Illinois Statewide Intelligent Transportation Systems (ITS) Strategic Plan

APPENDIX H

Potential ITS Solution Descriptions

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Appendix H – Potential ITS Solution Descriptions

Active Transit Station Signs

Small variable message signs can provide in-terminal real-time transit information to transit users. The signs can be coordinated with a transit agency's fleet tracking system to provide accurate next arrival information to waiting passengers. In some metropolitan areas, they can also be used to provide travel time comparisons between modes. The signs can also be used to alert transit customers by displaying emergency information. They can be installed at central transit terminals or at selected bus stops.

- **Benefits**
  - Provide more accurate travel time information for transit customers
  - Transit customer satisfaction
- **Estimated Cost**
  - $6,000/sign deployment; $1,000/sign/year operations and maintenance
- **Addresses identified program areas**: Traveler Information, Transit, Multi-modal Coordination
- **Geographic Scope**: Regions 2, 4, 5, 7, 8, 9

Advanced Railroad Highway Interface and Safety Technologies

This ITS solution encompasses the following two different types of railroad – highway interface technologies that are described in the sections below:

- Advanced Railroad Highway Interface Technologies
- Emergency Vehicle Rail Crossing Safety Systems

Advanced Railroad Highway Interface Technologies

This application would use technology to make at-grade railroad crossings safer and traffic patterns around the crossings more efficient. Highway traffic at highway rail intersections can be managed where operational requirements demand advanced features. The demonstration could feature detectors, warning/traveler information, and/or control devices to warn drivers of an imminent train crossing. All the current standard capabilities of an intersection would be present, but deployed technology would act to augment the safety of the intersection. A preliminary study would be necessary determine which of several strategies to pursue based on a national literature and best practices review. Projects would be deployed based on those findings and recommendations.

In rural areas without cross bars at highway railroad crossing, train detection systems would activate flashing lights at the crossing to alert drivers. Special consideration would have to be given to powering the system at a crossing and available infrastructure to support the system. Access to these resources is readily available in a high-volume urban area but may be difficult to access in a low-volume rural area.

- **Benefits**
  - Reduce incidents and injuries from train/car crashes

- Potentially reduce delays at railroad crossings
- **Estimated Cost**
  - $25,000 per crossing for equipment and installation; $1,000/year for operations and maintenance
- **Addresses identified program areas**: Traveler Information, Traffic Management, Transportation Safety
- **Geographic Scope**: Regions 2, 3, 5, 6, 7&9, Small Urban/Rural

Emergency Vehicle Rail Crossing Safety Systems

At-grade railroad crossings present two distinct types of challenges for rural areas. The first challenge relates to the potential for vehicle-train collisions. The second challenge is that presented by long trains passing through rural towns that prevent traffic, including emergency vehicles, from crossing over the rail line. This strategy would focus on the latter challenges. Many existing active warning systems for grade crossings provide valuable information that can be easily imported into a computer aided dispatch system. The information would be used to alert emergency vehicle dispatch centers of approaching trains so that they may identify the best routes for emergency response vehicles to follow. Because of data transmittal costs, this is more cost-effective to deploy in urban areas. East Peoria currently has a vehicle crossing warning in place that uses changeable message signs to alert drivers that a railroad will be going through a crossing. The system also notifies emergency response dispatchers about the current or planned crossing closure so that they can adjust a response vehicle's route.

This solution could also be coordinated with the Advanced Railroad Highway Interface project to provide advance warning to both emergency vehicle drivers and regular drivers. Train detection systems could activate signal flashers as well as send messages to emergency dispatch centers.

- **Benefits**
  - Decrease response time to incidents
  - Reduce incidents and injuries from train/car crashes
- **Estimated Cost**
  - $20,000 to $50,000 per intersection for deployment in urban area
- **Addresses identified program areas**: Incident Management, Transportation Safety
- **Geographic Scope**: Regional, Small Urban/Rural

Automated Traffic Signal Performance Measures (ATSPM)

ATSPM is defined as a suite of performance measures, data collection and data analysis tools to support objectives and performance-based approaches to traffic signal operations, maintenance, management and design to improve the safety, mobility and efficiency of signalized intersections for all users.

The technology allows for agencies responsible for traffic signal timing updates to use the data provided through ATSPM to determine how best to optimize traffic signal timings based on the collected data. More information on this approach and case studies performed in other states can be found at: https://ops.fhwa.dot.gov/arterial_mgmt/performance_measures.htm.

- **Benefits**
  - Increase efficiency of traffic signal systems
  - Reduce delay for motorists along signalized arterials
- **Estimated Cost**
  - Variable, dependent on size of overall system
    - Utah DOT, an early adopter of the technology, estimates implementation costs for small ATSPM systems (about 50 signals) would be approximately $20,000. Large systems (on the order of 1,000 signals) would be approximately $230,000. Case study details are at: https://ops.fhwa.dot.gov/publications/fhwahop18048/index.htm.
- **Addresses identified program areas**: Traffic Management
- **Geographic Scope**: Regional

Automated Vehicle (AV) Deployments

Automated Vehicle (AV) Deployments refer to the testing and deployment of automated vehicles throughout the state. These are vehicles equipped with sensor and camera technology on the exterior of the vehicle for the purpose of detecting the built and mobile environment surrounding the vehicle. Technology on the automated vehicles determines the appropriate driving actions to take based on the observations made by vehicle sensors and / or cameras.

