System Safety and Efficiency

TEA-21 challenged FHWA and FTA to move beyond traditional infrastructure-based approaches to improve the movement of people and goods. Emphasized in TEA-21 was a greater need to improve the way transportation systems are managed and operated, therefore this became a Planning Emphasis Area (PEA). The goal of transportation management and operations is to provide safety and system efficiency to the traveling public. Activities in the Duluth-Superior Long Range Transportation Plan that accomplish these safety and efficiency goals are:

- Integrating Intelligent Transportation Systems (ITS) technology
- Conducting Traffic Impact Reports to optimize the efficiency of the transportation system
- Developing a transportation systems management (TSM) plan for Duluth-Superior to analyze unsafe locations and reduce future accidents and to improve safety for the traveling public

Metropolitan Intelligent Transportation Systems (ITS) Initiatives

ITS technology incorporates advanced computer technology, electronics, and communications to develop a safer and more efficient transportation network. TEA-21 emphasized deploying the technology to improve operations, and management. ITS infrastructure, or architecture as it is commonly referred to, has been implemented in metropolitan areas across the country. Most areas have technology centers that are fed data from live cameras that display incidents, weather, and congestion. Much of the funding for ITS activities has been derived from CMAQ dollars, as ITS activities generally improve air quality in non-attainment and maintenance areas. Examples of ITS services include: messaging boards displaying incident and traveler information, traffic and transit management and communications, electronic toll collection, and advanced vehicle safety systems.

Duluth Transit Authority (DTA) ITS Implementation

In 2000, DTA worked with BRW to complete a *Final ITS Scoping Study*. Since that time DTA has worked extensively with Siemens Inc. to implement a variety of ITS technologies including scheduling software for regular route and paratransit services. Currently on their website, DTA riders can view a live map, schedule, arrival times and departure times. The new ITS system includes automatic vehicle location (AVL), automatic passenger counters (APC), on-board signs, voice annunciation, and interior bus destination signs. The UMD Kirby Center Hub, Downtown Duluth Transit Centers, and the Miller Hill Mall have many of these technologies in place (signs and computers).

ITS Onstreet Sign

This technology has improved the DTA's ability to manage its operation and improve efficiency by providing more accurate, more comprehensive, and more economically collected data for service planning, and more powerful and effective computerized analysis and reporting tools. In the future, it will allow the DTA to enhance its partnership with other transportation organizations in the region and the DTA's overall commitment to area mobility. This will be achieved by offering more flexible and convenient services that can help expand cost-effective service to areas without service, provide customers with more options, and reduce waiting and missed transfers.

Future enhancements to the system may include an electronic fare payment system, which will provide riders with more convenient payment options and reduce DTA fare handling. As funding allows, an Internet-based automated itinerary planning system will be installed for use by DTA riders and DTA Information Operators. Working cooperatively with the City of Duluth and area EMS agencies, traffic signal priority for buses and emergency vehicles may also be implemented.

DTA ITS Software

At present, DTA has seven on-street ITS signs focused within the Downtown Duluth, UMD, and Miller Hill Mall area. These signs provide real-time bus arrival and departure information to riders, utilizing GPS tracking and odometer readings. At both Transit Center East and the Holiday Center, outdoor signs display route information for all departing buses. At UMD's Kirby Transit Center, signs inside the center display departure information on all routes passing through the University while UMD's three transit shelters have signs displaying departure information only for the routes that the shelter serves. The Miller Hill Mall (Door 8) has a sign installed that displays information on all buses departing from Door 8 either to Downtown Duluth or other areas around the mall. Lastly, signs also display information such as time, date, and DTA marketing items.

The on-street ITS signs have worked well for DTA with just a few minor technical glitches while the WebWatch component has had more technical glitches. Glitches have included schedules being presented in ABC order rather than stop order and real-time bus locations on maps not being accurate. DTA continues to work with Siemens to correct errors that arise with the ITS system. DTA will also be re-geocoding some stops to ensure that ADA stop announcements are as accurate as possible.

