Latest Results from FHWA’s Road Weather Management Program

presented to
National Rural ITS Conference
Session B1: Clarus – Advanced Tools for Road Weather Management Program

presented by
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August 2, 2010

“Anytime, Anywhere Road Weather Information”
Overview

- The Scope of the Problem
- The Road Weather Management Program
- Accomplishments
- Next Steps

“Anytime, Anywhere Road Weather Information”
The Scope of the Problem – Safety

Average Annual Fatalities

- Flood: 74
- Lightning: 44
- Tornado: 62
- Hurricane: 117
- Heat: 170
- Cold: 18
- Winter Storm: 41
- Wind: 47
- Total NWS tracked*: 573
- Adverse Road Wx*: 7130

“Anytime, Anywhere Road Weather Information”
The Scope of the Problem – Safety

Average Annual Fatalities

- 24% of all crashes occur under adverse weather conditions:
  - 1.5 million crashes (↓ 100k)
  - 673,000 injuries (↓ 44k)
  - 7,130 fatalities (↓ 270)

14 year average (1995-2008) (versus previous 11-year averages)
Weather Impacts – Mobility +

- **Mobility**: Cost of congestion is $9.45 billion/yr for the 85 major urban areas (weather causes ~25% of non-recurrent delay on freeways)

- **Productivity**: Weather-related delay adds $3.4 billion to freight costs annually

- **Environment**: Chemicals affect watersheds, air quality and infrastructure
Road Weather Management Program

- SAFETEA-LU, Section 5308

» Establish a Road Weather R&D program:
  - Maximize use of available road weather information & technologies
  - Expand research & development efforts
  - Promote technology transfer
  - Follow *Where the Weather Meets the Road*

» Multi-disciplinary stakeholder input:
  - NOAA
  - NSF
  - State DOTs (AASHTO)
  - Private Sector
  - Non-profit Orgs

» Funding: $5m/yr for 4+ years
Road Weather Management

- Day-to-day operations includes managing the system under all types of weather
  - “Anytime, anywhere road weather information” is the program’s mission
  - This includes current and predicted information about weather’s affect on roads…
  - … and the decision support tools to aid road users and operators to make effective decisions, e.g.,
    - When to pre-treat roads for snow & ice control
    - When to post traveler advisories (fog, floods, rain, snow, etc.)

“Anytime, Anywhere Road Weather Information”
Road Weather Management

Accomplishments

Through extensive coordination and collaboration across the full breadth of stakeholders, we now have…

“Anytime, Anywhere Road Weather Information”
Road Weather Management

Accomplishments

Through extensive coordination and collaboration across the full breadth of stakeholders, we now have...

- Maintenance Decision Support System (MDSS)

“Anytime, Anywhere Road Weather Information”
Road Weather Management

Accomplishments

Through extensive coordination and collaboration across the full breadth of stakeholders, we now have…

- Maintenance Decision Support System (MDSS)
- The *Clarus* Initiative

“Anytime, Anywhere Road Weather Information”
Through extensive coordination and collaboration across the full breadth of stakeholders, we now have…

- Maintenance Decision Support System (MDSS)
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- Weather-responsive Traffic Management
Through extensive coordination and collaboration across the full breadth of stakeholders, we now have…

- Maintenance Decision Support System (MDSS)
- The *Clarus* Initiative
- Weather-responsive Traffic Management
- Weather-sensitive Performance Measures

… and, an educated, aware and engaged community

“All the time, anywhere Road Weather Information”
Road Weather Management

Latest Efforts

- The *Clarus* Initiative
- IntelliDrive℠ & Weather
- Integrated Mobile Observing & Dynamic Decision Support

“Anytime, Anywhere Road Weather Information”
The **Clarus Initiative**

- A database management system for all surface transportation weather observations in North America
- One database removes borders
- Provides advanced quality checking for both atmospheric & pavement data
- Includes extensive metadata
- Easy access via web portal & subscription
- Once development completed, transfer to NOAA for operations

“Anytime, Anywhere Road Weather Information”
Participation Status for **Clarus**
as of June 1st, 2010

**Local DOT Participation**
- City of Indianapolis, IN
- McHenry County, IL
- City of Oklahoma City, OK
- Kansas Turnpike Authority
- NY State Thruway
- City of Denver, CO
- Washington, DC
- City of Overland Park, KS

**Clarus Connection Status**
- **Connected**
  - (37 States, 4 Locals, 3 Provinces)
- **Pending**
  - (4 States, 3 Locals)
- **Considering**
  - (4 States)

Sensor & Station Count
- 2,127 Sensor Stations (ESS)
- 47,231 Individual Sensors
New Research: Advancing Road Weather Management Using Clarus Data

Objective: Foster multi-disciplinary collaboration to use Clarus System data to:

- develop new or improved surface transportation weather management/operations procedures,
- create innovative user interfaces, and/or
- develop new applications including weather-responsive traffic management tools

“Anytime, Anywhere Road Weather Information”
Latest Efforts

- The Clarus Initiative
- IntelliDrive℠ & Weather
- Integrated Mobile Observing & Dynamic Decision Support

“Anytime, Anywhere Road Weather Information”
Latest Efforts…

**IntelliDrive℠ & Weather – Research Goals**

- Identify and explore a range of mobile platforms as a source of robust data

- Develop algorithms and processing capabilities to translate the mobile data into useable weather and road condition observations
  - Is the probe data of sufficient quality?
  - What are the minimum # of samples and minimum sampling period per road segment to get valid obs?
  - What QC algorithms are needed?
  - What are the best ways to package/disseminate the obs?