There are various Automated Vehicle initiatives that can be undertaken throughout the state to improve the safety and efficiency of travel along Illinois roads and highways. Illinois state agencies and community partners have recently started working together as part of a new initiative called Autonomous Illinois, which will help agencies to develop and use both connected and automated vehicles (CAV). Further information can be found at the following: http://www.idot.illinois.gov/autonomous.

- **Benefits**
  - Improved travel safety and efficiency
  - Reduced vehicle incidents on roadways
- **Estimated Cost**
  - Variable depending on the scope and scale of AV Deployment
- **Addresses identified program areas**: Traffic Management, Transportation Safety, Transit, Connected and Automated Vehicles
- **Geographic Scope**: Statewide

Automated Vehicle Location (AVL) / Computer Aided Dispatch (CAD) Systems

AVL and CAD systems are utilized by public service agencies to assist in the overall management and operation of vehicle fleets by central office dispatchers.

AVL systems on vehicles use GPS or other location technologies to manage vehicle fleets. GPS units in vehicles transmit data to a central processor that coordinates the location of all GPS units in the fleet. This enables the dispatch center to locate vehicles and calculate average speeds on a real-time basis.

CAD systems assist dispatchers to decrease response times and more efficiently manage a fleet of vehicles. The CAD system tracks all information entered into it, whether automatically or by hand so that the dispatcher is presented information in a useful manner and bits of data are not misplaced or skipped over during an event. This can be used by emergency response dispatchers to keep track of events during an incident or by transit dispatchers to respond to customer information requests, respond to vehicle breakdowns, or reroute vehicles around road closures. CAD and AVL technology are often used in conjunction to increase fleet efficiency. This technology is useful in both metropolitan and rural areas, as long as a fleet is being dispatched and monitored.

AVL and CAD technology systems can be used for various types of vehicles, from police squad cars and maintenance trucks to local transit buses. AVL can be used by metropolitan, small urban, and rural transit or maintenance agencies to track their vehicles, gather data on schedule adherence, and provide route guidance for on-demand service. AVL in emergency response vehicles can help dispatchers easily find the closest response team for a fast response.

- **Benefits**
  - Better fleet management
  - Faster response time
  - Better use of time and resources
  - Better management of resources (salt dropped, vehicle repair/vehicle use)
  - Reduce distance vehicles travel
  - Increase transit operational efficiency, service, and ridership
  - Increase roadway maintenance operational efficiency
- **Estimated Cost**
  - $15,000/vehicle for equipment and integration, $300,000 for central system; $50/year/unit for operations & maintenance
  - $300,000-$450,000 for CAD system and integration ($1 million for system offering automated recommendations); $25,000/year for operations & maintenance
- **Addresses identified program areas**: Incident Management, Construction & Maintenance, Transit
- **Geographic Scope**: Regional, Small Urban/Rural

Commercial Vehicle Enforcement / Inspection Technologies

This solution encompasses a variety of commercial vehicle enforcement / inspection solutions and includes the following technologies that are described in the sections below:

- Automated Commercial Vehicle Inspection
- Commercial Vehicle Enforcement Systems
- Virtual Weigh Stations

Automated Commercial Vehicle Inspection

A number of technologies can be used to address safety concerns with commercial vehicles by helping to remove unsafe vehicles from the roadway. Infrared technology can detect defective breaking systems, emissions detectors can identify dangerous chemicals, and low-level radiation screening can be used to detect contraband and determine the composition of the freight. These detectors can be deployed at existing traditional weigh stations or at weigh in motion units to detect unsafe vehicles or security concerns. The detection systems can be coupled with cameras to identify vehicles at weigh in motion locations.

- **Benefits**
  - Increase safety on roadways
  - Identify security threats
  - Reduce delay for compliant truckers
- **Estimated Cost**
  - Variable, dependent on detectors
    - Sample costs: $300,000 deployment; $50,000/year operations and maintenance
- **Addresses identified program areas**: Commercial Vehicle Operations, System Security
- **Geographic Scope**: Statewide

Commercial Vehicle Enforcement Systems

This solution encompasses a variety of systems that can enhance the commercial vehicle enforcement process for state patrol and other enforcement agencies. The solution can be an expansion of existing systems, or introduction of new systems.

Examples include PrePass, which allows commercial vehicles to bypass roadside weigh stations through the communication of safety, credentials, and weight data through vehicle-based transponder equipment and roadside communications devices. Other roadside systems can also include automated license plate readers that allow law enforcement to quickly identify commercial vehicles that are either not in compliance or require enforcement due to past violations.

Illinois currently uses CVIEW as an information portal that makes a firm or individual trucker's safety compliance history available to troopers in the field, and allows troopers to focus their efforts on those truckers with a history of safety violations and to verify that

they have proper permits. This removes a greater number of unsafe vehicles and drivers while minimizing the delay to drivers in compliance. Other central office systems support commercial vehicle permitting and routing requests to improve commercial vehicle travel on supported roadways.

