8. TECHNOLOGY AND CUSTOMER INFORMATION GUIDELINES

It is important to note that the Transitway Guidelines are not meant to be overly prescriptive, but rather provide a basis for understanding the elements important to decision-making in a quickly evolving industry. The guidelines should be considered collectively when make technology and customer information decisions for transitways.

8.1. AUTOMATIC VEHICLE LOCATION (AVL)

The regional AVL system, or a system that is compatible and can communicate with it, should be provided on all transitway vehicles.

AVL is a critical system for many other technology systems in these guidelines. It is considered a base infrastructure upon which other features and applications can be integrated and built upon. AVL technology is used to monitor the location of transit vehicles in real time through the use of global positioning system (GPS) devices or other location monitoring methods. Information about the vehicle location is transmitted to a centralized control center. Transitway technology features and applications utilizing AVL technology include automatic passenger counters, transit signal priority (TSP), and real-time customer information systems.

8.2. AUTOMATIC PASSENGER COUNTERS (APCS)

Automatic passenger counters should be provided on all station-to-station transitway vehicles. APCs should be provided on a sample of other transitway vehicles.

APCs provide valuable information on ridership, station demand, and vehicle loads for service planning and data collection analysis. When coupled with AVL data, APC data assists service deployment decision-making at specific stations and specific trips. APC data could also be used to determine real-time busloads for use in conditional-based TSP. In the absence of fare boxes on buses and trains, APCs also assist in ridership data collection and verification.

8.3. COMMUNICATIONS LINK

Proven communication systems that are compatible and coordinated with regional transit control center communication systems should be provided on all bus-rapid transit (BRT) service to link vehicles and stations.

Communication between systems and personnel is critical to transit service operation and safety. Common or compatible systems are required for operations to ensure proper service coordination and public safety. Communications technology implementation can be complex and often involves the coordination of different jurisdictions, agencies, and technologies. Collaboration between transit providers is essential to ensure that the communication systems implemented are viable and sustainable. An analysis of the corridor should look at all existing and potential communication systems and the effort and characteristics required for implementation.

8.4. TRANSIT SIGNAL PRIORITY COORDINATION AND VIABILITY

TSP implementation needs to be a collaborative effort between transit providers who will utilize the technology on their vehicles and local road authorities who will utilize the technology at their signal controls. Before the implementation of TSP in a corridor:

- **An analysis should be done to determine the potential viability of and coordination required for the use of TSP in that corridor.**
- **Approval should be sought by the implementing agency from coordinating parties such as cities, counties, MnDOT, and transit providers. Formal action may be necessary when appropriate.**
- **Ongoing operation and support roles and responsibilities should be identified and established.**

TSP implementation is complex and often involves the coordination of different jurisdictions, agencies, and technologies. Collaboration between transit providers and local road authorities is essential to ensure that the system implemented is viable and sustainable. Agency collaboration may include the development of an operational plan for TSP, such as a concept of operations, prior to deployment of any TSP system. Analysis of the corridor should look at all potential TSP intersections and the effort and characteristics required for implementation. Long-term maintenance also needs to be addressed and coordinated. Formal approval (i.e. memorandum of understanding, etc.) from cooperating agencies may be necessary. Any operation and support roles need to be identified early, in planning stages of TSP implementation, to allow for proper planning of staff and resources within agencies.

8.5. TRANSIT SIGNAL PRIORITY COMPATIBILITY

The TSP technology used in a corridor should be compatible for use by transit service providers operating in that transitway. A regional TSP system (or systems) that can be compatible with limited additional resources is preferred and implementing agencies should explore maximum compatibility across the region, when feasible.

TSP technology will continue to evolve as it becomes more established. There are a variety of TSP systems available today and there are a variety of traffic control systems implemented throughout the Twin Cities region. The relationship between TSP technology and traffic control technology is essential for proper operation of the system. Ideally, a regional TSP system will be developed that is consistent or compatible with all potential applications in the region. This would reduce overall TSP system costs and eliminate the need for coordinating multiple technologies among transit providers. However, there may be significant barriers to the implementation of a consistent or compatible system.

