INTELLIGENT TRANSPORTATION SYSTEMS (ITS): ARCHITECTURE, DEPLOYMENT, AND ADVANCES

MOHAMMAD SMADI

ADVANCED TRAFFIC ANALYSIS CENTER
Outline

- Definitions and Introductions
- ITS Architecture
- ITS Deployment
- ITS Advances
- Video Demonstrations
Intelligent Transportation Systems: ITS

- ITS is the integrated application of advanced information and communications technologies to improve transportation safety and mobility and enhance system productivity.
ATAC’s ITS Activities

<table>
<thead>
<tr>
<th>Planning for ITS</th>
<th>Evaluating ITS projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finding ITS solutions for transportation problems</td>
<td>Estimate impacts</td>
</tr>
<tr>
<td>ITS feasibility assessment</td>
<td>Market research</td>
</tr>
<tr>
<td></td>
<td>Before-and-after studies</td>
</tr>
<tr>
<td>Developing &amp; Maintaining ITS architecture</td>
<td>Support ITS integrations</td>
</tr>
<tr>
<td>Statewide</td>
<td>Inter-jurisdictional coordination</td>
</tr>
<tr>
<td>Regional</td>
<td>Institutional issues and agreements</td>
</tr>
<tr>
<td>Project-level</td>
<td>Software solutions</td>
</tr>
<tr>
<td>Support ITS deployment</td>
<td>Technical Training</td>
</tr>
<tr>
<td>Functional requirements</td>
<td>ITS architecture and standards</td>
</tr>
<tr>
<td>Technical specifications</td>
<td>ITS design manuals</td>
</tr>
<tr>
<td>Communications alternatives</td>
<td></td>
</tr>
</tbody>
</table>
ITS Architecture

- Framework (roadmap) for guiding ITS deployment
- Defines
  - Functions that must be performed (user services)
  - Physical entities where these functions reside (subsystems)
  - Interfaces between subsystems (information flows)
  - Communications requirements for interfaces
  - Stakeholder roles
ITS RA Federal Conformity Rule

- ITS projects shall conform to the National ITS Architecture and standards
  - Requires:
    - Use of the National ITS Architecture to develop a regional ITS architecture (RA)
    - All subsequent ITS projects must comply with the RA
  - Applies to:
    - ITS projects funded by the Highway Trust Fund
- ITS projects development must include a systems engineering analysis
North Dakota’s ITS Architecture

- State and 3 MPOs covered by federal rule
- ATAC to develop and support architecture
  - Partnership agreement
  - Strong support from FHWA
- Advantages
  - Streamlined process
  - Consistency
  - Effective organizational structure
    - ATAC team
    - MPO leadership
    - Technical stakeholders
  - Cost savings
RA Requirements

- Describe the region, agencies and stakeholders
- Operational concept (roles and responsibilities)
- Agreements (existing or new) required for operations
- System functional requirements
- Interface requirements and information exchanges
- ITS standards supporting regional and national interoperability
- The sequence of projects required for implementation
RA Development

- No single approach
  - Must at a minimum meet the federal requirements
- Level of detail varies by time frame for deployment of various projects
- Systems/projects of regional significance should receive greater attention
  - Possible agreements
ND’s Approach

- Stakeholder kickoff meeting to introduce the architecture
- Stakeholder small groups according to functional areas: Traffic, Transit, MCM, Emergency Mgmt
- Scenario-based discussion → Market Packages
- Customize MPs
- Re-present to stakeholders → refine
- Convene all stakeholders and present RA
- Re-refine
Market Packages

- Slices of the architecture that address specific services
- Represent subsystems, equipment packages, and information flows that provide an ITS service
- There are 88 MPs in the National Architecture in several service areas
  - Advanced Data Management
  - Public Transportation
  - Traveler Information
  - Traffic Management
  - Vehicle Safety
  - Commercial Vehicle Operations
  - Emergency Management
  - Maintenance & Construction Management
ATMS03 – Surface Street Control

Traffic Management
- signal control data
- signal control status
- traffic flow + traffic images
- traffic sensor control + video surveillance control
- request for right-of-way

Roadway
- Roadway Basic Surveillance
- Roadway Equipment Coordination
- Roadway Signal Controls

Information Service Provider
- transportation information for operations
- traffic operator data

Traffic Operations Personnel
- traffic operator inputs

Other Roadway
- roadway equipment coordination

Driver
- driver information
- crossing call
- crossing permission

Pedestrians
- traffic characteristics

Traffic
- traffic characteristics
Fargo-Moorhead’s RA

Travelers
- Remote Traveler Support
- Personal Information Access

Centers
- Traffic Management
- Emissions Management
- Transit Management
- Toll Administration
- Fleet and Freight Management
- Archived Data Management

Wide Area Wireless Communications

Fixed-Point to Fixed-Point Communications

Vehicle to Vehicle Communications
- Emergency Vehicle
- Commercial Vehicle
- Transit Vehicle
- Maintenance and Construction Vehicle

Field
- Roadway
- Security Monitoring
- Toll Collection
- Parking Management
- Commercial Vehicle Check

Vehicles
Regional ITS Architecture

Home

This web page is dedicated to facilitating the development of regional ITS architectures in North Dakota. Parties involved in the architecture development include the Grand Forks-East Grand Forks MPO, Bismarck-Mandan MPO, Fargo-Moorhead Metro COG and the North Dakota Department of Transportation.