- **Benefits**
  - Increase safety on roadways
  - Reduce delay for compliant truckers
  - Coordination opportunity with neighboring states
- **Estimated Cost**
  - Variable dependent on
- **Addresses identified program areas**: Interagency Coordination, Data Management, Commercial Vehicle Operations, Transportation Safety
- **Geographic Scope**: Statewide

Virtual Weigh Stations

The objective of virtual weigh stations is to employ sensor and communication technologies to more effectively enforce weight restriction laws. Virtual weigh stations can be used to complement interstate weigh stations by improving weight enforcement capabilities on non-interstate routes throughout Illinois. By using weigh-in-motion (WIM) scales in conjunction with highly focused enforcement strategies, enforcement personnel can screen more vehicles on more routes for excessively overweight trucks. Trucks that are in compliance with vehicle weight restrictions are not required to stop for inspection. Reductions in dramatically overweight trucks will reduce the damage caused to road surfaces and serve to lengthen the lifespan of pavement on roadways.

Virtual Weigh Stations also seek to improve the effectiveness of commercial vehicle weight enforcement throughout the corridor by establishing cooperative agreements among the states. These agreements could take the form of reciprocity agreements allowing one state to take enforcement action on a vehicle identified as overweight, or flagged as a vehicle likely to be overweight, by another state.

- **Benefits**
  - Significantly reduce damage to roads
  - Reduce delay for compliant truckers
  - Coordination opportunity with neighboring states
- **Estimated Cost**
  - $250,000/location deployment; $10,000/year operations and maintenance
- **Addresses identified program areas**: Data Management, Commercial Vehicle Operations, Construction & Maintenance
- **Geographic Scope**: Statewide

Connected Vehicle V-2-V and V-2-I Deployments

Connected Vehicle deployments can include characteristics of both Vehicle-to-Vehicle (V-2-V) and Vehicle-to-Intersection (V-2-I) communications. Various projects include the testing and deployment of vehicles that can communicate with and receive data in real time from other vehicles and roadside infrastructure (i.e., traffic signals) on the roadway. These vehicles are equipped with Dedicated Short Range Communications (DSRC) technology within the vehicle for the purpose of enabling the V-2-V communications.

Examples of V-2-V applications under development for use by passenger vehicles include Forward Collision Warning, Blind Spot Warning / Lane Change Warning, and Do Not Pass Warnings. Examples of V-2-I applications include Red Light Violation Warning, Curve Speed Warning, and Work Zone Warning. Additional details on these types of applications under development can be found at: https://www.its.dot.gov/pilots/cv_pilot_apps.htm. Two other V-2-I examples are further detailed within this ITS solution as the following:

- In-vehicle CVO Traveler Information
- In-vehicle traffic probes

There are various Connected Vehicle initiatives that can be undertaken throughout the state to improve the safety and efficiency of travel along Illinois roads and highways. This should involve the inclusion of CV roadside units as part of upgrades to traditional ITS infrastructure like vehicle detection and dynamic message signs, as well as standalone CV projects. Illinois state agencies and community partners have recently started working together as part of a new initiative called Autonomous Illinois, which will help agencies to develop and use both connected and automated vehicles (CAV). Further information can be found at the following: http://www.idot.illinois.gov/autonomous.

- **Benefits**
  - Improved travel safety and efficiency
  - Reduced vehicle incidents on roadways
- **Estimated Cost**
  - Variable depending on the scope and scale of AV Deployment
- **Addresses identified program areas**: Traveler Information, Traffic Management, Transportation Safety, Construction & Maintenance, Connected and Automated Vehicles
- **Geographic Scope**: Statewide

In-vehicle CVO Traveler Information

One detailed example of a V-2-I project be providing in-vehicle traveler information to commercial vehicle operators. Traveler information could be provided via a wireless feed to special in-vehicle receivers installed in participating commercial vehicles. Unlike highway advisory radio, these communications allow for transmission of digital information, allowing maps and images to be broadcast. Information could either be sent from a traffic information system to trucking dispatchers or directly to equipment in

vehicles. Possible applications include alternate route plans or rest area parking information.

In-vehicle Traffic Probes

Mobile technologies located in vehicles can be used to measure travel times. New low-cost methods of gathering this traffic data use technologies previously deployed for other reasons, such as toll transponders and cell phones. These methods are being tested in several parts of the country in public-private partnerships. This strategy would allow for better collection of data on arterial routes and interstates in rural areas. Data already gathered on some routes would be enhanced by this new stream of data to provide better information, while this system would also provide data on routes where higher-cost detection systems are not deployed. Portable readers can be used in rural areas or in work zones, though the transmission of collected data will need to be considered if deployed in a temporary manner or in an area without an existing communications infrastructure.

