Dynamic Mobility Applications (DMA) Program Overview

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Mobility Workshop 2012
May 24, 2012
Kate Hartman
ITS-JPO
Overview

- Introduction
  - Key Concepts
  - Program Roadmap
- Current Projects and Products
  - Overview of DMA Bundles
  - Open Source Portal
  - Transformative Mobility Impacts
- Nomadic Devices
- Stakeholder Q&A
Dynamic Mobility Applications Program

**Vision**
- Expedite development, testing, commercialization, and deployment of innovative mobility application
  - maximize system productivity
  - enhance mobility of individuals within the system

**Objectives**
- Create applications using frequently collected and rapidly disseminated multi-source data from connected travelers, vehicles (automobiles, transit, freight) and infrastructure
- Develop and assess applications showing potential to improve nature, accuracy, precision and/or speed of dynamic decision
- Demonstrate promising applications predicted to significantly improve capability of transportation system
- Determine required infrastructure for transformative applications implementation, along with associated costs and benefits

**Project Partners**
- Strong internal and external participation
  - ITS JPO, FTA, FHWA R&D, FHWA Office of Operations, FMCSA, NHTSA, FHWA Office of Safety
## Dynamic Mobility Applications Program

### Program Activity Track

<table>
<thead>
<tr>
<th>Activity</th>
<th>Phase 1 (9/09)</th>
<th>Phase 2 (9/11)</th>
<th>Phase 3 (9/13)</th>
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<tr>
<td>Stakeholder Engagement</td>
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<tr>
<td>Program Planning</td>
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<tr>
<td>Institutional and Policy</td>
<td>Inst. and Policy Assessment</td>
<td>Inst. and Policy Requirements</td>
<td>Revised Policies, Possible Rulemaking</td>
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<tr>
<td>Standards</td>
<td>Standards Plan</td>
<td>Standards Development and Testing</td>
<td>Standards Demonstration</td>
</tr>
<tr>
<td>Research and Development</td>
<td>Open Source Portal Development</td>
<td>Deploy Open Source Portal</td>
<td>Maintain Open Source Portal</td>
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<td></td>
<td>State-of-Practice Tech Assessments</td>
<td>Develop and Refine Tools/Analytics For Impacts Assessment</td>
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<td></td>
<td>Prototype Application</td>
<td>Ph. 2 Applications Development</td>
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<tr>
<td>Testing</td>
<td>Application Identification</td>
<td>Ph. 2 Applications Testing</td>
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<td></td>
<td>Ph. 2 Applications Downselect</td>
<td>Data Capture</td>
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<tr>
<td>Demonstrations</td>
<td>Demo Coordination Planning</td>
<td>Connected Vehicle Demo(s)</td>
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<td></td>
<td>Phase 3 Demo Planning</td>
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<td>Phase 3 Demo Site Downselect</td>
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<tr>
<td>Evaluation</td>
<td>Define Measures</td>
<td>Evaluation Planning</td>
<td>Phase 2 Apps Evaluation</td>
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<td>Outreach</td>
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</tbody>
</table>

### Decision Points

**Phase 2 Decision Point**

- Ph. 2 Applications Testing
- Data Capture

**Phase 3 Decision Point**

- Ph. 3 Apps Testing (OPT.)
- Data Capture

### Questions

- Do the candidate applications show enough promise to be tested?
- Do these applications address key performance measures?
- Do we understand the communications requirements of these applications?
- Are there clear and compelling arguments for deployments showing significant benefits?

### LEGEND:

- **Decision point**
- **Program Activity**
- **Data Capture**
- **Open Source Applications**
- **Open Source Portal**

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High-Level Roadmap v1.5a (5/17/2011)
Dynamic Mobility Applications Program: Application Development Process

- **Current Focus:**
  - Create, develop, and demonstrate applications utilizing multi-source data

- **Transformative Application Bundles**
  - 9-month process to engage stakeholders and make a decision
    - collected innovative, transformative ideas
    - prioritized stakeholder and federal interest
  - Identified the most promising applications to pursue in Phase 2 (Announced at TRB 2011)
  - Initiated Concept of Operations and System Requirements development efforts in 2011 that are currently ongoing

- **Open Source Portal**
  - Foundational capability to share and coordinate application development
  - Concept of operations completed
  - Implementation underway
Dynamic Mobility Application Bundles