Figure 4.1: DTA ITS Software

TransitMaster APTS (Advanced Public Transportation Systems)	Paratransit operations
Advanced voice & data communications	Customer outreach systems
Computer-aided dispatch	Real-time bus information on the Web
Automatic vehicle location - differential GPS correction	Real-time on street signage
ADA stop annunciation	Public safety operations
Automatic report generation	Automatic passenger counters
Vehicle maintenance monitoring	On-board surveillance video
Transfer management	Wireless LAN
Headway analysis & roster management	

Minnesota Department of Transportation ITS Initiatives

In 1997 and 1998, a series of three reports were completed in the ITS realm for this region: *Duluth Area Transportation Management System Feasibility Study Phase 1* and *Scoping Study Phase 2*; and the *Minnesota Statewide Plan for Advanced Traveler Information Systems*. Based on information from these reports, Duluth was the first region in Minnesota to implement a Traffic Operations and Communications Center (TOCC) and therefore there was no template or model to follow. Duluth TOCC elements deployed included cameras, dynamic message signs, autoscope sensors, and communications infrastructure. Identifying the right stakeholders was essential to the planning and development of the TOCC system, which included end users. Recognizing the differences between agencies and organizations along with their expectations was also important. While maintaining flexibility, stakeholder groups had to agree upon a common and clear end product goal. Communication in every form throughout the project made the process successful. Delays and emerging issues have arisen. Currently, the focus is being placed on future challenges including maintenance, expansion, and upgrades in Duluth. MnDOT District 1 also participated in the development of the *Wisconsin District 8 ITS Deployment Plan* Team (2003/2004) that will guide TOCC infrastructure in the WisDOT NW Region.

Infrastructure Components

ITS infrastructure was integrated into the MnDOT transportation system in Duluth for three primary reasons: (1) steep geography (hill) and icy bridges, (2) congestion, and (3) I-35 tunnels east of Downtown Duluth. The Duluth Transportation Operations Communications Center (TOCC) is a traffic management center that is equipped to address transportation problems. Duluth TOCC elements include: 17 Cameras, 5 Drum Sign Retrofits, 4 New Vehicle Messaging Signs, 3 Variable Speed Limit Signs, 6 Autoscope Sensors, a Signal Timing Plan, an Incident Management Plan and Ice Sensors. The TOCC evolved from a 1998 MnDOT congestion study that identified three challenges to the I-35/I-535 corridor:

1. **I-35 tunnel incident potential:** there are a series of 4 tunnels through which hazardous cargo is allowed, Lake Superior weather conditions can create icy tunnel conditions, in the past tunnels have been closed and on-coming traffic has not been forewarned.
2. **Downtown congestion and parking issues, special event traffic problems:** tourists are attracted to the Duluth Entertainment and Convention Center (DECC) and waterfront which are located at the same exit straining the transportation system during peak use.
3. **I-35 west of downtown Duluth has high crash rates due to weather conditions:** there are a significant number of bridges west of downtown Duluth which create hazardous conditions when coupled with Lake Superior weather conditions.

Duluth TOCC technology allows dispatchers to notify appropriate response vehicles, display incident information on variable message signs along affected corridors, and issue information on the webpage http://www.511mn.org. Field devices have been strategically located to address unique geographic situations. Devices cover the I-35 corridor from Boundary Avenue (west limits of Duluth) to 26th Avenue East (end of I-35) and the Minnesota side of the I-535 Blatnik Bridge. This system includes a variable message sign on the Wisconsin side of the I-535 Bridge that is controlled by the Superior/Douglas County dispatch center.