These barriers include the need for cooperation and coordination between multiple jurisdictions and agencies, sole sourcing to a particular vendor or common TSP approach, “hidden” costs associated to other traffic signal system upgrades, and signal retiming required to make TSP fully functional. Some barrier examples:

- Planned TSP corridor goes through two jurisdictions. One jurisdiction may have a traffic signal system and field hardware that is able to support the TSP system. The other may have an outdated system or require system or hardware upgrades. The result to TSP is that this may prohibit implementation or significantly reduce overall TSP system functionality.
- Traffic signals in the TSP corridor may not be currently timed to provide sufficient timing to provide enough advantage to transit vehicles for granted TSP requests without significant cost and time to complete the needed signal retiming.
- Intersections within the traffic system may be operating at capacity with limited options for providing priority to the transit vehicle in terms of extended green or early green.

8.6. TRANSIT SIGNAL PRIORITY CHARACTERISTICS

When implementing a TSP system on a transitway, the following should be standard characteristics:

- **Optimal signal timing and transit scheduling for person throughput**
- **Minimal cross traffic delays, unless otherwise agreed upon by cooperating traffic authority**
- **Safe operation for all modes**
- **Conditions for TSP operation agreed upon by coordinating agencies**

Transit signal priority implementation can occur in a variety of forms. It can range from full priority over signal controls to a conditional-based system where transit vehicles only request signal priority when certain conditions are met. It is important to optimize the standard timing of signals along a transitway and synchronize that timing with transit schedules to ensure the maximum number of roadway users (*person* throughput) are benefiting from the timing. This will help limit or provide agreed upon justification for any limited potential associated cross traffic delays that could result from TSP requests and will limit the number of requests being made by the TSP system. In some cases, optimized signal timing incorporating person throughput strategies may negate the need for TSP, or the number of intersections requiring TSP implementation. In addition, the priority for a TSP system should be conditional-based to limit the disruption (number of requests) of the signal timing system. Conditional-based use may include when transit vehicles are running late, peak-hour only use, or only locations where allowing transit vehicles to proceed through would allow users to be picked up at a far side stop to reduce delay. Conditions for TSP operation should be developed as part of an operational plan, such as a concept of operations, for any TSP deployment.

8.7. TRAFFIC SIGNAL PRE-EMPTION

Traffic signal pre-emption will only be used when specifically agreed to by project stakeholders and in compliance with state and federal laws, regulations, and guidance.

Rail systems may require the use of signal pre-emption due to the different physical characteristics of rail systems and rules or regulations governing their operation.

Pre-emption is defined as the transfer of the normal control (operation) of traffic signals to a special signal control mode for the purpose of servicing railroad crossings and emergency vehicle passage. It is also used in some transit applications, upon agreement with local jurisdictions and in compliance of the Minnesota Manual on Uniform Traffic Control Devices (MnMUTCD). This guideline recognizes that there may be rare special cases where the use of traffic signal pre-emption technology is needed for a specific project or transitway corridor to increase transit speed and reliability. In addition, the use of signal pre-emption along rail systems may be required by rules or regulations. Rail vehicles operate differently than bus vehicles and require longer stopping distances and increased safety precautions. In some cases, pre-emption may be the appropriate system for achieving required operating parameters. Impact of the transit vehicle pre-empting the signal when an opposing emergency vehicle requests service needs to be considered. This is a potential conflict, resulting in emergency vehicle delay that would not occur if transit signal priority were employed.

8.8. REAL-TIME CUSTOMER INFORMATION SYSTEM

Implementers of real-time customer information technology should deploy systems that supply/receive real-time data in a format compatible and able to be shared with all transit providers.