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
<th>Lead Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-ISIG:</td>
<td>Multimodal Intelligent Traffic Signal System</td>
<td>Ben McKeever</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cooperative Transportation Systems: University of Arizona/PATH</td>
</tr>
<tr>
<td>INFLO:</td>
<td>Intelligent Network Flow Optimization</td>
<td>Mohammed Yousuf</td>
</tr>
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<td>SAIC/Delcan</td>
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<td>Uniform Management, and Evacuation</td>
<td>Battelle</td>
</tr>
<tr>
<td>Enable ATIS:</td>
<td>Enable Advanced Traveler Information Systems</td>
<td>Bob Rupert</td>
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<tr>
<td></td>
<td></td>
<td>CS/Kimley-Horn</td>
</tr>
<tr>
<td>FRATIS:</td>
<td>Freight Advanced Traveler Information Systems</td>
<td>Randy Butler</td>
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<tr>
<td></td>
<td></td>
<td>CS</td>
</tr>
<tr>
<td>IDTO:</td>
<td>Intelligent Dynamic Transit Operations</td>
<td>Ron Boenau</td>
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<td></td>
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<td>SAIC</td>
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<tr>
<td>Other Programs:</td>
<td>ICM</td>
<td>Weather</td>
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<tr>
<td></td>
<td>ATDM</td>
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<tr>
<td></td>
<td>Weather</td>
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Dynamic Mobility Applications Program: Key Recent Accomplishments

- Completed four application bundle Concepts of Operations/Operational Concepts
  - FRATIS, EnableATIS, IDTO, INFLO

- M-ISIG bundle development effort initiated by Cooperative Transportation System (CTS) Pooled Fund Study (Virginia DOT, lead), 2/27

- Initiated Open Source Portal implementation effort, 3/12
  - ConOps and Systems Requirements effort completed, 12/1

- Continued program of extensive stakeholder engagement
  - 19 bundle-specific stakeholder workshops and other events

- Completed BSM Assessment white paper Ver. 1, 2/12
Next Phase in Application Development

How will we be learning more about application bundles?

- **Phase 2 will be answering key questions:**
  - What are the required data and communication needs for mobility apps?
  - What is the role of the BSM in supporting mobility applications?
  - What are the expected impacts from DMA application deployment?

How will this be accomplished?

- **Phase 2 Integrated Research Plan:** A coordinated set of research, prototyping and impacts analysis activities over the period 6/12-12/13
  - Cellular-Augmented BSM (Parts 1 and 2): Mobility-Focused Research
    - Cross-cutting tests (e.g., role of cellular BSM)
    - Development of nomadic platform (mobile device) capabilities
  - Application Prototyping
    - Application development and prototype testing
  - Impact Assessment
    - Applications and Bundles in isolation
    - Integrated impact at the regional and national level over time
### Key Next Steps in Phase 2

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td><strong>Stakeholder Engagement</strong></td>
<td>- Maintain stakeholder engagement throughout prototyping/testing</td>
</tr>
<tr>
<td><strong>Mobility Applications Development and Testing</strong></td>
<td>- Initiate application prototyping (staggered start)</td>
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<tr>
<td></td>
<td>- Nomadic Device Prototyping</td>
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<td></td>
<td>- Cross-cutting testing</td>
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<tr>
<td><strong>Open Source Portal</strong></td>
<td>- Portal Development and Enhancement</td>
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<tr>
<td><strong>Analytical Tools</strong></td>
<td>- Tool enhancement for DMA-focused regional integrated impacts estimation, coordinated with ATDM/ICM test beds</td>
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<td>- Application/bundle impacts analysis assessment coordinated with prototyping</td>
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<tr>
<td><strong>Program Evaluation and Performance Measures</strong></td>
<td>- Program Evaluation and national-level DMA-bundle impacts assessment, including uniform assumptions on technology evolution</td>
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<tr>
<td><strong>Standards</strong></td>
<td>- Training and coordination</td>
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Randy Butler
FHWA
Open Source Applications Portal

- **Purpose**: Develop, operate, and maintain an open source portal that will enable multiple stakeholders to collaborate on application development

- **Coordination**: Application bundles require concurrent, collaborative development
  - E.g., in the M-ISIG bundle, pedestrian signal phases in the PED-SIG application must be coordinated with applications providing priority or pre-emption services
  - This coordination extends to both DMA-funded application development and research conducted at UTCs, other organizations

- **Transparency**: the Open Source Portal provides the mechanism to ensure application development is transparent and broadly available
Open Source Portal Goals and Outcomes

- **Open Source Portal supports:**
  - Configuration management of core assets
  - Creation of new projects by stakeholders
  - Submission of new applications and corresponding benchmark test data sets, test procedures and documentation to a project
  - Collaboration among stakeholders interested in inter-related projects
  - Recognition of contributors of core assets

- **Open Source Portal outcomes:**
  - Portal governance development and licensing agreement
  - Well-documented and accessible core assets
  - Deployment of secure portal infrastructure
  - Promote collaboration and preserve intellectual capital
  - Engage partners from academia and industry who may not be directly involved in funded applications development and testing
1: Algorithms and code used to transform RDE data into estimates of intersection arrival time, resides in OS Portal.

