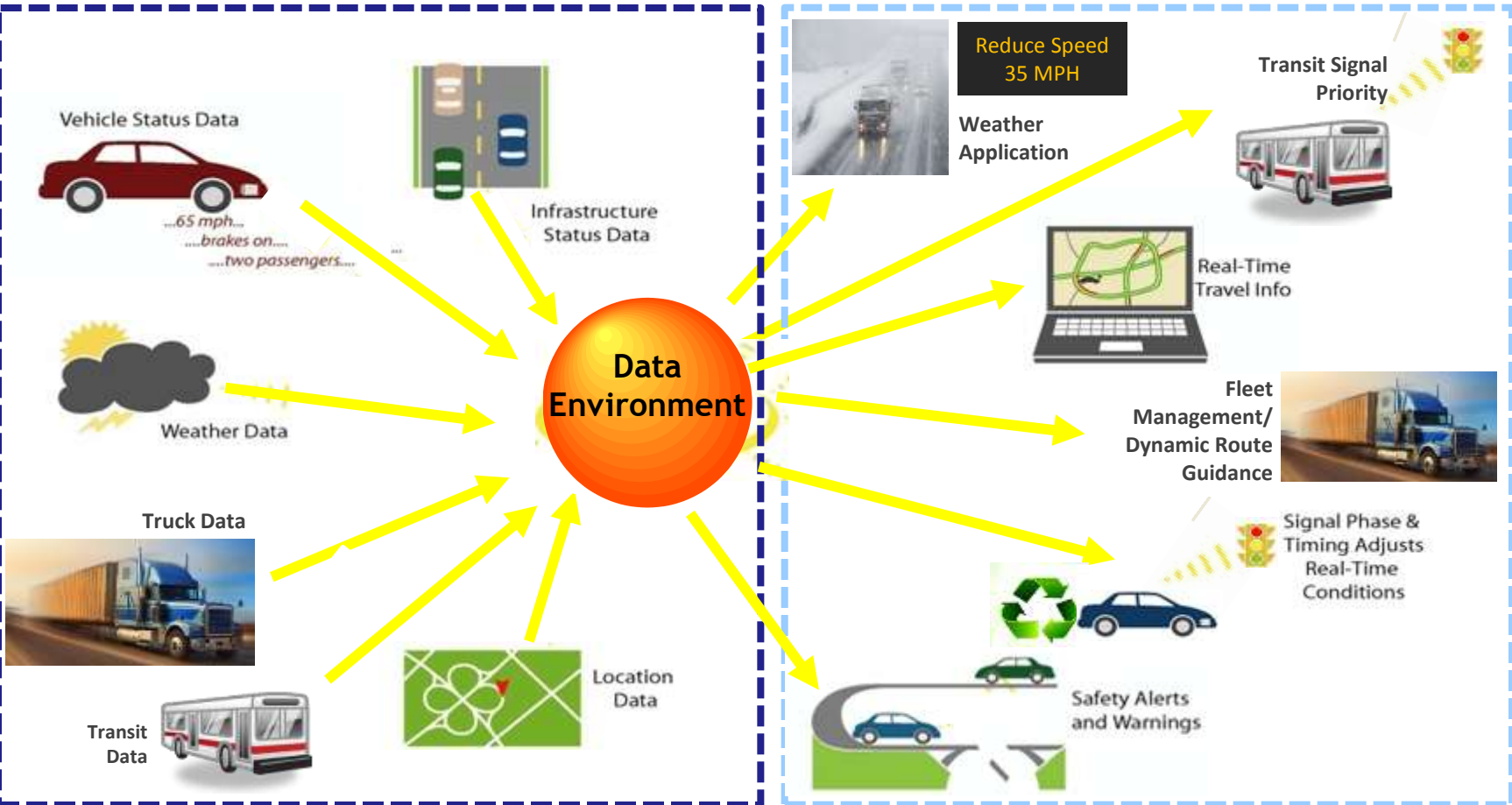- Areas of Potential Research
  - How do we integrate Connected Vehicle data into existing weather sources?
  - How do we integrate this new data into information management and decision support and tools?
  - What efficiencies can be gained as a result of the improved information?

Why the IMO Project...?

Real-time Data Capture and Management

Vehicle Status Data
...65 mph...
....brakes on....
....two passengers....