- **Benefits**
  - More accurate travel time information
  - Travel time information on new routes
  - More effective response to congestion
- **Estimated Cost**
  - $300,000 implementation; $25 per transponder in new probe devices are used, or existing devices could be used as probes at no cost to consumers; $45,000/year operations and maintenance (costs would be shared with vendor through public/private partnership)
- **Addresses identified program areas**: Traffic Management, Data Management, Asset Sharing & Control
- **Geographic Scope**: Statewide, Regions 2A-9, Small Urban/Rural

Crash Investigation Systems

Efforts under this strategy focus on the use of specific crash investigation technologies that expedite the collection of data required at crash sites, such as three dimensional photographic equipment and modeling software. The use of these systems on heavily traveled corridors in metropolitan areas can have a significant impact on clearing crashes and other incidents more efficiently and therefore minimizing secondary crashes and congestion. These systems are portable and can be used in both urban and rural areas. They provide the most benefit in the areas with greatest delay from accidents.

- **Benefits**:
  - Reduce incident clearance time
  - Improve accident investigation quality
  - Reduces paperwork for enforcement officers
- **Estimated Cost**:
  - $15,000/unit implementation, $4,000/year operations & maintenance
- **Addresses identified program areas**: Incident Management, Transportation Safety

- **Geographic Scope**: Regional, Small Urban/Rural

Drones for Incident / Traffic Management

Efforts under this strategy focus on the use of drone technology to assist in incident management and traffic management efforts. Drones can provide overhead video of roadway networks in response to both planned lane closures and unplanned roadway incidents. Drones could be quickly deployable with Illinois State Police and local police departments responsible for deployment. Drones can also be utilized for infrastructure maintenance activities, such as bridge maintenance.

- **Benefits**:
  - Reduce incident clearance time
  - Increase safety of roadway and infrastructure maintenance
- **Estimated Cost**:
  - Variable depending on the scale and use of drones for traffic / incident management
- **Addresses identified program areas**: Traffic Management, Incident Management, Transportation Safety, Construction and Maintenance
- **Geographic Scope**: Regional, Statewide

Emergency Traffic Patrol / Emergency Patrol Vehicle (ETP/EPV) Expansion

This ITS solution refers to the expansion of two similar emergency traffic assistance programs to cover additional areas of the state. As part of IDOT's 24-hour-a-day commitment, IDOT's Chicago area Emergency Traffic Patrol (ETP) and Metro-East area Emergency Patrol Vehicle (EPV) programs, respectively, dispatch teams of emergency patrol vehicles and drivers to traffic disruptions and potential safety problems caused by accidents, disabled vehicles or hazardous debris.

The primary objective of the ETP/EPV workers, also referred to as "Minutemen," is to respond to all disruptive incidents on the state's busiest urban expressway systems and to take immediate corrective action to safely restore normal traffic flow. Minutemen then execute help that motorists need when breakdowns or mishaps occur. Further information is available at: http://www.idot.illinois.gov/travel-information/roadway-information/driver-information/emergency-traffic-patrol/index.

IDOT's Highway Maintainers, outside of Chicago and the Metro-East, currently assist with traffic incidents across the state. The expansion of these services into a program similar to either the ETP or ETV programs would provide additional assistance to other areas of the state.

Enabling Backbone Communications Infrastructure

In order to make many ITS projects truly statewide and to share information between different areas of the state, communication links need to be finalized. Communications links must be deployed to connect various traffic management centers or IDOT communications centers together and to the Central Office in Springfield. These links can include fiber optic cable and associated equipment or, in cases where fiber-optic cable is not feasible, wireless transmissions can be used to send and receive information between a local center and a processor connected to the backbone.

Use of the Illinois Tollway fiber system and Illinois Century Network are other possibilities, depending on location. The Illinois Department of Information Technology (DoIT) manages the Illinois Century Network, a high speed telecommunications network for state agencies, as well as Illinois schools, libraries, and several other public agencies throughout the state. DoIT also provides service and maintenance of fiber and wireless communications infrastructure that can help to enable center-to-field communications for important ITS projects.

This project would eventually link centers in all IDOT districts to the Illinois Statewide Transportation Information Network (ISTIN).

- **Benefits**
  - Share real-time information statewide
  - Allow for deployment of statewide ITS systems
- **Estimated Cost**
  - $20,000 to $60,000/mile of fiber installation, $20,000 to $40,000 for integration; $1,000 to $2,000 per year per mile for maintenance, $8,000 per installation of wireless link, $1,0000 to $2,500 for operations and maintenance
- **Addresses identified program areas**: Traveler Information, Traffic Management, Interagency Coordination, Improved Communications, Data Management, Standardization, Asset Sharing & Control
- **Geographic Scope**: Statewide

Enhanced Communication Links to Field Devices

To ensure operations of traffic management devices, communications links to some field devices need to be enhanced and the addition of secure, diverse links need to be explored. Depending on the importance of various field devices and the age of the devices and their communications connections, outdated connections/conduits should be upgraded to provide more reliable device operation.

- **Benefits**
  - Increased reliability of field device operations
  - Reduces long-term maintenance costs
- **Estimated Cost** – the cost of this initiative would depend on the type and length of connections needed to devices determined to be of highest priority (e.g., $500-5,000 for 8 to 15 miles of T1 or T3 communication lines, with $5,000-$60,000 operations and maintenance per year; $600-$1,800 per month for wireless communications)
- **Addresses identified program areas**: Traffic Management, Incident Management, Improved Communications, Data Management, Transit, Standardization, Asset Sharing & Control
- **Geographic Scope**: Regional

High Volume Rest Area Truck Parking Management

This system would alert truck drivers of available parking spaces at rest areas before they reach key decision points. Truck drivers often park at rest area to avoid fatigue and comply with federal hours of service limits. Advance knowledge of whether a space is available will help them decide whether they should turn into the rest area or look for another place to stop. This helps truckers better plan their rest stops and will reduce parking in illegal and unsafe areas, such as the shoulder of entrance ramps.

