IntelliDrive℠
Data Capture and Management Program

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Federal Highway Administration
Office of Operations Research and Development

Mobility and Environment Workshop
Arlington, Virginia

November 30, 2010

IntelliDrive is a service mark of the U.S. Department of Transportation.
• Program Vision and Objectives
• Key Concepts
• Current Projects and Products
• Upcoming Activities
• Issues
• Question and Answer
IntelliDrive Mobility

Real-time Data Capture and Management

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

Mobility and Environmental Applications

- Reduce Speed 35 MPH
- Weather Application
- Real-Time Travel Info
- Fleet Management/Dynamic Route Guidance
- Signal Phase & Timing Adjusts Real-Time Conditions
- Safety Alerts and Warnings
- Transit Signal Priority

Data Environment
Real-Time Data Capture and Management

Vision
• Active acquisition and systematic provision of integrated, multi-source data to enhance current operational practices and transform future surface transportation systems management

Objectives
• Enable systematic data capture from connected vehicles (automobiles, transit, trucks), mobile devices, and infrastructure
• Develop data environments that enable integration of data from multiple sources for use in transportation management and performance measurement
• Reduce costs of data management and eliminate technical and institutional barriers to the capture, management, and sharing of data
Data environment:
• well-organized collection of data of specific type and quality
• captured and stored at regular intervals from one or more sources
• systematically shared in support of one or more applications
Key Issues in Defining A Data Environment

What Data Do We Capture?

How Do We Use The Data?

What Data Do We Keep?

How Do We Structure The Data?
Data Sources and Uses

**Sources**
- Mobility Safety Environment
- Transit Freight Light Vehicle
- Loop Radar Other
- Infrastructure Location Decisions
- Traveler Performance Measurement
- Traveler Information
- Variable Speed Limits Other
- Eco-Drive Queue Warning
- Environment Other
- Other

**Uses**
- Traveler
  - Location Decisions
- Vehicle
  - Transit Light Vehicle Freight
- Infrastructure
  - Loop Radar Other
- Other
- Performance Measurement
- Traveler Information
- Mobility
- Variable Speed Limits
- Safety
- Queue Warning
- Other
- Other
Data Aggregation and Structure

AGGREGATION

AREA-WIDE AGGREGATION

RAW DATA

STANDARDS
QUALITY
ACCESS
IP
STORAGE
REGULATION

STRUCTURE

8
Potential End State

Current State

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<td>“nearly zero”</td>
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Potential Interim States

Potential End State

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<td>“some”</td>
<td>“nearly all”</td>
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• **Meta data:**
  – Provision of well-documented data environment

• **Virtual warehousing:**
  – Supports access to data environment and forum for collaboration

• **History/context:**
  – Objectives of data assembly

• **Governance:**
  – Rules under which data environment can be accessed and procedures for resolving disputes
Each Data Environment Supports Multiple Apps

Overlapping data needs and synergy between application concepts

High risk
- Pedestrian detection
- Intersection vehicle control

Low risk
- Smart transit signal priority
- Dynamic transit dispatching
- Connected Eco-driving
- Signal optimization

Arterial + Transit Data Environment

Near-term (0-3 years)
- Pedestrian detection
- Dynamic transit dispatching

Long-term (>10 years)
- Intersection vehicle control
- Connected Eco-driving
- Signal optimization
Federated Data Environments

- Federated Data Systems
  - Decentralized
  - Virtual
  - Independent
  - Heterogeneous
  - Systematic data exchange among federated environments

- Each data environment supports a specific level of system control/decision
  - For example, geographic (figure)
  - Might also be functional or jurisdictional, other
IntelliDrive<sup>SM</sup> Data Capture and Management Program: High-Level Roadmap

<table>
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<th>Program Activity Track</th>
<th>FOUNDATIONAL ANALYSIS PHASE 1</th>
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**Legend:**
- Decision point
- Data Environment
- Program Activity