Infrastructure Status Data

Weather Data

Truck Data

Transit Data

Location Data

Data Environment

Dynamic Mobility Applications

Reduce Speed 35 MPH
Weather Application

Transit Signal Priority

Real-Time Travel Info

Fleet Management/ Dynamic Route Guidance

Signal Phase & Timing Adjusts Real-Time Conditions

Safety Alerts and Warnings

ROAD CLOSED

How are we doing this…?

- Enhancing the capabilities of the VDT
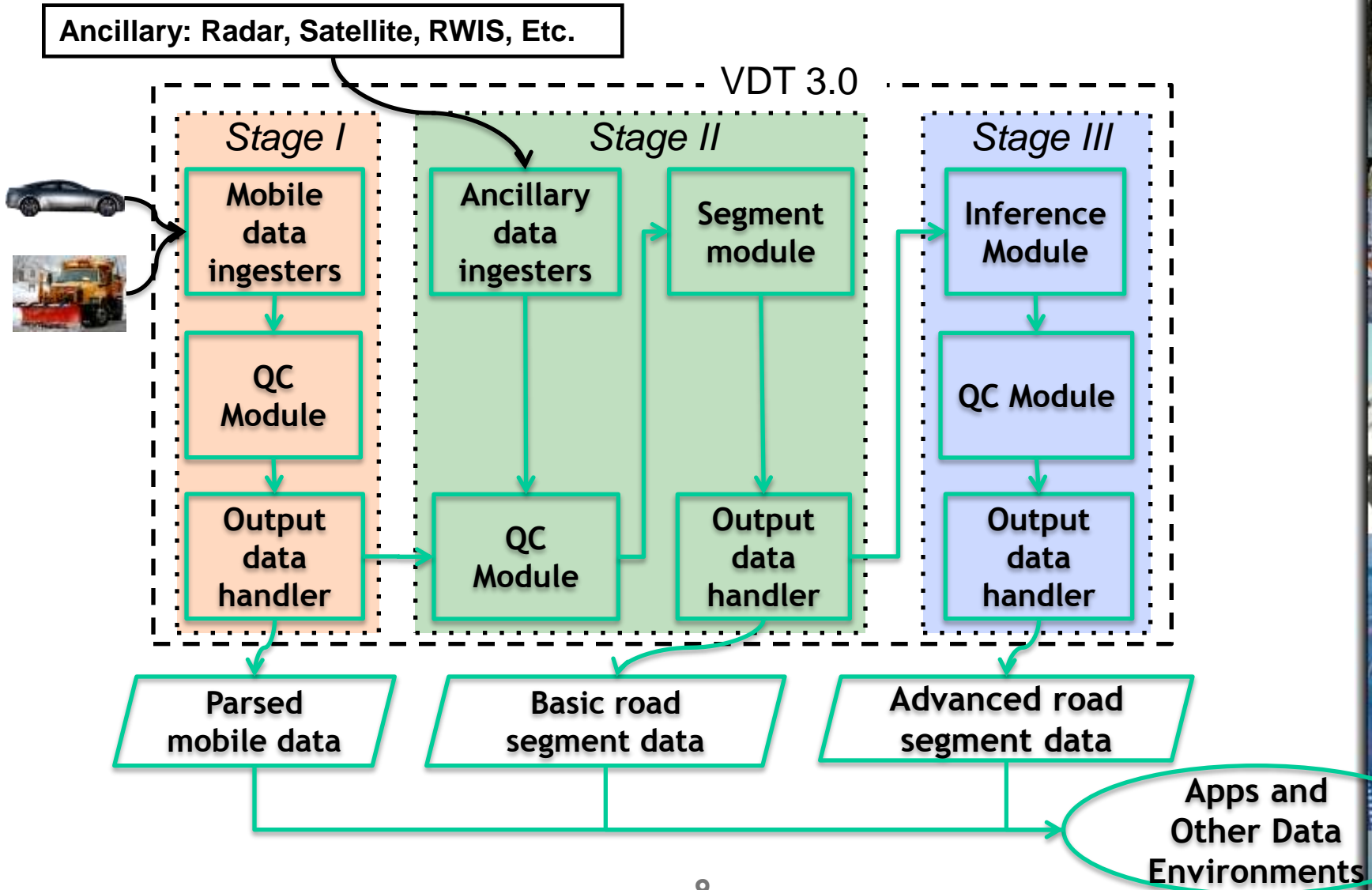- Partnering with State Dots

How are we doing this…?

Enhancing VDT

Developing VDT v.3.0

- Incorporate mobile data to characterize current road weather conditions

- Ingest, process, and facilitate the archiving of data already present in vehicle probes

- Quality check the data

- Ingest ancillary weather data

- Serve as an "observation database" for decision support and other applications

Vehicle Data Translator (VDT) 3.0

Ancillary: Radar, Satellite, RWIS, Etc.