Induction loops at the entrance and exit of truck parking areas can be used to track the number of trucks in an area and the number of spaces available. When the rest area is at capacity, an LED or changeable message sign upstream of the rest area will display "Rest Area Truck Parking Full," and could recommend an alternate rest stop. Rest Area Parking Management systems could be integrated with In-vehicle CVO Information sources to alert truckers about rest area parking status before major interstate decision points.

- **Benefits**
  - Reduce truck crashes caused by fatigue
  - Helps truck drivers better plan stops
- **Estimated Cost**
  $150,000/rest area, $15,000 annual operations and maintenance cost per rest area
- **Addresses identified program areas:** Traveler Information, Commercial Vehicle Operations, Transportation Safety
- **Geographic Scope:** Statewide

Illinois Statewide Transportation Information Network (ISTIN)

Based upon stakeholder input, traveler information is the most important need that ITS can address in Illinois. The Gateway Traveler Information System in Chicago has garnered national attention for gathering and distributing traveler information in the region. Using this program as a starting point, IDOT Gateway hardware and software could be deployed at regional transportation management centers across the state to turn regional data into traveler information. These regional systems can then be linked to a central server to provide statewide traveler information. This statewide system would also channel traveler information to the statewide 511 telephone system and website.

This solution would deploy IDOT Gateway hardware and software in district centers and integrate it with the existing regional traffic data and traveler information systems. These separate centers, or nodes, would be integrated with an Illinois Statewide Information Hub. The regional nodes would send information into the Statewide Hub to be fused with data from other regions to provide useful traveler and operational information to be distributed back to the regional nodes.

To successfully deploy a statewide information network, configuration management guidelines will also be developed so the system will operate in the most effective manner.

- **Benefits**
  - Increased amount of traveler information

- Traveler information available statewide
- Reduced future statewide cost of upgrades because of standardization

- **Estimated Cost**
  - $100,000 to $300,000 for implementation and integration per district; $30,000 to $60,000 per year for each district deployed
- **Addresses identified program areas**: Traveler Information, Traffic Management, Improved Communications, Data Management, Standardization
- **Geographic Scope**: Statewide, Regional

Integrated Payment Systems

In order to increase the efficiency of movement across multiple modes of transportation, public transit operators throughout the country have gradually moved towards contactless smart farecard systems that allow travelers to access multiple modes of transportation within a region. This effort can help to provide efficiencies across transit operators and improve overall customer service. Integration of these cards with retailers and financial institutions provide greater opportunities for both travelers using the farecards, as well as the financial institutions.

Other types of integrated payment systems can support travelers as they shift away from personally-owned modes of transportation towards mobility as a service (MaaS) solutions. This can be enabled by combining transportation services from public and private transportation providers through a unified gateway that creates and manages the overall trip, which users can pay for with a single integrated payment account.

- **Benefits**
  - Increased payment efficiency for travelers
  - Improved customer service for public transportation users
- **Estimated Cost**
  - Variable depending on the scope and scale of integrated payment systems
- **Addresses identified program areas**: Transit, Multi-Modal Coordination
- **Geographic Scope**: Regional, Small Urban/Rural

Integrated Transportation Corridors

In order to increase the efficiency and safety of routes inside Illinois, coordinated ITS can be deployed along selected high-priority corridors to the benefit of all travelers. This solution area would include ITS improvements on a major interstate or highway and a parallel route, in either an urban or rural area. Deployment in rural areas may be more expensive because of the lack of existing communications infrastructure and available power sources. A candidate corridor would be chosen based on accidents, congestion, travel patterns, availability of alternate routes, and interest of local participants. Specific recommendations for corridors would be developed to address the needs of that corridor and incorporate the systems already in place. Systems would be integrated to work together in order to maximize benefits to travelers at a corridor-level. Potential improvements include traffic detectors, variable message signs, highway advisory radio, traffic signal coordination, and transit signal priority.

- **Benefits**
  - Reduced congestion
  - Increased safety
  - Standardization of systems along corridor
- **Estimated Cost**
  - Highly variable dependent on corridor and identified needs; sample costs: $200,000 for planning/scoping study; $1Million for deployment; $70,000/year operations
- **Addresses identified program areas**: Traffic Management, Transportation Safety, Standardization, others variable based on corridor
- **Geographic Scope**: Regional, Small Urban/Rural

Integration of Communications Channels

Integrating radio communications among agencies that respond to incidents is a priority to ensure timely coordination and an effective response.

Illinois' statewide radio system, IREACH, was launched in October 2004. It increases communications between agencies responding to events and between a center and the site. One enhancement would be to develop a parallel radio system and designate one for use at the site and the other for use between a central site location and a number of centers. This would reduce the amount of voices and information on the frequency and better target the audience for communications. Response units would need to have equipment to use the parallel system. Units would also have to be within distance of a broadcast or relay tower to use the system, which might limit its use in rural areas. The Association of Public-Safety Communications Officials International has been developing standards for digital wireless communications for public-safety professionals.