**Questions:**
- Is there substantive research to be conducted in a proof-of-concept test?
- Is the program well-defined and connected to the ITS Program?
- Do the results from the POC tests motivate larger-scale demonstrations?
Projected Program Outcomes

- Establish a system of IntelliDrive federated data environments
- Broad collaboration supporting data environment utilization
  - Leverage data to support high-priority application development
  - Encourage technical exchange between researchers
- Implementation of data management processes representing best practices
Current Projects and Program Products

• Current Projects
  – Technical State-of-the-Practice/Innovation Scan
    • USDOT Lead: Mohammed Yousuf (FHWA R&D)
    • Principal Investigator: Dick Mudge (Delcan)
  – Policy Assessment*
    • USDOT Lead: Walter During (FHWA Office of Operations)
    • Lead Researcher: Suzanne Sloan (Volpe Center)
  – Standards Assessment*
    • USDOT Lead: Tom Stout (FHWA)
    • Principal Investigator: Nu Rosenbohm (SAIC)
  – Data Environment Evaluation Framework
    • USDOT Lead: Walter During (FHWA)
    • Principal Investigator: Anita Vandervalk (Cambridge Systematics)

• Available Program Products
  – Program vision, other documents on IntelliDrive website
  – Prototype Data Environment

*Joint activity with Data Capture and Management Program
Data Capture Prototype
Data Environment

- [https://datacapture.noblis.org/](https://datacapture.noblis.org/)

- Data (and meta-data) from the Michigan IntelliDrive Test Bed
  - Documented probe data samples from recent tests (POC/NCAR)
  - Open source analytical tools
  - Simulated 100% market penetration data for the test bed contributed by the University of Michigan Transportation Research Institute (UMTRI)
  - Forums for researchers to register projects, flag erroneous data, contribute analyses and data views

- Prototype objectives
  - Refine the Data Environment concept
  - Test key hypotheses about governance and user collaboration
Log Files from Onboard Equipment (OBE)

Raw (Detailed) Log File

Trajectory Extract

Trajectory Plot with Google Earth using

Also: extracts of snapshots in log file and RSE interaction events
Snapshots Collected by Roadside Equipment (RSE)

XML Format (J2735 standard)

Parsed, spreadsheet format

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Trajectory Conversion Analysis (TCA) Program

• Open Source Python program
• Inputs
  – Vehicle Trajectory Files (Actual or Simulated)
  – RSE locations and range
  – Parameters for snapshot generation & transmission
• Outputs
  – Snapshots generated and transmitted to RSEs
  – Snapshots discarded for buffer overflow or RSE gap
  – Probe segment number changes
UMTRI Paramics Simulation of the Testbed

- 189 Origin/Destinations
- Models 6 AM – 11 AM
- 10,000 concurrent vehicles
- RSE interactions modeled
POC Data Files

The first major set of trials conducted at the DTE was the Proof of Concept (POC) trials during 2008. The POC trials featured fifty-two RSEs within 45 square miles, 27 vehicles configured with OBES, and a Dedicated Short-Range Communications (DSRC) network. The testing program had three major phases: subsystem test, system integration and test, and public and private applications test. The public application testing portion of the POC trials were conducted during August 2008. RSE data for the public application tests were available for eight days in August 2008. The data in this prototype data environment consists of RSE and OBE data for the middle six of these days. These six days were chosen for inclusion in the data environment because the first and last days had much higher number of duplicate records and questionable data values.

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Upcoming Activities

• Precise nature, extent and timing are not yet known, however, the program expects to procure assistance in the following areas:

  – Test Data Sets
    • Assemble already collected data sets featuring multi-source data collected using emerging technologies
    • Supports early application research
  – Data Environment Development
    • Develop and make available data environments supporting high-priority applications research and development
  – Federated System Data Manager
    • Connect, foster and manage system of federated data environments
Key Issues

- Intellectual property rights
- Privacy
- Governance
- Standards and Regulation
- Meta-Data
- Quality Assurance
- Storage
- Access and Security
- Operations and Maintenance
Questions?

- Thank you