Real-time customer information can be disseminated to the public through a variety of means including, but not limited to, **pre-trip** (website), **en-route** (dynamic message signs or wireless web), **on the platform** (dynamic message signs), and **on-vehicle** (next stop information). The following are types of information provided: real-time bus/rail departure, park-and-ride space availability, and transit/car comparison travel times. Real-time customer information (the information used by transit users) should be accessible across all technology platforms, which requires real-time data (the information used by providers as the basis for real-time customer information) to be compatible and be able to be shared across various technology platforms and providers.

8.9. TECHNOLOGY NEEDS OR BENEFITS ASSESSMENT

The implementation of a technology requires a process for identifying the appropriate solution. At a minimum, there are key steps in the process that should be addressed during each assessment.

- **The first step is identifying the need for, or benefit of, a technology solution and establishing the outcome goals of implementation**
- **The second step is exploring technology solutions that exist and are operational in the region today**
- **If no existing solutions adequately address the need, the third step is exploring new technologies and determining their viability and sustainability in addressing the need for or providing an added benefit to the transitway system**

Technology needs assessments are primarily focused on emerging technologies or areas of need, but they should also be considered when implementing existing technologies. The needs assessment should ensure that a technology solution can adequately address an area of need, that solutions that capitalize on existing infrastructure are considered to reduce costs and increase interconnectivity, and that any new technologies introduced to the region are a viable and worthwhile investment. Other technology assessments may not directly address an identified need within the system, but may provide worthwhile benefits that would enhance or improve the system if implemented. An assessment similar to the needs assessment should address the potential benefits, existing technologies, and other factors.

8.10. TECHNOLOGY IMPLEMENTATION VIABILITY CONSIDERATIONS

At a minimum, technology viability, as discussed in Guideline 8.9., should consider the following:

- **Relative costs of potential technology solutions including initial capital investment and ongoing operations, support, and maintenance, including staff time and staff training**
- **Costs from all levels of the technology's implementation including vehicle costs, station costs, road infrastructure costs, technology system costs, agency resource costs, and other areas as identified in the needs assessment**
- **Advantages of each technology solution in addressing the need for or potential benefits of the technology**
- **Potential barriers to implementation of the technology solution**
- **Expected useful life of the technology solution**
- **Relationships to other technologies, including other required technology systems or required changes to other technology systems**

Technology viability is an essential analysis because technology is dynamic and constantly changing and adapting. As such, considerations like costs, advantages, barriers, and useful life are also constantly changing and should be reviewed periodically for technology. To reduce risk and ensure ongoing system viability, technology for large scale or fleet-wide deployment needs to be commercially available, sustainable, and maintainable. Planned implementations need to consider its relation to other corridors, similar existing implementations, and impacts to other systems and stakeholders. Barriers may include coordination with other agencies or technologies and may significantly limit the viability of some technology solutions.

8.11. OTHER TECHNOLOGY FEATURES FOR TRANSITWAYS

The following technology features should be included on transitways, in addition to previous guidelines, if supporting infrastructure exists:

- **Real-time Information Systems:**
  - **Real-time schedule information should be provided at high-volume stations through dynamic message signs (or similar technologies)**
  - **Real-time park-and-ride space availability information should be provided at major park-and-ride facilities**
  - **Real-time transit travel time to general traffic travel-time comparison information should be considered for implementation near major park-and-ride facilities where transit advantages are provided**
- **Security and safety systems should be incorporated into station and vehicle designs**

Transitways are premium, high-demand corridors where customers will benefit from enhanced amenities. Real-time customer information at stations and park-and-rides is an emerging technology that enhances the customer experience. However, this technology may not be appropriate at every station or park-and-ride along a transitway. The characteristics of the service and facility may require additional analysis about the value of the technology at lower-volume facilities. In such cases, alternatives should be investigated to provide guidance to customers on how to obtain real-time information from other sources (for example, smart phones), if possible.

See Chapter 4. Station and Support Facility Design Guidelines for safety and security systems at transitway stations. There are existing fleet policies for security systems on buses. Guidelines and policies for these systems provide more detail on what is, and is not, expected to be included on transitway vehicles and facilities.