Figure 4.2: MnDOT ITS Devices and Locations

DEVICE	LOCATION
Variable Message Signs (VMS)	
Full Matrix VMS	NB I-35 at Ugstad Road
Three line VMS	NB I-35 at Cody Street
Full Matrix VMS	NB I-35 at Central Avenue
Full Matrix VMS	NB I-35 at Garfield Avenue
Full Matrix VMS	NB I-35 at Lake Avenue
Three line VMS	SB I-35 at London Road and 27th Avenue E
Full matrix VMS	SB I-35 at 16th Avenue East on pedestrian bridge
Three Line VMS	SB I-35 at 14th Avenue West
Full Matrix VMS	SB I-35 at Central Avenue
Two line VMS	SB I-535 near Garfield Avenue in Duluth
Two Line VMS	NB I-535 at Hammond Avenue in Superior
Two full matrix VMS	On T.H. 61 NB at the Silver Cliff Tunnel and SB at the Lafayette Bluff tunnel (Duluth TOCC controlled)
Two Line VMS	On T.H. 53 between Virginia and Eveleth to warn of weather conditions (Virginia MSP dispatch controlled)
Cameras	
Camera 1 (pole mount)	SB I-35/TH 2
Camera 2 (pole mount)	NB I-35 at Cody Avenue exit
Camera 3 (pole mount)	I-35, Central Avenue NB Entrance Ramp
Camera 4 (pole mount)	NB I-35 @ 40th Avenue West
Camera 5 (pole mount)	NB I-35 at 38th Avenue West (Ore Docks)
Camera 6 (bridge mount)	NB I-35 @ 29th Avenue West
Camera 7 (signal mount)	NB I-35 & TH 53 NE Quad
Camera 8 (bridge mount)	SB I-535 Port Terminal exit
Camera 9 (bridge mount)	SB I-35 @ 14th Avenue West
Camera 10 (bridge mount)	NB I-35 @ 9th Avenue West
Camera 11	SB Lake Avenue exit ramp
Camera 12	SB I-35 at 9th Avenue E
Camera 13 (sign bridge mount)	I-35 Lake Place & West Historic Tunnels
Camera 14 (wall mount)	I-35 West Historic & East Historic Tunnels

Cameral 15 (sign pole)	SB I-35 at 9th Avenue E
Camera 16 (ceiling mount)	NB I-35 in Leif Erickson Tunnel
Camera 17 (ceiling mount)	SB I-35 in Leif Erickson Tunnel
Camera 18	WB T.H. 2 (Bong Bridge – Minnesota side)
Camera 19	I-535 NB – Blatnik Bridge Main Span
Camera 20	I-535 NB – Blatnik Bridge – Pier 16
Camera 21	I-535 SB - Blatnik Bridge – Pier 15
Camera 22	T.H. 194 (Mesaba Avenue) at Second Avenue E
Autoscopes	
Autoscope 1 (sign bridge mount)	SB I-35 @ 24th Avenue West
Autoscope 2 (sign bridge mount)	SB I-35 north of Garfield Avenue
Autoscope 3	I-35 at Lake Avenue
Autoscope 4	SB I-35 at 7th Avenue East
Autoscope 5 (cantilever sign bridge mount)	I-35 no. portal, Leif Erickson Tunnel
Autoscope 6 (signal pole mount)	I-35 (I-35/TH 61/26th Ave. E.)

MnDOT Implementation Status

Since the initial TOCC Implementation, additional cameras have been installed on the Blatnik and Bong bridges to enhance both traffic coverage and security. MnDOT has partnered with WisDOT and the Coast Guard in creating wireless links to share video images. The Coast Guard will be monitoring (24/7) the cameras on and near the Blatnik and Bong Bridges. A link will be made through the WisDOT Office in Superior to provide a link between MnDOT and the City of Superior/Douglas County Dispatch Center. Dispatchers in both locations will be able to view the same live video.

In 2005, MnDOT and Lake County received a Homeland Security Grant to install cameras in the Silver Cliff tunnel on T.H. 61. These cameras will be monitored by the Lake County Sheriff's office, with a possible future expansion to the Duluth TOCC. The system will be expandable, with additional cameras planned for the Lafayette Bluff tunnel.

