Intelligent Transportation Systems (ITS) and the Regional ITS Architecture

Intelligent Transportation Systems (ITS) refers to a broad range of technologies, including information processing, communications, traffic control, and electronics, which can be used to improve the safety, efficiency, dependability, and cost effectiveness of the transportation system. More specifically, ITS technologies can:

- Collect and transmit real-time information on traffic conditions and bus transit schedules for travelers before and during their trips, making trips more predictable and thereby saving traveler's time and money;
- Improve the efficiency of the roadway network with technologies such as traffic signals that respond to flows and peak demands;
- Improve the productivity and cost effectiveness of public transit through automated vehicle locator systems that increase on-time performance and in-vehicle monitoring systems that ensure timely vehicle maintenance;
- Mitigate congestion by reducing the number of traffic incidents, clearing them more quickly when they occur, and rerouting traffic around them where appropriate;
- Support better emergency response times and services;
- Improve safety through monitors that detect early bridge and roadway icing and alert drivers;
- Improve the productivity of commercial fleets by using automated tracking, dispatch and weigh-in-motion systems that speed vehicles through much of the paperwork typically associated with interstate commerce; and
- Assist drivers in reaching desired destinations with navigation systems enhanced with path finding or route guidance.

Given all the different existing and emerging technologies, it is important that standards be developed nationally and regionally to ensure that projects are integrated and will work together with ITS systems from other agencies and jurisdictions. Federal law requires that all Federally funded ITS projects be in conformance with an adopted national ITS architecture and appropriate technical standards in order to provide consistency with ITS strategies and projects. However, it is recognized that not all elements of the national architecture may be applicable for every state or region. Thus, conformance with the national architecture is interpreted to mean use of it to develop a regional architecture, which is required for larger metropolitan areas such as Madison.

An ITS architecture is a structured approach or framework for defining, planning, and integrating ITS. It defines needed systems and functions and how to integrate different types of existing and future technology projects so they work seamlessly and cost effectively. The architecture identifies agreements and standards and the interconnections and information exchanges among the different systems of each agency and jurisdiction. A common vocabulary defined by the ITS architecture allows better communication between colleagues.

As part of its Southwest ITS Program, WisDOT contracted with a consultant, TransCore, to prepare the Southwest Wisconsin ITS Architecture for the ten-county southwest Wisconsin area, which includes Dane County. The architecture was commissioned to look at the needs of WisDOT SW District and local agencies and to identify how communications and data could be shared over a wide range of time horizons.

Development of the Southwest Wisconsin ITS Architecture was completed in 2002 and includes the following federally required components:

- Description of the region;
- List of participating agencies and other stakeholders and their ITS inventories (see Table 15 for list of stakeholders in Dane County);
- An operational concept that assists in defining roles and responsibilities of the participating agencies and other stakeholders;
- List of interagency agreements necessary to operate and implement the systems identified in the inventory;
- Functional requirements for systems;
- Interface requirements between systems and information flows between subsystems and terminators;
- ITS standards that support regional and national interoperability; and
- Sequence of ITS projects required for implementation.

Table 15
Southwest Wisconsin ITS Architecture Stakeholders Within Dane County

Traffic Management
• WisDOT Southwest District Transportation Management Center (Madison) • WisDOT Southeast District Traffic Operations Center (Milwaukee) *[Note: Shown even though outside county due to significant role it is anticipated to play in statewide freeway operations.]* • City of Madison Traffic Engineering Division • City of Middleton and Sun Prairie Public Works Offices
Emergency Management
• Wisconsin State Patrol District 1 Dispatch Center (DeForest) • Dane County Sheriff's Department • Dane County 911 Center • City of Fitchburg, Middleton, Monona, and Sun Prairie Dispatch Centers • UW-Madison Police and Hospital Dispatch
Information Service Provider
• WisDOT Southwest District Transportation Management Center (Madison) • WisDOT Southeast District Traffic Operations Center (Milwaukee) • UW-Madison Special Events Office
Transit Management
• Metro Transit Dispatch • Canadian Pacific (CP) Rail/AMTRAK Management Center
Operations and Maintenance
• Dane County Highway Department Dispatch • City of Madison Maintenance Dispatch
Parking Management
• Dane County Regional Airport Parking • Dane County Alliant Energy Center Parking • Dane County Parking Ramp • City of Madison Parking Structures • UW-Madison Parking Structures

Development of the regional architecture started with a stakeholder outreach effort focused on determining existing and planned ITS deployments. User needs were assessed and user services that could fill stakeholder needs were determined. Service categories identified as needed are: (a) Travel and Traffic Management; (b) Public Transportation Management; (c) Electronic Payment; (d) Emergency Management; and (e) Information Management. Service categories recognized as not being needed at the present time are Advanced Vehicle Safety Systems and Commercial Vehicle Operations. Applicable market packages were then identified along with critical project concepts. This information was then utilized to build the regional architecture that maps market packages to user services and encompasses critical project concepts. Finally, from the regional architecture, a list of National ITS standards necessary to deploy the architecture was identified.