VDT 3.0

Stage I
- Mobile data ingesters
- QC Module
- Output data handler

Stage II
- Ancillary data ingesters
- Segment module
- QC Module
- Output data handler

Stage III
- Inference Module
- QC Module
- Output data handler

Parsed mobile data

Basic road segment data

Advanced road segment data

Apps and Other Data Environments

How are we doing this...?

PARTNERING WITH State DOTs

Speed and Heading
Adaptive Cruise Control
Location & Elevation
Hours of Operation

Sun/Rain Sensor
Windshield Wiper Setting
Headlight Status
Ambient Air Temperature

Anti-lock Braking System (ABS)
Brake Status
Stability Control
Traction Control

How are we doing this…?

Partnering with State DOTs

- NCAR issued the solicitation last fall (2010)
  - Scope of Work
  - Funding assistance / Grant
- Pool Funds and Consortia were targeted: Aurora, ~~IntelliDrive~~, Clear Roads, MDSS
- Just a handful of states expressed interest:
  - Idaho
  - Minnesota
  - Nevada
  - North Dakota
  - South Dakota

Partnership with States…

- Selection based on
  - Fleet
  - Maturity of the maintenance ITS program
  - Integration of mobile obs into state's application – MMS, MDSS, MODSS, TIS….
  - Other factors/synergies (multi-state, corridor, etc.)
  - Willingness to make data and lessons learned widely available /open source

Selected States

- Minnesota

- Nevada

Minnesota

- Why
  - Mature AVL/MDSS program
  - Relatively new fleet
  - Strong upper management support
  - Strong proposal
    - Significant # of vehicles fitted for the test
    - Proposed integration with MDSS, MMS, TIS
    - Ability to collect desired data parameters (from CAN-Bus and add-on sensors)
- Funding: Grant - 80/20

Why MN….

- Project Team
  - Champion: Steve Lund
  - Project Manager: Curt Pape
  - Consultant: Ameritrak, LLC
  - NCAR: Sheldon Drobot & Mike Chapman, Brice Lambi
  - FHWA: Paul Pisano & Gabe Guevara

Minnesota: Project Status / Details

- Ameritrak is the AVL provider; has already developed and tested the prototype system:
- Mobile Computer Device
  - AVL/GPS
  - CAN-Bus Interface
  - Interface with external sensors, sander/controller, etc.
- Mounting brackets
- Wiring harnesses
- MN uses Cellular as its communication platform

- By October/November, 2011: 140-160 Snowplow vehicles collecting and sending data

FHWA / NCAR / MnDOT Parameter List

|	
External air temperature	Accelerometer
Pavement temperature	Impact sensor
Atmospheric pressure	Steering angle
Rain (rain sensor)	Yaw rate
Relative humidity	Anti-lock braking system
Wiper status	Brake boost status
Headlight status	Brake status
Pavement wetness	Stability control system
Sun (sun sensor)	Traction control status

FHWA / NCAR / MnDOT
Parameter List *(continued)*

Differential wheel speed	**Emission data** **(NOx, HC, CO, CO2, particulate matter, etc)**
Short-range wide beam radar	**Date and time**
Adaptive cruise control	**Vehicle location, heading**
Camera imagery	**Vehicle velocity**
	Elevation
Gray => CAN-Bus	**Blue => External Sensor**