Open Source Portal Use Case
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1: Algorithms and code used to transform RDE data into estimates of intersection arrival time, resides in OS Portal

2: Researcher “Sally” interested in estimating pedestrian approach time to intersection downloads source code

U.S. Department of Transportation
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3: “Sally” modifies code to add pedestrian approach. “Sally” implements version 2 prototype and uploads source code for version 2 back into OS Portal
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4: Freight researcher “Mac” interested in adding approach time for freight vehicles downloads estimator version 2
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5: “Mac” modifies code to add freight vehicle approach times. “Mac” implements version 3 prototype and uploads source code for version 3 back into OS Portal
Open Source Portal Use Case

1: Estimator uses data from RDE, resides in OS Portal and estimates vehicle approach time to intersection

2: Researcher “Sally” interested in adding pedestrian approach time to intersection downloads source code

3: “Sally” modifies code to add pedestrian approach. “Sally” implements version 2 prototype and uploads source code for version 2 back into OS Portal

4: Freight researcher “Mac” interested in adding approach time for freight vehicles downloads estimator version 2

5: “Mac” modifies code to add freight vehicle approach times. “Mac” implements version 3 prototype and uploads source code for version 3 back into OS Portal

6: Transit researcher “Finn” interested in adding approach time for buses downloads estimator version 3
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4: Freight researcher “Mac” interested in adding approach time for freight vehicles downloads estimator version 2

5: “Mac” modifies code to add freight vehicle approach times. “Mac” implements version 3 prototype and uploads source code for version 3 back into OS Portal

6: Transit researcher “Finn” interested in adding approach time for buses downloads estimator version 3

7: “Finn” modifies code to add bus approach times. “Finn” implements version 4 prototype and uploads source code for version 4 back into OS Portal
Open Source Portal Use Case

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5: “Mac” modifies code to add freight vehicle approach times. “Mac” implements version 3 prototype and uploads source code for version 3 back into OS Portal

6: Transit researcher “Finn” interested in adding approach time for buses downloads estimator version 3

7: “Finn” modifies code to add bus approach times. “Finn” implements version 4 prototype and uploads source code for version 4 back into OS Portal

8: “Holly” downloads estimator that supports optimization of network and prototypes application bundle
Open Source Portal Schedule

- Architecture and High-level Design – May 2012
- Prototype Development – Begins June 2012
- Prototype Open Source Portal goes live – September 2012
  - Performance Measures Application to OS Portal
  - Other Mobility Applications to OS Portal
- Open Source Portal Updates - 2013
Bob Rupert
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Defining Mobility Impacts

- What do we mean by mobility?
- How do we measure it?
- How can connected vehicle and traveler data transform mobility measurement as well as mobility?

Performance Measure Application (to be posted to Open Source Portal)
- Source code and documentation on calculating travel time, delay and reliability measures from a mix of fixed sensor and probe data
- Mode-independent approach identifies trip-level measures rather than relying on aggregation of facility measures
Data Available to Mobility Applications Evolution

Current State

- TRAVELER: “nearly zero”
- VEHICLE: “a few”
- INFRASTRUCTURE: “some”

Potential End State

- TRAVELER: “some”
- VEHICLE: “nearly all”
- INFRASTRUCTURE: “where needed”
Data Available to Mobility Applications Evolution

Current State
- TRAVELER: “nearly zero”
- VEHICLE: “a few”
- INFRASTRUCTURE: “some”

Potential Interim States
- TRAVELER
- VEHICLE
- INFRASTRUCTURE

Potential End State
- TRAVELER: “some”
- VEHICLE: “nearly all”
- INFRASTRUCTURE: “where needed”

Data Available to Mobility Applications Evolution
- "some"
- "a few"
- "nearly zero"
Near-term Impacts

Possible Applications:
- Traveler information
- Priority and preemption signal control
- Coordinated incident management
- Transit and fleet management
- Weather