- **Benefits**
  - Reduced confusion, duplication of effort, and danger at incident sites
  - Improved communications between inter-agency incident response teams
  - Reduced incident response time
  - Reduction in incident duration
  - Reduction in delay to travelers
  - Increase in driver safety by reducing secondary crashes
  - Possible emissions reductions from shortened incident duration
- **Estimated Cost –**
  - $300,000-$1 million for integration and equipment; $4,000 year operations & maintenance for coordination meetings/operating information; $1,000 to $1,500 per 2-way radio
- **Addresses identified program areas:** Incident Management, Interagency Coordination, Improved Communications, Standardization, System Security, Asset Sharing & Control
- **Geographic Scope:** Regional, Small Urban/Rural

ITS Data Collection Systems

A variety of devices can be deployed to gather information and manage traffic on highways or arterials. These separate ITS devices can be deployed individually and integrated with a traffic management center to form the foundation to a traffic management system. These basic ITS devices include:

- Traffic Detectors
- Closed Circuit Television (CCTV) Cameras
- Regional Weather Information System (RWIS)

ITS data collection installations should also include roadside units (RSUs) to support Connected Vehicle applications. As a larger portion of the general vehicle fleet takes on CV features, these RSUs will play a critical role in sharing traveler information and promoting traveler safety.

- **Benefits**
  - Faster incident detection and response
  - Improved traffic monitoring
  - Increased security surveillance
  - Increased amount of interactive traveler information
  - Reduce congestion and delay
- **Estimated Cost**
  - CCTV - $20,000/camera deployment; $2,000/camera/year operations and maintenance
  - Information Kiosk - for single phase demonstration project: $450,000 for implementation (10 kiosks, data connections, integration); $45,000/year for operations and maintenance
  - Cost could be defrayed by incorporating tourist information with paid advertisements
  - HAR - $15-30,000/unit for additional units to existing system, $5,000/sign with flashers; $8,000/year/unit for Operations and Maintenance
  - Dynamic Message Signs
    - Metro area signs –
      - over highways: $180,000/sign; $6,000/sign/year operations & maintenance
      - smaller signs on arterials: $50,000/sign; $2,500/sign/year operations & maintenance
    - Rural signs – $50,000/sign (cost for transmitting data); $2,500/sign/year operations & maintenance
  - RWIS - $13,000/station, $1,000 for annual operations and maintenance
  - Connected Vehicle Roadside Unit - $5,000 for hardware and configuration
- **Addresses identified program areas**: Traveler Information, Traffic Management, Incident Management, Data Management, Transportation Safety
- **Geographic Scope**: Statewide, Regional, Small Urban/Rural

Localized Traffic Advisory Systems

This ITS solution encompasses the following two different types of localized traffic advisory technologies that are described in the sections below:

- Localized ITS Warning Systems: Includes technologies such as Curve Warning Systems and Dynamic Speed Warning Systems
- Traveler Information Systems: Includes technologies such as permanent and portable Dynamic Message Signs

Localized ITS Warning Systems

This solution encompasses a variety of roadside systems that provide warnings to drivers based on data collected from roadside sensors and other ITS equipment combined into one localized system. As with ITS Data Collection Systems, Localized ITS Warning Systems should include Connected Vehicle roadside units (RSUs) to leverage the growing portion of vehicles that have CV capabilities. This includes the following types of systems that are described in the sections below:

- Curve Warning Systems
- Dynamic Speed Warning Systems
- Overheight Detection Systems
- Portable Speed Detectors

Curve Warning Systems

These systems would be deployed at areas that have a high frequency of crashes caused by vehicles traveling too fast on curves in the road. A static sign stating "Curve Ahead" would be placed upstream of a curve. Detectors would measure the speed of a vehicle before it enters a curve and if the speed is above a set limit, an LED sign attached to the static sign would be illuminated to read "Reduce Speed". Each system would place a sign and detector before the curve in each direction. This project is similar to the Dynamic Speed Warning Signs but based on other projects designed to reduce curve-related crashes.

- **Benefits**
  - Increase safety on roadways
- **Estimated Cost**
  - $10,000 to $20,000 deployment per pair of sign; Connected Vehicle Roadside Unit - $5,000 for hardware and configuration; $2,000/year operations and maintenance
- **Addresses identified program areas**: Traffic Management, Transportation Safety
- **Geographic Scope**: Regional

Dynamic Speed Warning Systems

This concept has a variety of uses at spot applications to enhance the safety of the traveling public, especially during poor weather conditions. This strategy includes the use of various roadway and weather detection devices to provide data on traffic or pavement conditions and, through traveler information technologies, relay information to the appropriate agency

and to motorists. This project would implement dynamic message signs, vehicle speed detectors, and possibly weather sensing equipment at key locations identified as having high crash rates. Deployed at these areas, the system would reduce crash rates by posting an advisory speed based on vehicle speed or current weather conditions. When the device detects vehicles exceeding the posted or advisory speed for the location, the changeable message sign automatically activates a warning message displaying the speed of the vehicle followed by the recommended speed. Weather detectors can be added to detect hazardous conditions, like rain, fog, or ice, and post an appropriate advisory speed. These can be especially useful on rural highways, where drivers may travel at high speeds and they might not expect changes in the roadway. They are less dependent on information infrastructure than many other solutions and are frequently deployed in rural areas.