Future additions to the Duluth TOCC will enhance national and bridge security and traffic safety with automatic gates for bridge closures. VMS will be added to enhance the bridge closure system. For added security, various types of intrusion alarms are being studied.

WisDOT ITS Strategic Deployment Plan

Developed by the Wisconsin Department of Transportation (WisDOT), the objective of the *WisDOT District 8 Region ITS Strategic Deployment Plan* is to guide the deployment of ITS technology throughout the WisDOT NW Region. ITS in the region would mean the application of advanced information, communication and computer technologies to improve the safety, efficiency and convenience of the transportation system. The plan describes the vision, goals and objectives to be achieved through ITS deployment, includes an assessment of available technology and provides an overall organizational structure to be followed by the implementing agencies. The plan identifies both a long-range strategy for addressing the unique transportation challenges of the region as well as detailed descriptions of prioritized projects.

Plan Recommendations for Superior

The *WisDOT District 8 ITS Strategic Deployment Plan* recommended that a series of ITS technologies be implemented in the Superior area, over the next ten years. Projects recommended from the plan are organized under the time frames of immediate, short term (2-5 years), and medium term (6-10 years). Types of projects recommended include: surveillance cameras connected to Duluth TOCC, permanent/portable changeable message signs, RWIS (road, weather, information signs) processing units, a virtual traffic operations center (VTOC), automated vehicle location/computer aided dispatch for EMS, weather and pavement condition reporting information, roadway gate closures, bridge deck de-icing system, and integrated EMS communications. Specific projects recommended for the Superior area included:

<u>Immediate Project Recommendations for Superior</u>

Bridge security and surveillance cameras (CCTV cameras mounted above and below the bridge deck). Connect Bong and Blatnik bridge cameras to the Duluth TOCC by providing wireless connection communication between the cameras and the Duluth TOCC. The required communications would be deployed in conjunction with the bridge security and surveillance cameras for the Blatnik and Bong bridges. The project would be a cooperative effort between WisDOT and MnDOT as they share these bridge facilities and technology would be complementary and synchronized between the two states.

Permanent changeable message signs (CMS) allow en-route travelers information regarding incidents, congestion, construction and detours along their intended routes. Permanent CMS would be strategically installed at key decision points and high crash areas to provide timely traveler information, including:

- USH 53 southeast of split with USH 2
- USH 53 near Blatnik Bridge (I-535)
- USH 53 southbound at south end of Blatnik Bridge (I-535)
- USH 2 eastbound at east end of Bong Bridge
- USH 2 at STH 35 (WB Traffic)

Virtual Traffic Operations Center (VTOC) is Internet-based and incorporates many of the features of the traditional traffic operations center but does not require a dedicated physical plant. A central server allows operators from the various agencies to access information and control functions remotely from a desktop or laptop computer using an Internet browser and standard telephone and network connections. Control functions include management of congestion, incidents, and events; as well as monitoring of ITS device operations and traffic conditions.

Mobile Data Computers for the City of Superior proposed project to be funded by local grants.

<u>Short Term Projects 2-5 years</u>

Additional Road, Weather, Information, System (RWIS) Remote Processing Units (RPUs): (1) Bong Bridge, (2) south end of Blatnik Bridge linked to existing MnDOT RWIS station on Blatnik Bridge. This project would deploy three additional RWIS RPUs for gathering and disseminating pavement conditions to assist travelers in trip planning.

<u>Medium Term Projects 6-10 years</u>

Bridge Deck De-Icing System (Bong and Blatnik) would involve deploying automated de-icing system on selected bridges in the district to increase safety at areas with recurring ice problems. The system is automated and triggered by RWIS and surface sensors that inform the computerized control system when hazardous winter driving conditions are detected. When sensors indicate icy conditions, de-icing chemicals are released onto the bridge deck and other areas leading up to the bridge. An effective de-icing system will prevent the formation of ice on the bridge deck, reduce weather-related crashes, and keep traffic flowing smoothly.