“Anytime, Anywhere Road Weather Information”
Latest Efforts…

**IntelliDrive℠ & Weather – Research Goals**

- Incorporate these observations into effective mgmt. systems and decision support tools (e.g., MDSS, weather-responsive traffic management strategies)
  - What is gained by utilizing mobile observations?
  - What are the resultant data and communications requirements?
Latest Efforts…

Vehicle-based Probe Data

- Barometric Pressure
- Windshield Wiper
- Accelerometer Data (steering & yaw)
- Brake Status & Boost
- GPS Position, Heading, Elevation & Vehicle Speed
- Headlight Status
- State & Speed
- External Air Temperature
- Data (steering & yaw)
- Tire Pressure
- Vehicle Traction Control
- Vehicle Stability Control
- Anti-lock Braking System

IntelliDrive℠ & Weather – Research Goals

“Anytime, Anywhere Road Weather Information”
Work Completed to Date

- 2 analyses along the Dulles Toll Road conducted by Noblis (2006)
  - Exploratory look at mobile observing

- National Center for Atmospheric Research (NCAR) was tasked to develop the Vehicle Data Translator (VDT)
  - Feasibility study (2007)
  - VDT Ver1.0 completed in July, 2009
  - VDT Ver2.0 on target for completion this summer

- IntelliDrive™ Development Test Environment in Detroit
  - Source of most of the probe data for the VDT development

“Anytime, Anywhere Road Weather Information”
The Vehicle Data Translator (VDT)
sophisticated processing of data

Functions
• Parsing
• Filtering
• Quality Checking
• Data integration
• Statistical processing
• Data export

“Anytime, Anywhere Road Weather Information”
Initial Focus of Weather Research

Vehicle Data Translator (VDT) prototype, developed by NCAR

- Air temperature
- Barometric pressure
- Precipitation occurrence (yes, no)
- Precipitation intensity (none to heavy)
- Precipitation type (liquid, frozen)
- Pavement condition (slippery yes/no)
- Fog (likely, not likely)

“Anytime, Anywhere Road Weather Information”
Vehicle Data Translator (VDT) prototype, developed by NCAR

Vehicles measuring “Rain” and “Road Splash”
Latest Efforts

- The *Clarus* Initiative
- IntelliDrive\(^{\text{SM}}\) & Weather
- Integrated Mobile Observing & Dynamic Decision Support
Project Objectives

1. Derive data and communications requirements for weather, road condition, and vehicle status variables from mobile platforms (Using State DOT vehicles as the source)

2. Enhance and expand post-processing algorithms to turn the data into useful observations that are tied to existing mesonets (e.g., Clarus)

3. Explore the use of these and other observations in weather-related decision support systems.

“Anytime, Anywhere Road Weather Information”
Integrated Mobile Observing & Dynamic Decision Support

New Project

Step I

Project Vision

State DOT Vehicles

Wireless communications e.g. 3G/4G cellular or RF datalink

State DOT

“Anytime, Anywhere Road Weather Information”
Integrated Mobile Observing & Dynamic Decision Support

New Project

Step I

State DOT Vehicles

Wireless communications e.g. 3G/4G cellular or RF datalink

Step II

State DOT

VDT (NCAR)

IntelliDrive Data Capture

“Anytime, Anywhere Road Weather Information”
Integrated Mobile Observing & Dynamic Decision Support

Project Vision

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Vehicles

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State DOT

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VDT
(NCAR)

Clarus

IntelliDrive Data Capture

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New Project

Step I

1. State DOT Vehicles
   - Wireless communications e.g. 3G/4G cellular or RF datalink

Step II

2. State DOT

Step III

3. VDT (NCAR)

Step IV & V

4. IntelliDrive Data Capture

5. Other IntelliDrive Applications

6. Regional Demo 2-5

7. MMS

8. MDSS

9. DOT Operations

“Anytime, Anywhere Road Weather Information”
Integrated Mobile Observing & Dynamic Decision Support

Legend:
- State DOT entity
- Clarus entity
- IntelliDrive Entity
- Commercial or gov’t program
- NCAR
- Internet data flow
- Wireless data flow

New Project

Project Vision

Step I
State DOT Vehicles
Wireless communications e.g. 3G/4G cellular or RF datalink

Step II
State DOT

Step III
VDT (NCAR)

Step IV & V
Clarus

Clarus Regional Demo 2-5

MDSS

MMS

DOT Operations

IntelliDrive Data Capture

“Anytime, Anywhere Road Weather Information”
Integrated Mobile Observing & Dynamic Decision Support

Next Steps

FHWA will task NCAR to:

- Define mobile data and communication needs
- Identify potential States based on available, non-proprietary data and prospective dynamic application(s)
- Develop the next generation of open source algorithms (VDT version 3.0), including documentation & code
- Provide VDT input to Clarus

FHWA will task Mixon Hill to:

- Ingest data from both the State server and the VDT
- Develop any new mechanisms that may be needed to capture the data and create the metadata for the observations
- Disseminate the data in support of the selected application

“Anytime, Anywhere Road Weather Information”
Next Steps

- FHWA will work with State DOT(s) to support the collection and processing of the mobile data and the execution of the application
  - Coordination will be via the following pooled fund studies:
    - Aurora
    - Clear Roads
    - MDSS
    - IntelliDrive™
  - A webcast for PFS States is planned (specific date TBD)
  - Subsequent coordination with NCAR for site selection

“Anytime, Anywhere Road Weather Information”
Contact Information

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Helpful Links:
- FHWA Road Weather Management
  » www.ops.fhwa.dot.gov/weather/index.asp
- Clarus Initiative
  » www.clarusinitiative.org
  » www.clarus-system.com

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