AT500 Transponder
Data Acquisition (DAQ)
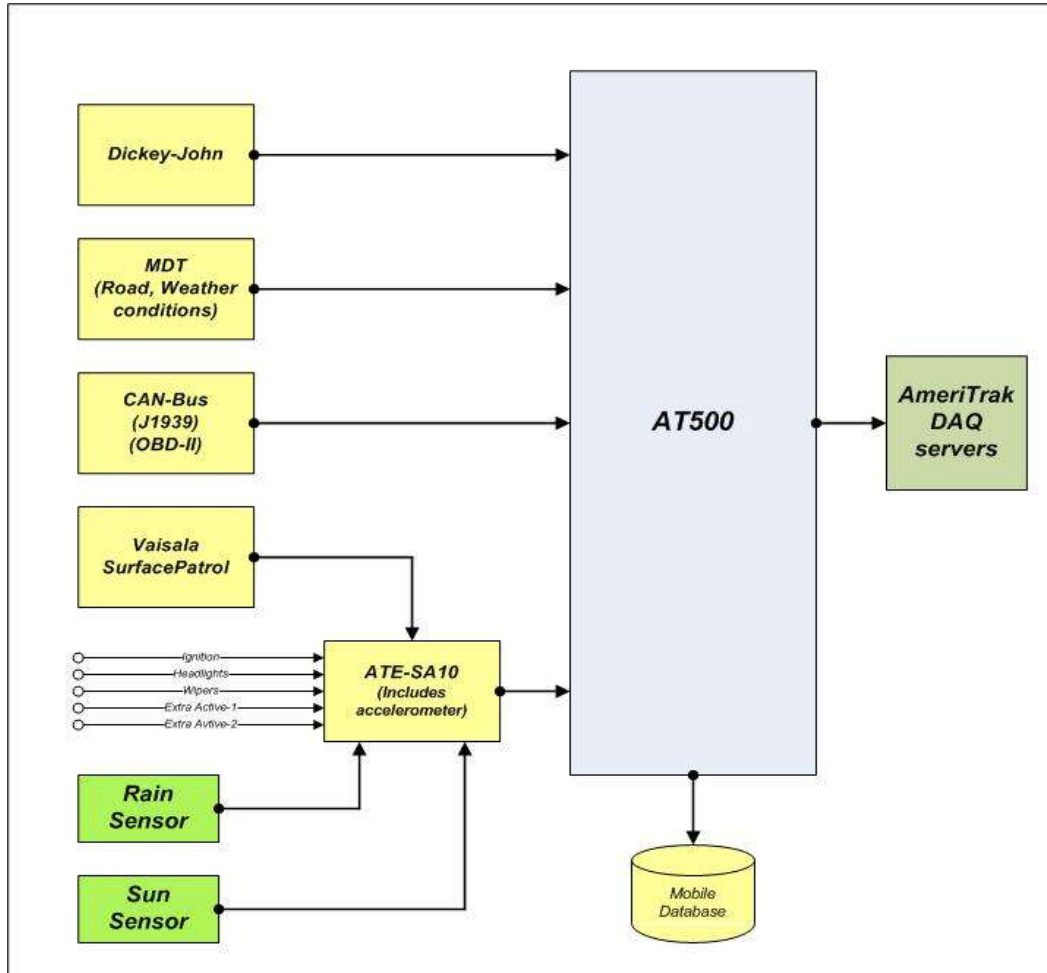
The AT500 in-vehicle transponder hardware and software has been modified to accept data from many different in-vehicle sources.

2010 International MaxxForce Truck Fleet

The AT500 prototype mount for the 2010 International MaxxForce trucks. The project will include 40 new MaxxForce vehicles and older Sterling trucks.

2010 International MaxxForce Truck Fleet

Prototype mechanical packages being worked on for the new MaxxForce trucks.

2010 International MaxxForce Truck Fleet

The Mobile Data Terminal (MDT) will feature a custom dash mount for the new MaxxForce trucks.