Transportation System Management

The objective of Transportation System Management (TSM) is to fully coordinate the movement of all transportation modes to achieve the maximum system efficiency and productivity. TSM is a general term used to describe techniques that increase efficiency, safety, capacity or level of service of a transportation facility without major capital improvements. Examples of improvements could include: signals, facility design treatments, access management, high occupancy vehicle (HOV) lanes, ramp metering, incident response, targeted traffic enforcement and programs that improve transit operations.

MIC staff may refer to the St. Cloud Area Planning Organization's (APO) Transportation System Management Plan as an example. The objective of their TSM element is to attain maximum efficiency and utilization from the existing transportation system with low cost actions. Biannually, APO develops a "TSM Document" that identifies deficiencies of the St. Cloud area's transportation system. Policy elements of APO's TSM document focus on assessing the transportation system by reviewing data such as: traffic volume, accident severity rates, network level of service, functional classification, transit revenue and cost, transit patronage, and transit travel characteristics. APO devised a quantifiable assessment that examines the following criteria: 5-year accident trend (average severity), current year accident severity, level of service, and functional classification. Solutions generally fall into the following categories:

- Actions to ensure efficient use of existing road space
- Actions to reduce vehicle use in congested areas
- Actions to improve transit service utilization
- Actions to improve internal transit management efficiency

Once APO staff have identified deficiencies, they evaluate possible solutions. The process is as follows:

1. Engineering staff of each agency with jurisdictions over the deficient location are contacted and informed of the areas where problems are found.
2. Technical representatives from affected jurisdictions are asked for possible alternative solutions to each deficiency. Information provided in other planning documents is reviewed at this time for compatibility purposes. The

TSM action list is used as a guide for formulating those alternatives.

3. Alternative solutions are then analyzed in relation to policy strategies, objectives, and criteria. This procedure results in choosing the preferred solution to a particular deficiency.
4. A list is then prepared itemizing the preferred solution and recommended TSM direction for each identified deficiency.
5. Projects are devised to address deficiencies and are submitted for MPO TIP funding.

Developing a Duluth-Superior Transportation System Management Plan

The MIC will identify, on a corridor basis, short to mid term transportation deficiencies across the metropolitan area. Data from the MIC's crash analysis and travel demand model (TP+/Cube) will play a role in our analysis. Mitigation measures to be considered include: lane channelization, parking solutions, traffic control devices and proper signage. A MIC TSM element may include conducting annual traffic impact reports.

Traffic Impact Reports

The MIC's reports will identify efficiencies in the surrounding roadway network for auto, transit, bike and pedestrian movements. MIC staff will conduct this work with assistance from our traffic modeling consultant.

The MIC's analysis will be, in nearly all cases, an additional input for a jurisdiction in their decision-making process. Developers are required to complete, in most instances, a Traffic Impact Assessment for the affected jurisdiction. The MIC's work will complement that conducted by a developer, by:

- Investigating traffic flow and capacity at a site or corridor with a specific proposed traffic generator as a focus.
- Identifying all access points and recommending potential changes for specific points of ingress/egre
- Identifying areas of inefficiencies for pedestrian, bicycle and transit movements (if applicable).
- Incorporating traffic model capabilities (TP+/Cube) and Geographic Information System (GIS) data where applicable.
- Commenting on site design with respect to all modes of transportation.

- Documenting Environmental Justice component.
- Providing recommendations that may include median treatments, shared access locations, parking solutions, signalization changes and options for traffic channelization.

