FHWA/MDOT/UMTRI Integrated Mobile Observations 2.0 (IMO)

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MDOT Fleet Vehicles for IMO 2.0

• Vehicles traverse portions of I-94 on a regular basis
• 20 snowplows and 30 light fleet vehicles on the southwest portion of I-94 (Southwest Region, 4 counties)
• 7 light fleet vehicles on the middle portion of I-94 (University Region, 2 counties)
• 3 light fleet vehicles on the southeast portion of I-94 (Metro Region, 3 counties)
DataProbe App on Droid Smartphone

- DataProbe: Android application runs on Droid phones.
- Has Bluetooth, a USB port and a 3-axis accelerometer
- Droid mounted in a windshield docking station
- DataProbe can work alone or in combination with other data sources

- DataProbe gathers one set of data every second
- Five minutes (300 seconds) of data is collected in a data file and prepared for sending
- When the Droid has a cellular connection made (4G/3G), DataProbe sends available files (1MG) to UMTRI virtual servers.
- Collected to date: 135,000 vehicle miles of data (over 25 GB of data)
System Components

NDA/PIDS have been secured with Ford & GM

Road Surface Temperature

12v switched vehicle power

CAN to Bluetooth

Powered by CAN connector

Droid Interfaces with two Bluetooth devices

Powered by USB connector take-out

Vehicle Switched Powerpoint
DataProbe Data Sources

- Flexible configuration
- Near real time data access with cellular services
- Not all CAN networks have desired data
  - Varies by model year and car line
- Surface Patrol requires hardware installation

<table>
<thead>
<tr>
<th>SIGNAL</th>
<th>Droid</th>
<th>OBDKey</th>
<th>Surface Patrol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position</td>
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<td>speed</td>
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<td>pavement temp</td>
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<tr>
<td>humidity</td>
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<td>X</td>
</tr>
<tr>
<td>dew point</td>
<td></td>
<td></td>
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<tr>
<td>Number of vehicles</td>
<td>(60)</td>
<td>(40)</td>
<td>(20)</td>
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</table>
Mobile Device and OBD Install

- Droid in WMT’s is mounted to ceiling (left)
- Droid in light fleet is mounted to dash (center left)
- Light fleet vehicles have OBD key (lower left)
- Display contents will vary based on system configuration/mode (below)
Surface Temperature Sensor Placement

- Surface temp sensor on sedans mounted on engine fire wall (left ex. of pilot trunk install)
- Surface temp sensor on WMT’s mounted between air tanks (below)
- Humidity sensor mounted on front lip of trunk decklid (below)
- Sensor data broadcast via serial Bluetooth adaptor
Roadway Camera Images

- Images (jpg files) taken with the Droid camera of the roadway
- Images can be triggered manually, on ABS lockup, or remotely
  - Optionally, a single or three image sequence can be captured
  - Three image sequence separated by two seconds between them
- All images are sent to servers within five minutes
Pushing Messages to Driver

- Operations center may send text message to driver of fleet vehicle for 10 second display
- Current display data is replaced with incoming text
  - Example text:
    - “Call the office when available”
    - “Redeploy to Exit 112”
    - “Take photos of problem area”
- No driver physical interaction required to get text display
- Display annunciation (“beep”) heard when text received
# Web Portal for Sending IMO Messages and Images

**DATAPROBE FLEET COMMUNICATIONS**

**Message to be sent:**

![Operator types messages, selects vehicle, then clicks SEND](image1)

<table>
<thead>
<tr>
<th>Region</th>
<th>Location</th>
<th>Driver</th>
<th>Year</th>
<th>Model</th>
<th>Config</th>
<th>In Service</th>
<th>Req Photo</th>
<th>Send Message</th>
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<tbody>
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</tbody>
</table>

**Vehicle fleet details maintained by administrator/operator**

**Identifies which vehicles are currently in-service**

![Operator selects images to be taken then clicks SEND](image2)
Data Management and Distribution

- Data files (csv) sent to UMTRI servers are tested for validity
  - Files are stored on a secure University of Michigan Virtual Server with access to files limited to specific UMTRI, Intersog, and MDOT staff

- Non-valid files received at UMTRI are not re-transmitted
  - Containing errors (CRC checking)
  - GPS data without three or more satellites
  - Vehicle speed over file duration never over 0 mph (vehicle setting stationary for more than 5 minutes)

- Valid files are sent via FTP to Connected Vehicle servers
  - NCAR
  - Meridian (MDSS)
  - DUAP (Mixon-Hill)
  - Navteq (DMS Travel Times)
  - Atkins (RITIS 4DX: User Delay Cost I-94)
Risk Severity Summary

Top 3 Issues:
- Bluetooth interface to Surface Patrol
- Lack of GM CAN PID support
- Random interaction between car and OBD device
Applications

- Weather and road condition data into MDSS
- Real time road quality monitoring
- Fleet monitoring and management (miles, hours, routine maintenance, etc.)
- Targeted individual messages (augments DMS)
- Provide travel times and incident updates
- Remote imaging and physical monitoring of environment
- Visibility monitoring (snow, fog, rain, etc.)
- Emergency detection (ABS lockup & differential wheel speed reports)
- Slippery surface notification
- Weather ground truth augments ESS (surface temperature, dew point, etc.)
- Vehicle/device health monitoring (are devices installed on vehicles working?)
- Vehicle diagnostics
- Performance Management
- Regain Times
## Summary IMO 2.0 Schedule

<table>
<thead>
<tr>
<th>System requirements &amp; build</th>
<th>Design imaging function</th>
<th>User Interface</th>
<th>Software development &amp; test</th>
<th>Mounting - 19 variations</th>
<th>Power strategy</th>
<th>System testing</th>
<th>Server deployment</th>
<th>Configure, install &amp; test</th>
<th>Transfer data process</th>
<th>Connected vehicle servers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Build and Launch</td>
<td>Procure components</td>
<td>Install Surface Patrols</td>
<td>Install Droids and test</td>
<td>Deploy vehicles</td>
<td>Data collection</td>
<td>Monitor &amp; validate operation</td>
<td>Maintain vehicle system operation</td>
<td>Reports</td>
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</tr>
</tbody>
</table>

**Months:**
- Nov
- Dec
- Jan
- Feb
- Mar
- Apr
- May
- Sept
- Feb
- Mar

**Weeks:**
- 1
- 2
- 3
- 4

**Data Collection**
- Monitor and validate operation
- Maintain vehicle system operation
- Reports
Contact Information

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