Integrating Mobile Observations in Maintenance and Operations Management Tools

Road Weather Management Program Stakeholder Meeting
Albuquerque, NM July, 2011

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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
- Infrastructure Status Data
- Weather Data
- Truck Data
- Transit Data
- Location Data

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
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

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

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

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

Parsed mobile data
Basic road segment data
Advanced road segment data

Ancillary: Radar, Satellite, RWIS, Etc.

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
<table>
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<th>Parameter</th>
<th>Sensor/System</th>
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<td>External air temperature</td>
<td>Accelerometer</td>
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<td>Pavement temperature</td>
<td>Impact sensor</td>
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<tr>
<td>Atmospheric pressure</td>
<td>Steering angle</td>
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<tr>
<td>Rain (rain sensor)</td>
<td>Yaw rate</td>
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<tr>
<td>Relative humidity</td>
<td>Anti-lock braking system</td>
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<tr>
<td>Wiper status</td>
<td>Brake boost status</td>
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<td>Headlight status</td>
<td>Brake status</td>
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<tr>
<td>Pavement wetness</td>
<td>Stability control system</td>
</tr>
<tr>
<td>Sun (sun sensor)</td>
<td>Traction control status</td>
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</table>
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**

Gray => CAN-Bus | Blue => External Sensor
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.
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

Road
N/A
Air N/A
Maps & Forecast
Skype

Road Conditions
Compacted Snow
Weather Conditions
Drizzle
Lane Position
CenterLine
AT500 MDT
Road Conditions Input

Road Conditions

- Dry
- Wet
- Slush
- Frost
- Snow
- Blowing Snow
- Compacted Snow
- Ice

Road 70
Air 70

Maps & Forecast
AT500 MDT
Maps: Meridian General Radar
AT500 MDT
Maps: Truck-Centered Radar
<table>
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<th>Time</th>
<th>Wind speed</th>
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<th>Wind Gust</th>
<th>Precip Type</th>
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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

• 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

- 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.
FHWA Road Weather Research Team

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