The page serves as a focal point for sharing information and documents among project participants and interested stakeholders. It also provides background information on the regional ITS Architecture and the architecture development process, as well as project activities for each region including meetings, meeting minutes, draft documents, etc.

Information relevant to each area’s ITS architecture development can be accessed by clicking on the participating region located on the left side of the screen.

Final reports are now available for:

- Grand Forks/East Grand Forks
- Bismarck-Mandan
- Fargo-Moorhead
- North Dakota

What is an ITS Architecture?

An ITS architecture provides a tool to guide future ITS planning, define system requirements, coordinate agency roles and integrate functions across jurisdictional lines.
ITS Architecture Usage

- **Example:** Red River Bridge automated anti-icing system
  - Northwest Passage

- **Challenges**
  - 2 jurisdictions NDDOT & MnDOT’s District 4 (40 miles away)
  - Lack of dedicated communications
  - Desire to support full-motion video
  - Desire to share operations of the cameras and DMS
  - Possibility of providing video to state patrol

- **Goals:**
  - Streamlined and cost-effective project development process (one RFP)
Red River Bridge

Fargo, ND

Moorhead, MN

PROJECT LOCATION
ND Bridge No. 94-352.458 & 94-352.457L
MN Bridge No. 3046 & 3047
RR Bridge Project Architecture

- Developed project architecture
  - Based on Roadway Automated Treatment Market Package
  - Preliminary operational concept
- Decision document
  - Project technical team
- Communications options
- Finalize architecture and operational concept
- Issue RFP (NDDOT)
MC05 - Roadway Automated Treatment

Other Roadway

Roadway
- Roadway Automated Treatment
- Roadway Equipment Coordination
- Roadway Traffic Information Dissemination

Driver

Roadway treatment system control
roadway treatment system status

Maintenance and Construction Management
- MCM Automated Treatment System Control

Maintenance and Construction Center Personnel

Roadway equipment coordination

Driver information

Maintain and constr center personnel inputs
Maintain and constr operations information presentation
RR Bridge Anti-Icing and Monitoring System
Information Flows

NDDOT Fargo District
- roadway treatment system control
- roadway treatment system status
- monitoring camera control
- video images + camera status

MN/DOT District 4

Field Devices
- NDDOT anti-icing system
- NDDOT video monitoring camera
- MnDOT anti-icing system
- MnDOT video monitoring camera

- roadway treatment system status
- roadway treatment system control

Networks:
- Fiber
- Dialup
- Web/IP
- Web/IP
DMS and Bridge Automated Treatment System Communications

Fargo District DOT Headquarters

Windows 2000 Server with Control Software

Terminal Server (Citrix)

Media Converter

2 Fibers

Media Converter

4 Fibers

Media Converter

EB DMS

LAN

Firewall

Webcam Video Server

Media Converter

2 Fibers

Media Converter

PTZ Cameras EB & WB (2)

Internet

ND/MN DOT remote access via internet or dial-up connection to the Terminal Server

Spray Disks
Flush mounted pavement or parapet mounted

Accumulator & Valve Units
Pre-pressurized accumulators are continually ready for spray release at all times

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Prepared By:
Red River Bridge FAST: Live Jan 2006
RA Maintenance & Training

- ND RA’s were completed by April 2005 (met the federal deadline)
- Live “document”
- Updates needed for changes in:
  - The National Architecture
  - The region: scope, stakeholders, etc
  - ITS priorities
  - Project deployment
- Original ND RA’s were scheduled for 2-3 year update cycle
  - F-M and Bis-Man: updates completed
  - NDDOT statewide: ongoing
  - GF/EGF: upcoming (Fall 2008)
- Training
Federal ITS Program Initiatives

- Vehicle Infrastructure Integration (VII)
- Next Generation 9-1-1
  - Emergency communications services in a wireless mobile society
- Clarus
  - Integrated weather information from RWIS stations network
Vehicle Infrastructure Integration (VII)

- 21,000 out of 43,000 deaths on roadways are due to road departures & intersection crashes
- Crash prevention and congestion relief through vehicle-to-vehicle and vehicle-to-roadside communication
- Advances in vehicle technologies and wireless communication will allow for saving lives
VII Overview

- Build on advanced vehicle safety systems
- Building blocks:
  - In-vehicle devices (automotive industry)
  - Roadway devices (FHWA, DOT’s)
- Data examples
  - ABS & traction control activation
  - Windshield wipers activation
- Data exchanged roadside-to-vehicle & vehicle-to-vehicle warns from:
  - Entering unsafe intersection
  - Lane departures
  - Obstacles and road/weather conditions
VII Overview

- Vehicles as data collectors & anonymous transmitters of traffic & road condition information
- VII consortium
  - Goals
    - Determine feasibility
    - Establish implementation strategy
  - Members
    - Vehicle manufacturers
    - AASHTO
    - US DOT
    - 10 state DOT’s (trials in CA, MI)
PReVENT

- Integrated project
  - European Commission
  - European auto industry
- Develop and demo preventive safety applications
  - Intersection safety
  - Safe speed and following distance
  - Collision mitigation
Videos

- LateralSafe
- UseRCams
- WILLWARN
- INTERSAFE

Thanks to Dr. Maxime Flament, ITS Europe