AT500 MDT
Main Screen

AT500 MDT
Road Conditions Input

AT500 MDT
Maps: Meridian General Radar

AT500 MDT
Maps: Truck-Centered Radar

AT500 MDT
Maps: Meridian Forecast

http://localhost/maps.php

Road
N/A
🔴 5:19

NWS

Map
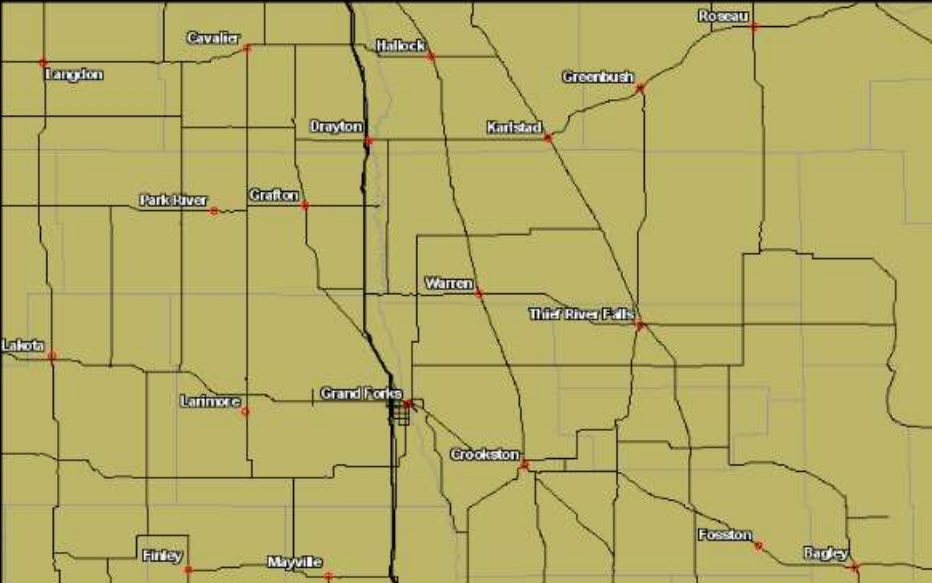
Radar

Forecast

Rec'm

Close

Data Aquired At 6:52 PM
Forecast

Time	Wind speed	Wind Direction	Wind Gust	Precip Type	Precip Prob	Snow Rate	Cloud Cover	Air Temp
Fri 07:00 PM	17	NNW		-	0	0.00	0	57
Fri 08:00 PM	9	NNW	15	-	0	0.00	0	53
Fri 09:00 PM	7	NNW	14	-	0	0.00	0	50
Fri 10:00 PM	4	NNW		-	0	0.00	0	47
Fri 11:00 PM	4	NNW		-	0	0.00	0	44
Sat 12:00 AM	3	NNW		-	0	0.00	0	43
Sat 01:00 AM	4	NNW		-	0	0.00	0	40
Sat 02:00 AM	2	NNW		-	0	0.00	0	39
Sat 03:00 AM	2	NNW		-	0	0.00	0	38
Sat 04:00 AM	3	NNW		-	0	0.00	0	37
Sat 05:00 AM	1	NNW		-	0	0.00	0	35
Sat 06:00 AM	3	NNW		-	0	0.00	0	34

Nevada

- Why
  - Actively pursuing an AVL/MDSS program
  - Fleet adds variety to the study (different manufacturer)
  - Strong upper management support
  - Strong proposal
    - Potential corridor-wide participation (I-80 corridor)
    - Strong partnership with academia (Univ. Nevada-Reno)
    - Proposed integration with MDSS, MMS, TIS
    - Ability to collect desired data parameters (from CAN-Bus and add-on sensors)

- Level of Funding: 80/20 Grant

- Accomplished so far:
  - Prototype system fully developed in-house
  - Seven units fitted with the equipment; 20 total units by November/December 2011

Nevada

- Project Team
  - Champion: Rick Nelson
  - Project Manager: Denise Inda
  - Consultant: University of Nevada, Reno
    - Dr. Jeff LaCombe
    - Dr. Eric Wang
  - NCAR: Dr. Sheldon Drobot & Mike Chapman, Brice Lambi
  - FHWA: Paul Pisano & Gabe Guevara

Various Weather & MDSS Data Parameters

Collaborative NDOT & UNR Installation teams

In-vehicle computer

Road and weather sensors

- Numerous sensors and devices are controlled or monitored by a vehicle-mounted computer.

- Data is logged in-vehicle as well as sent via radio to UNR in near-real-time using the NDOT EDACS radio network.

- All instrument and equipment installations are being done by UNR &NDOT teams who are familiar with the vehicles (NDOT) and instrumentation (UNR).

Data Being Gathered
NV IMO Project (UNR/NDOT)

- ## General Data
  - GPS Date, time, location, bearing, speed, altitude, accuracy

- ## Road Conditions
  - Road surface temperature
  - Vehicle accelerations (surface friction)
  - Road condition images (camera)

- ## Atmospheric Conditions
  - Pressure, temperature, relative humidity, dew point
  - Wind speed and direction

- ## Vehicle & Equipment Data
  - Speed, brake status, engine intake air temperature & pressure
  - Spreader and plow status
  - Steering, traction control, ABS, yaw, accelerations, emissions data, engine data, headlight and wiper status

Blue denotes parameter being implemented
Gray denotes parameter "under study"

Two Vehicle Types
Based in NV Districts 2 & 3 Along I-80 Corridor

Snowplows

Light Duty Vehicles (Crew, general purpose)

- Vehicles with winter assignments along I-80 were selected.

- Makes & models are presently limited to vehicles with compatible CANBus or OBDII vehicle data formats.

What is next…

- This project will be completed April 2012

- Further refinements to the VDT

- Continue to seek partnerships with State DOTS

- Refinement of Standards and communication protocols

- Work with the OEM's to be able to access the metadata for the parameter ID's

- Continue to send data to *Clarus*, the Prototype Data Environment, any other relevant DCM environments and contribute with the Dynamic Mobility efforts as opportunities arise.

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