ITS applications that have been implemented as part of WisDOT's Southwest Wisconsin ITS Program were discussed above in the Section on Transportation System Management (TSM). Components of this program include real-time information from traffic detectors and closed-circuit cameras, communications system, a comprehensive incident management program, and Beltline ramp meters.

Also discussed above in the TSM section, the City of Madison Traffic Engineering Division has a traffic signal control system for optimizing traffic flow. Most every arterial corridor in the Madison area is part of this coordinated system. The City has also implemented an electronic parking payment system at its parking ramps.

The Madison Area MPO is in the process of implementing an Internet-based ride matching service in cooperation with the Wisconsin Department of Administration (WisDOA), UW-Madison, and Dane County.

The Dane County Highway Department has implemented automatic vehicle locator (AVL) technology on its maintenance vehicles to facilitate quicker response to changing winter conditions and more accurate maintenance response (?).

Metro Transit has installed an ITS system for its fixed route and directly operated paratransit services with the following features:

1. New Voice Radio System. Metro will use its own talk groups, but have the capability of joining talk groups set up for emergencies.

2. New Data Radio System. On-board computer terminals allow for data messaging, reducing the quantity of voice traffic.

3. Automatic Vehicle Location (AVL). Metro fixed route, paratransit, and support vehicles are equipped with Geo graphic Positioning Signal (GPS) devices, providing real-time vehicle location information to Metro's Dispatch Center. The location information is used to estimate bus arrival times and this information is available to passengers via information signs at the bus transfer points and UW and MATC campuses. Beginning this fall, passengers will be able to access the real-time bus location and schedule information via the Internet. The AVL data is providing Metro with accurate on-time performance data, which is being used to create more efficient route schedules. The data also allows Metro to better manage the fleet on bad weather days and provides bus drivers with a visual display of their schedule adherence and next scheduled time point.

4. Automatic Passenger Counters (APCs). Forty buses are equipped with APCs that count boardings and alightings and mark the data by time (trip) and location. The APCs are being rotated through the fleet to provide data on all route services, providing valuable information for planning purposes.

5. Passenger Information. All fixed route buses are equipped with internal and exterior automatic annunciators and a visual display sign for stop announcements. As noted above, real-time schedule information is available via signs and will be available via the Internet.

6. Electronic Fare Collection. All fixed route buses have been equipped with new fare box card readers that use preprogrammed magnetic strip "swipe" card technology. The electronic fare system is interfaced with the AVL system, providing data on the number of passenger boardings by fare type at the route, trip, and bus stop level.

7. Transit Security. Video surveillance cameras have recently been installed on some buses and at two of the four transfer points.

8. Transit Maintenance. On-board vehicle condition sensors monitor system status and transit a data message if the bus may have a problem.

Metro's system has been built with an open architecture that will allow future applications to be relatively easily plugged into the system. Metro is currently exploring use of technology that allows for use of signal priority, extending the green phase at an intersection in the event a bus is running behind schedule.

As a result of the disaster along the Gulf cost of the United States from hurricane Katrina, the Governor of Wisconsin mandated plans be developed for the complete evacuation of the twelve largest cities in the State. Therefore, the City of Madison is currently in the process of developing an emergency evacuation plan with assistance from Wisconsin Emergency Management (WEM) and Dane County Emergency Management (DCEM). MPO staff is providing assistance to this effort in the form of data necessary to complete the project.

All Federally funded ITS projects must be developed using a systems engineering approach. The systems engineering analysis shall include, at a minimum the following:

· Identification of portions of the regional ITS architecture being implemented;
· Identification of participating agencies roles and responsibilities;
· Requirements definitions;
· Analysis of alternative system configurations and technology options to meet requirements;
· Procurement options;
· Identification of applicable ITS standards and testing procedures; and
· Procedures and resources necessary for operations and management of the system.

The following future high priority project concepts have been identified, which comply with the regional architecture, address stated critical needs of the region's stakeholders, and are likely candidates for future regional deployments. Partial deployment has already occurred for some of these, including (1) traffic monitoring and traveler information, (3) county maintenance management project, (4) agency data sharing, (7) ramp meters, and (9) dynamic message signs.

1. Interstate Traffic Monitoring & Traveler Information
2. Advanced (i.e., Adaptive vs. Closed Loop) Signal Operations/Coordination & Surface Street Traffic Monitoring
3. County Maintenance Snow & Ice Management Project
4. Agency Data Sharing
5. Public Safety In-Vehicle Signing with Real-Time Route Selection
6. Enhanced Weather and Pavement Conditions Monitoring
7. Madison Area Ramp Metering
8. Rural, Non-Interstate Traffic Monitoring

9. Arterial Dynamic Message Signs & Dynamic Trailblazer Signing
10. Smart Work Zone

The Madison Area MPO, as the MPO for the Madison metropolitan area, is responsible for the creation, maintenance, and updating of the regional ITS architecture. It is anticipated that WisDOT Southwest District will continue to take the lead on ITS deployment, given the expertise of its staff. The Madison Area MPO will continue to act as a forum for the development of ITS projects. Updates to the regional ITS architecture will be done as part of the overall regional transportation planning process. As new ITS initiatives are developed, the regional ITS framework with ensure that operational and cost efficiencies are realized and that transportation system performance is improved—the ultimate goal of these investments.