Michigan DOT
Connected Vehicles
Michigan Traffic Safety Summit 2015
March 24th, 2015
PRESENTATION OVERVIEW

• Toward Zero Deaths Initiative
• Connected Vehicles (CV) Overview
• USDOT Safety Pilot Model Deployment
• MDOT Connected Vehicle Projects
• MDOT Smart Corridor
  • Location
  • Applications
• MDOT AV Support
Michigan Traffic Fatality Trends
CONNECTED VEHICLES

Drivers/Operators

Vehicles and Fleets

Wireless Devices

Infrastructure
USDOT SAFETY PILOT MODEL DEPLOYMENT

- Determine effectiveness of safety technology and applications
- Support NHTSA decision-making
- $18 Million, 2.5 year program
- > 2,800 cars, trucks & buses
- 73 lane-miles
- 29 roadside equipment installations
- “Road Test” from 8/21/12 to 8/30/13
MDOT
CONNECTED VEHICLE PROJECTS

- Integrated Mobile Observations (IMO)
- Vehicle-based Information and Data Acquisition System (VIDAS)
- Data Use Analysis and Processing (DUAP)
- Weather Responsive Traveler Information (Wx-TINFO)
- I-94 Truck Parking
- MDOT Smart Corridor Project
INTEGRATED MOBILE OBSERVATIONS

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

Data Users: University of Michigan, National Center for Atmospheric Research, MDOT MDSS & DUAP & TOCs/RITIS - UDC
- Cellular Service Providers Network Operations Center
- NCAR & WxDE
- U of M Server
- Transportation Operations Center
- Traveler Information Systems
- Traffic Management Systems
- Winter Maintenance Operations
- ITS/CV Demonstrations
- Detroit 2014

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Road Surface Roughness and Distress
Surface Temp & Atmospheric Conditions
Vehicle Positioning GPS
Photo Image
3-axis accelerometer
VEHICLE-BASED INFO DATA ACQUISITION SYSTEM

Mounted Processing Unit or Data Acquisition system (DAS)

Bluetooth
Vehicle OBD

Antenna
Vehicle Power

Pavement Asset Condition Sensors

Expandable as needs are identified (i.e., atmospheric conditions, wheel speed sensors, camera, wipers, etc.)

VIDAS Architecture
<table>
<thead>
<tr>
<th>Planning &amp; Asset Management</th>
<th>Design</th>
<th>Construction</th>
<th>Maintenance</th>
<th>Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavement Conditions</td>
<td>Pavement Conditions</td>
<td>Pavement Performance Correlation with environment</td>
<td>Pavement Conditions</td>
<td>Pavement Conditions</td>
</tr>
<tr>
<td>• IRI</td>
<td>• Measure Rutting (traction control?)</td>
<td>• Long term pavement performance and cracking</td>
<td>• Friction</td>
<td>• Ice Forming</td>
</tr>
<tr>
<td>• PASER sufficiency ratings</td>
<td>• Pavement Roughness vs. Fuel Consumption</td>
<td>• Tracking pavement conditions for verification of reported vehicle damage</td>
<td>• Ride Quality</td>
<td>• Tracking pavement conditions for verification of reported vehicle damage</td>
</tr>
<tr>
<td>• Accelerometry</td>
<td></td>
<td>• Cure time in environmental conditions</td>
<td>• Defect Type and Location</td>
<td>• Friction</td>
</tr>
</tbody>
</table>
<pre><code>                                                             | • Trending data for cost/benefit analysis | • IRI PASER | • Markings |
</code></pre>
<p>| Traffic Planning             | Intelligent Construction Probes for comprehensive As-builts | Weather/Environment Information | Weather | Traffic Management |
| • Volume Distribution       | • Determine actual subgrade compaction state | • Monitoring weather parameters | • Winter Weather Maintenance | • Volume |
| • Volume Growth             | • Environmental conditions at time of placement | • Frost Depth | • Response Times | • Occupancy |
| • Congestion Relief         |                                  | • Best paving Conditions monitoring | • Analyzing &amp; Tracking weather systems | • Speed |
| • Roadway System Planning   |                                  | • Work Conditions Monitoring, i.e. Rain Delays | • Winter maintenance activities | • Travel Time |
| HAMS &amp; TMS                  | Weather stations | • Greenhouse gases emissions | • General Year-round Maintenance | • Seasonal Volume Changes |
| • Asset Location            | • Ongoing environmental monitoring |                                  |                         | • Route Guidance |
| • Current Conditions        | • Impact on life of pavement  |                                  |                         | • Incident Notification |
| • Systems Performance       | • Rate of degradation of pavement |                                  |                         | • User Delay Cost |
| Reporting:                  | • Traffic conditions, i.e. speed, volume, queue lengths | Work Zone | Incident Management | Incident Management |
| • Volume                    | • Lane Departures | • Traffic Conditions, i.e. speed, volume, queue lengths | • Time of Occurrence | • Incident Report |
| • Speed                     | • Worker Safety | • Lane Departures | • Pinpoint locations | • First Responders Times |
| • Occupancy                 | • Monitor Safety | • Worker Safety | • Damage tracking on infrastructure | • First Responders Guidance |
| • Classification            | • Monitor when active | • Worker Safety | • Incident Cause | • Incident Locations |
| • Travel Time               |                                  | • Time to repair | • High Incident Locations | • High Incident Locations |
| • Origin &amp; Destination Planning |                                  | • Damage Log | • User Delay Cost | • User Delay Cost |
| • Weather impact             |                                  | • Time to repair | • Treatment Status | • Condition Status |
| • Fixed Station Placement   |                                  | • Damage Log |                         |                         |
| Site Monitoring             | Real-time site monitoring | Signals | Signals | Signals |
| • Utility Location for Construction Equipment (DSRC), i.e. Overhead Power Lines | • High precision as built mapping | • Cost to Operate | • Vehicle Location | • Traffic Management |
|                              |                                  | • Phase Analysis | • Signal Phasing | • Driving Conditions Status |
|                              |                                  | • Volume | • Signal Phasing |                         |
|                              |                                  | • Incident Analysis | • Signal Delay |                         |
|                              |                                  | • Vehicle Location |                         |                         |
| Counts Path                 | Traffic monitoring | Rest Areas | Rest Areas | Traffic Management |
| • Pedestrian                | • Impact of traffic on pavement over time | • Vehicles Pulling in | • • Vehicles Pulling in | • Freight |
| • Bike                      | • Classification, Load cell | • Time spent | • Time spent | • Light |
| Truck Tracking              | Contractor Management | • Parking availability | • Parking availability | Topological Analysis |
| • Freight                   | • Conditions of Temporary Pavement (Ride Quality) | • Channel Systems Migration | • Channel Systems Migration | • Land Erosions |
| • Light                     | • Monitor Road/Lane Closures | • Land Erosions | • Land Erosions | • Water Levels |
|                             | • Work Progress for Incentive Payments | • Water Levels | • Water Levels |                         |</p>
DUAP APPLICATIONS