- **Benefits** –
  - Improve driver safety
  - Reduce number of crashes
- **Estimated Cost** –
  - $15,000/sign and $15,000 for speed or weather detector; Connected Vehicle Roadside Unit - $5,000 for hardware and configuration; $2,000/device/year operations & maintenance
- **Addresses identified program areas**: Traveler Information, Traffic Management, Transportation Safety
- **Geographic Scope**: Regional, Small Urban/Rural

Overheight Detection Systems

Overheight detection systems inspect vehicles approaching a height-restricted roadway sections and warn drivers of overheight vehicles of the impending danger. Sensors and signs can be installed prior to a decision point on a roadway with a tunnel or bridge. If a vehicle triggers the system, the sign would activate, alerting the driver that they are overheight for the upcoming entryway and they should turn off for the alternate route. This would be especially useful in small urban or rural areas where truck routes might not be as well known to drivers and there may be less frequent exits from a roadway. Powering the system may be an issue in remote areas.

- **Benefits**
  - Information to commercial vehicle operators
  - Increase safety
  - Reduce delays from backtracking
- **Estimated Cost**
  - $50,000/sign deployment; Connected Vehicle Roadside Unit - $5,000 for hardware and configuration; $5,000/sign/year operations and maintenance
- **Addresses identified program areas**: Commercial Vehicle Operations, Transportation Safety
- **Geographic Scope**: Regions 2A, 3-9, Small Urban/Rural

Portable Speed Detectors

Portable speed detection systems can be used to slow drivers in residential areas or urban and rural areas with a high incident rate. This is a similar concept to Dynamic Speed Detectors, but is a less advanced, portable version. This system involves radar detectors and a portable DMS. Some systems are mounted on trailers, while others are housed in smaller units that can be mounted on street light poles or other infrastructure. The system also stores the vehicle speed data in a computer unit, so historical speed information can be analyzed to develop ways to reduce incidents in an area with high incident rates.

- **Benefits**
  - Increases safety by reducing speeding
- **Estimated Cost** – $12,000-$15,000/detection system, Connected Vehicle Roadside Unit - $5,000 for hardware and configuration; $1,800/year for operations & maintenance
- **Addresses identified program areas:** Traffic Management, Data Management, Transportation Safety, Construction & Maintenance
- **Geographic Scope**: Regional, Small Urban/Rural

Traveler Information Systems

This solution encompasses a variety of ITS technologies and applications that provide transportation-related information to travelers with the purpose of improving travel-related decisions across multiple modes of transportation. These include the following items that are further described below:

- Permanent and portable Dynamic Message Signs (DMS) that can act to provide drivers with information on real-time traffic conditions, work zone information, special events, and other transportation related information.
- Rest Area Information Kiosks as a means of traveler information dissemination at fixed locations
- Web-based information systems that provide information to travelers on parking availability, traffic conditions, and transit information to improve travel within a region

Permanent Dynamic Message Signs (DMS)

Permanent DMS are effective for alerting motorists to operational, regulatory, warning or guidance announcements to which motorists can respond by adjusting driving behavior or choosing an alternative route. Permanent DMS are utilized at locations along roadways where traffic information can be provided to drivers regarding traffic conditions upstream of decision points at interstate interchanges.

- **Benefits**
  - Provide improved motorist information
  - Improved safety
- **Estimated Cost** –
  - Range from $25,000 to $100,000 per sign depending on size and color of permanent DMS; Connected Vehicle Roadside Unit - $5,000 for hardware

and configuration; range from $2,000 to $5,000/sign/year operations & maintenance
- **Addresses identified program areas**: Traveler Information, Traffic Management, Incident Management, Asset Sharing & Control
- **Geographic Scope**: Regional, Statewide

Portable Dynamic Message Signs (DMS)

Portable DMS can be used at locations of temporary importance, such as construction zones and special events. Depending on agency guidelines, Portable DMS technology can be used to address several needs, such as providing information to travelers about special events, giving travelers information before decision points, and safely directing travelers through a work zones. A pool of portable DMS could be purchased and made available to public agencies throughout the state. Agencies borrowing the signs may or may not financially contribute toward maintenance of the signs, depending on the funding source for this project. Due to their portable nature, they can be deployed in both urban and rural areas.

ITS use in work zones has a major impact in reducing incident clearance times, sometimes up to 40%. Secondary benefits include increased safety and work zone information to travelers.