Potential Impact:
- Transform user, fleet and responder performance

Current State

- TRAVELER: "nearly zero"
- VEHICLE: "a few"
- INFRASTRUCTURE: "some"
End-state Impacts

Possible Applications:
- Integrated transit, signal and freeway optimization
- Integrated corridor response
- Real-time bottleneck flow management

Potential Impact:
- Transform system performance
- Transform user experience
End-state Impacts

Possible Applications:
- Integrated transit, signal and freeway optimization
- Integrated corridor response
- Real-time bottleneck flow management

Potential Impact:
- Transform system performance
- Transform user experience

Cross-cutting needs to understand the traveler:
- Explore use of BSM capable mobile device data
- Examine vehicle-device integration
Nomadic Platform Concept Explores Role of Mobile Devices and the Connected Traveler

- **Cross-Cutting Need to Consider Mobile Devices**
  - Bundle development efforts have noted the need to explore the potential value of BSM-capable mobile devices (DSRC, cellular and dual-mode), e.g.,
    - PED-SIG pedestrian safety/mobility application (M-ISIG)
    - INC-ZONE temporary work zone for responders (R.E.S.C.U.M.E)
    - Crowdsourcing traveler data for EnableATIS (itinerary data)
    - Flexible transit service matching and ridesharing (IDTO)
  - Devices may obtain or infer vehicle status data when carried into a vehicle (e.g., obtain external temperature by using a camera to read dashboard display)

- **Nomadic Platform Concept**
  - Explore the potential of mobile devices and supporting technologies to meet critical application and data needs for both connected vehicles and travelers

- **Next step**: Prototyping

- **Further discussion during exercises**: Need your feedback on most critical issues/opportunities with mobile devices
  - Breakout sessions will use the following assumptions
### DSRC and Cellular Vehicle-Centric Devices: Strawman Configurations and Capabilities

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Comm. Technology</th>
<th>Data Generated</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1</td>
<td>DSRC</td>
<td>BSM Part 1</td>
<td>0.1 seconds</td>
</tr>
<tr>
<td>V2</td>
<td>Cellular</td>
<td>BSM Part 1 + Weather Data + Vehicle Itinerary Data</td>
<td>180 seconds</td>
</tr>
</tbody>
</table>

- **Weather Data and Vehicle Itinerary Data:**
  - Provided as an element of an opt-in personalized traveler information service (business model includes aggregation and re-purposing of non-PII (Personally Identifiable Information) derived from these data)
  - Possible weather data elements:
    - Ambient air temperature, wiper status, traction control system status
  - Possible vehicle itinerary data elements:
    - Origin, destination, departure time, desired arrival time, purpose
  - Possible transit vehicle itinerary data elements:
    - Schedule delay, occupancy, # of empty seats, # of empty bike rack slots

- DSRC Range: 300 meters
# Dual-Mode Vehicle-Centric Devices: Strawman Configuration and Capabilities

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Comm. Technology</th>
<th>Data Generated</th>
<th>Frequency In Range of an RSE</th>
<th>Frequency Not in Range of an RSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>V3</td>
<td>DSRC + Cellular (Dual Mode)</td>
<td>BSM Part 1</td>
<td>0.1 seconds via DSRC</td>
<td>0.1 seconds via DSRC AND 180 seconds via Cellular</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Weather Data + Vehicle Itinerary Data</td>
<td>180 seconds via DSRC</td>
<td>180 seconds via Cellular</td>
</tr>
</tbody>
</table>
Cellular and Dual-Mode Traveler-Centric Devices: Strawman Configurations and Capabilities

<table>
<thead>
<tr>
<th>Mobile Device Type</th>
<th>Comm. Technology</th>
<th>Data Generated</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>In Range of an RSE</td>
</tr>
<tr>
<td>M1</td>
<td>Cellular</td>
<td>Position + Speed + Traveler Itinerary Data</td>
<td>180 seconds</td>
</tr>
<tr>
<td>M2</td>
<td>DSRC + Cellular (Dual Mode)</td>
<td>Position + Speed</td>
<td>0.1 seconds via DSRC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Traveler Itinerary Data</td>
<td>180 seconds via DSRC</td>
</tr>
</tbody>
</table>

- Traveler Itinerary Data:
  - origin, destination, departure time, desired arrival time, purpose, transit special request (e.g., need for bike rack, wheelchair)

- Mobile Devices:
  - Can support a range of mobility and safety applications
  - DSRC Range: 50 meters
Questions?