• Initial Applications:
  • Pavement:
    • Condition – Ride Quality, Surface Smoothness
    • Event – Pavement Defects & Severity – Potholes, Cracking
  • Weather:
    • Condition – Pavement Surface, Weather
    • Event – Pavement Advisory – Slippery, Icy, Snow Covered
  • Traffic:
    • Condition – Average Speed, SPaT
    • Event – Queues, Congestion, Incidents
WEATHER-RESPONSIVE TRAVELER INFORMATION
SAMPLE WX-TINFO MESSAGES

- White Out Conditions
  
  WHITE OUT CONDITIONS ON I-94
  REDUCE SPEED

- Icy Roads
  
  SLIPpery ROADS WB I-94
  REDUCE SPEED

- Tornado Warning
  
  TORNADO WARNING INGHAM COUNTY
  8:00 – 10:00 AM

- Low Visibility
  
  LOW VISIBILITY NEXT 5 MI
  REDUCE SPEED
TRUCK PARKING INFO & MANAGEMENT SYSTEM

- Provide Real Time Availability
- Improve Safety
- 5 Public Rest Areas
- 10 Private Truck Stops
- Counting ins/outs
- Dynamic Truck Parking Signs
- Mi Drive
- Truck Smart Parking Services
- Smartphone Application
- On-Board DSRC Equipment
TRUCK PARKING AVAILABILITY COMMUNICATION
MDOT SMART CORRIDOR PROJECT
MDOT SMART CORRIDOR
POTENTIAL CV APPLICATIONS

- **Vehicle-to-Vehicle (V2V)**
  - Emergency Electronic Brake Lights
  - Do Not Pass Warning
  - Forward Collision Warning
  - Intersection Movement Assist
  - Blind Spot/Lane Change Warning
  - Left Turn Assist

- **Vehicle-to-Infrastructure (V2I)**
  - Curve Speed Warning
  - Work Zone Speed Advisory
  - Spot Weather Impact
  - Road Hazard / Lane Closure Warning
  - Traffic Light Phase Information
MDOT SMART CORRIDOR NEEDS

- Vehicles
- Application Development
- Communications (Backhaul)
- Security System
- Partnering (i.e., business model development)
Autonomous vehicles are coming
- More than 95% believe within 25 years
- More than half believe within 10 years

Main barriers are institutional
- Liability
- Public Acceptance

Stakeholders desire clear regulatory framework
- Liability and insurance
- Certification procedures and needs

No consensus on best model for initial public deployment
- Public transportation
- Closed campus

Supporting infrastructure
- Personal transportation

Perceived Michigan strengths
- Presence of auto & defense hub
- Variable weather conditions
- Wide range of road types

<table>
<thead>
<tr>
<th>Time Frame</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Now</td>
<td>5.8%</td>
</tr>
<tr>
<td>0-5 years</td>
<td>17.4%</td>
</tr>
<tr>
<td>5-10 years</td>
<td>36.1%</td>
</tr>
<tr>
<td>10-25 years</td>
<td>36.8%</td>
</tr>
<tr>
<td>25+ years</td>
<td>3.9%</td>
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POTENTIAL MDOT SUPPORT OF AUTONOMOUS VEHICLES

- Road Use
- Road Surveying / Mapping
- Traffic Information
- Signing
- Pavement Marking
- Connected Vehicle “Connection”
- Traffic Signal Information
QUESTIONS

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