Metropolitan Crash Analysis

The Metropolitan Crash Analysis database, 1997-2001, was developed to provide accident rate information for future planning efforts and in conjunction with a MIC TSM Plan. Rates were compared with state averages to identify unusually high accident locations. Accident rates are calculated by using the following equation:

$$\frac{1{,}000{,}000 * \text{number of accidents along corridor}}{\text{ADT} * 365 * \text{number of years of accident data} * \text{length of road segment}}$$

Crash rates are measured in number of crashes per million vehicle miles. The average crash rate is 3.14 (crashes per million vehicle miles). Limited-access highways had the lowest crash rates. The highest crash rate on I-35 was between Hwy 2 (south of Proctor) and Hwy 23 (Grand Avenue), at a rate that is approximately half of the average rate. The seven highest crash rates were in Duluth, five of which were downtown (highest on 1st Ave E between Michigan and Superior). The highest crash rate location in Superior was on Tower Avenue between Winter and North 12th Streets. The highest crash rate outside of Duluth and Superior was in Proctor on 2nd Avenue North from Highway 2 to 5th Street East. In Hermantown, the highest crash rate was on Maple Grove Road from Midway to Solway Roads. The highest crash rate in a township was in Midway Township on Cloquet Road from Midway Road to the Carlton County border.

Access Management

Several area roadway agencies stress the importance of access management including MnDOT, WisDOT and St. Louis County. Access management is the process of planning in advance for land use impacts on the transportation system. This process entails designing and implementing strategies to minimize the number of access points for adjacent businesses and residences in order to protect the functionality of the roadway. The TH 53/TH 194 Miller Trunk Highway Implementation Plan and TH 61 London Road Corridor Study are local MnDOT efforts to address access management issues and concerns.

Access management entails planning, designing, and implementing land use and transportation strategies to ensure safe and efficient travel flow while allowing access to development. The benefits of access management include: reduced congestion and crashes; preserved road capacity and postponed roadway widening; improved travel times for the delivery of goods and services; ease of movement between destinations; and supports local economic development. In 2002, MnDOT officially adopted the "Access Category System and Spacing Guidelines." Ten of the key principles for local governments to manage access include:

1. Think land use AND transportation.
2. Identify and plan for growth areas.
3. Develop a complete hierarchy of roads.
4. Link access regulations to roadway function.
5. Avoid strip development. Promote commercial nodes.
6. Connect local streets between subdivisions.
7. Design subdivisions with access onto local streets.
8. Practice good site planning principles.
9. Correct existing problems as opportunities arise.
10. Coordinate local development plans with DOT and county road agencies.

MnDOT has developed extensive access management guidelines for transportation corridors based on their level of connectivity with other transportation corridors and how these corridors relate to different levels of land use development. The end result is MnDOT's Inter-Regional Corridor System (IRC) hierarchy that is defined in more detail in Chapter 2.

MnDOT uses three primary types of land use development scenarios and sets spacing guidelines based on these land use patterns.

<u>Urban Core</u>: fully developed areas with a tight network of local streets. Street spacing is based on block length (typically between 300 and 660 feet). Spacing for direct access is typically 200 feet to provide sufficient stopping distance.

<u>Urbanizing</u>: these are developing areas outside the urban core. Local governments are typically in the process of developing the transportation

network and should do so in a manner where local streets support and serve the major transportation network. Intersections should be spaced at 1/8, 1/4 or 1/2-mile increments, depending on the type of highway corridor. Access to businesses and homes should be provided through the local street system, not from a state highway.

Rural: these are areas where land uses are agricultural, forestry-based or low-density residential. Local street networks are typically limited and intersections should be spaced at 1/4, 1/2 or 1-mile increments depending on the type of transportation corridor. Direct access to homes and businesses should be provided by local streets when possible; otherwise limited direct highway access is permissible.

St. Louis County also has some roadways around the outskirts of Duluth that have access controls such as Rice Lake Road. Maintaining county access requirements has been difficult to uphold since the issue of acquiring access permits also involves planning and zoning officials. St. Louis County has found it is critical to have township support for access management to uphold these spacing and safety controls. They believe the best way for the townships to control access is to include access standards in their zoning ordinances.

Safety Conscious Planning

As discussed in Chapter 3, Safety Conscious Planning techniques will be examined as a component of the MIC's planning efforts. The federal initiative identifies various mitigation alternatives toward improving multi-modal transportation networks.