FHWA/MDOT Integrated Mobile Observations (IMO) Architecture

MDOT Vehicles – FHWA/MDOT Data Collection

- Vehicle Positioning GPS
- Smartphone
  - 3-axis accelerometer
- Photo Image
- Surface Temp & Atmospheric Conditions
- Road Surface Roughness and Distress
- 20 WMTs with phones & 10 with Surface Monitor Device
- 40 Ford vehicles with phones & OBD key & 10 with Surface Monitor Device

Data Users: University of Michigan, National Center for Atmospheric Research, MDOT DUAP/TOC – Motorist Advisory Warnings & MiDrive website

- Cellular Service Providers
- Network Operations Center
- Traveler Information Systems
- UofM Server
- MDOT-DUAP/NCAR-VDT
- MDOT Transportation Operations Center
- Demonstration Vehicles & TMC

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IMO Device Installations
# IMO DataProbe Data Sources

<table>
<thead>
<tr>
<th>SIGNAL</th>
<th>Droid</th>
<th>OBDKey</th>
<th>Surface Patrol</th>
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<tr>
<td>Dew Point</td>
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**Number of Vehicles:** (60) (40) (20)
Web Portal for Sending IMO Images

**Photo also activated by ABS & traction control event or manually**

![Web Portal Diagram](image)

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

<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>
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<th>Send Message</th>
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Operator selects images to be taken then clicks SEND

Identifies which vehicles are currently in-service
Roadway Camera Images

- Images (jpg files) taken with the Droid camera
- Images triggered by ABS lockup & traction control event, web portal or manually
  - Three image sequence every two seconds
- Images sent to server in five minutes
Cumulative Vehicle/Photo Inventory
Metro Region FY2014

Cumulative Miles Driven
Cumulative Photos Taken

Driver/Vehicle #
Keith Williams  03-4656
Ron Jackson    03-4802
Bill Bair      02-8014
Brian Murphy   02-8013
Reggie Washington 02-8035
Mark Gove      02-8025
George Burtwell 03-4761
Marion Spinks  02-8024
Bill Focker    02-8011
Amie Bellar    02-8021
Bill Greene    03-2122
Stanley Quinney 03-4701
Mark Gove      03-4791
Scott Singer   03-6005
IMO Final Report - Lessons Learned (first 17 months)

Vehicles:
• Auto Maker(s) providing the necessary CAN data and technical support
• Tracking vehicles in service is difficult

Hardware:
• Bluetooth serial adapter
• Phone charges can be significant: 60 phones ($37/month/phone) $2,220 per month
• Bluetooth link between the OBD key and DataProbe not consistent/reliable
• Wiring the phone power to the accessory fuse provided “key-on key-off” system

Software:
• Remote phone software update & need internal staff to support development
• Remote software updates require testing and validation

Communication:
• Survey of drivers brought all the issues up front and helped prioritize work/issues/importance of project
• Comparing weekly miles driven/photos
• Weekly meetings with all stakeholders
IMO Final Report - Conclusions (first 17 months)

• **Delivered 196,204 valid data files to 6 weather analyst organizations throughout the U.S (~5 minute file/may include photos, 172 gigabytes)
• **Drivers drove nearly 400,000 miles and took nearly 45,000 photos
• **Collected all targeted data available on the sensors from vehicle
• Provided data quality check before sending (number of satellites, vehicles idling, etc.)
• Data timeliness: 5 minute to 1 minute file uploads – UofM server QC for about 3 minutes (trying to reduce to less than one minute)
• Need more checking from server that data is within a valid range (QC)
• DataProbe system must become more reliable in its interactions with the OBD key and Surface Patrol
• **Automakers technical support for CAN data
• Designed a web portal to take pictures and send message from the portal, and monitor the fleet of IMO vehicles in service (problems with vehicle staying linked to site)
• Need more information about vehicle/sensor functionality while in service
• **Smartphone provides ubiquitous technology, affordable, widely used, etc.
• **Technology provides micro level weather data use and processing
• **Crowd sourcing opportunities with cell phone data collection
• **More vehicles on the road(s) are necessary to reach the critical mass necessary for micro level weather data reporting (what is that critical mass?)
• The OpenXC [open source third party development (lead by Ford)]
• Analyzing photos may open another window for micro level weather reporting (automated process)
IMO World Congress Demonstration - Belle Isle

400 feet
IMO Demo for WC - Two E350 Ford 10 Passenger Vans
<table>
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<th>Time</th>
<th>GPS Location</th>
<th>Velocity</th>
<th>Roughness</th>
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<tr>
<td></td>
<td>Long: -82.99703°</td>
<td>Heading: 272.6°</td>
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<tr>
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<td>Alt: 474.29 ft</td>
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<th>Engine</th>
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<td>Tach: - RPM</td>
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<td>Throttle: -%</td>
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<td>Wipers</td>
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<table>
<thead>
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<th>Temperature</th>
<th>Humidity/Dewpoint</th>
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<td>Surface: -°F</td>
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</tr>
<tr>
<td>Air: -°F</td>
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</table>
Contact Information
FHWA/MDOT/UMTRI Final IMO Report
www.michigan.gov/cv

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