- **Benefits**
  - Provide improved motorist information
  - Improved safety
  - Can be used at several locations
  - Manage special events traffic
- **Estimated Cost** –
  - $25,000/sign; Connected Vehicle Roadside Unit - $5,000 for hardware and configuration; $2,000/sign/year operations & maintenance
- **Addresses identified program areas**: Traveler Information, Traffic Management, Incident Management, Construction & Maintenance, Asset Sharing & Control
- **Geographic Scope**: Regional, Small Urban/Rural

Managed Lanes

Managed lanes are types of highway lanes that are actively operated by a traffic management agency to optimize traffic flow, vehicle throughput, or both through the use of lane restrictions or variable tolling. Managed lanes are generally implemented to achieve an improved operational condition along a highway, such as improving safety and efficiency of travel through increased traffic speeds and throughput and reducing air pollution.

Types of managed lanes include High-Occupancy Vehicle (HOV) lanes and High-Occupancy Toll (HOT) lanes, as well as express toll lanes, reversible lanes, and bus only lanes. HOT lanes allow for vehicles with more than one passenger to use the lane without having to pay a toll, however solo occupant vehicles can choose to pay a toll to use the lane. HOT lanes are frequently

implemented along highways that experience recurring traffic congestion to improve travel conditions along those highways.

- **Benefits**
  - Improved efficiency of traffic management
  - Increased vehicle throughput along congested roadways
- **Estimated Cost**
  - Variable, dependent on scope and scale of managed lane deployment
- **Addresses identified program areas**: Traffic Management
- **Geographic Scope**: Regional

Mobile Network Access

Being able to receive accurate, real-time information from the field is essential to appropriately respond to events. Mobile data terminals enable personnel in the field to enter data directly into a central automated system, allowing this information to be shared more easily. This data entry also reduces the paperwork and time staff spends on reporting events and reduce errors in data entry. Mobile terminals can be placed in enforcement, motor assistance, and maintenance vehicles to enhance those services. A pilot study is being performed in the Chicago area with IDOT's Emergency Traffic Patrol (ETP) which allows data entered by truck operators to be transmitted to the District 1 ComCenter and the Gateway system.

Another kind of mobile terminal allows remote users to access Traffic Management Center systems, allowing personnel to remotely operate them. This virtual TMC function can allow continuing operations if a TMC has restricted staff, other issues to address, or in cases of a security or emergency event.

Systems that could be deployed in Illinois include:

- Links to a statewide condition reporting system (CRS)
- Access to an alternate route plan database
- Remote ATIS work stations
- Public access to Wi-Fi at rest areas

  - **Benefits**
    - Remote data entry
    - Reduced labor time by personnel through elimination of duplicated entry
    - Improved data accuracy
    - Continued operations during emergencies
  - **Estimated Cost**
    - $500-$4,000/terminal, $150,000 - $200,000 integration; $300/month/terminal operations and maintenance
  - **Addresses identified program areas**: Traveler Information, Traffic Management, Incident Management, Data Management, Construction & Maintenance, Transit, System Security, Asset Sharing & Control
  - **Geographic Scope**: Regions 2-9, Statewide

Regional Communications Centers for Operations Interoperability

This ITS solution encompasses the following two different types of railroad – highway interface technologies that are described in the sections below:

- Regional Communications Centers
- Traffic Management Center (TMC) Interoperability

Regional Communications Centers

Regional hubs for communications and operations can be implemented to coordinate ITS systems and communications between agencies. Building from the successes of the ComCenter in District 1, and newly constructed communication centers in Districts 4 and 8, regional communications centers can be deployed in additional IDOT Regions. These centers can provide around-the-clock incident and communications coordination. The centers would be able to monitor, dispatch, and assist IDOT field personnel and coordinate information with the Illinois State Police, Illinois Emergency Management Agency, local police and fire departments, news media, and the general public. These communications centers could also serve as Traffic Management Centers, monitoring and operating systems in the region, coordination with local departments of public works and county/township highway departments, and serving as a collection and distribution point for statewide traveler information services.

Instead of newly constructed free-standing buildings, these regional communications centers could be created by upgrading existing radio dispatching centers, or remodeling available space within existing facilities to reduce costs and encourage integration of systems and functions. In many cases, regional communications centers could be used to co-locate different agencies, such as IDOT and the Illinois State Police or municipal public works and municipal police/fire/EMS dispatching. Additional staffing would be needed, with new staff sharing operations and information technology responsibilities with existing staff.

- **Benefits**
  - Improved communication
  - Coordinated communication
  - Centralized information source
  - Coordinated operations and management
- **Estimated Cost**
  - $350,000 to $700,000 per center for hardware and software installation and integration, $15,000 to$40,000/year Operations and Maintenance; $50,0000 to $75,000 annual cost for one additional staff
- **Addresses identified program areas**: Traveler Information, Traffic Management, Interagency Coordination, Improved Communications
- **Geographic Scope**: Regional

Traffic Management Center (TMC) Interoperability

This effort would integrate operations at different TMCs to allow for greater coordination of traffic and emergency management. Redundancy would also allow management continuity if one of the TMCs lost operations ability.

TMCs connected by a secure fiber line would be able to operate field devices controlled by another TMC provided they used the same operations software and devices were mapped to a central database/system. This would allow continuous operations in districts in case of a major incident that incapacitated a TMC or if staffing resources limit on-site presence.

TMC systems can also be arranged to provide off-site access to data and operational systems. Virtual TMC software can allow remote computers to control field devices via secure Internet connections.

- **Benefits**
  - Coordination between TMCs
  - Redundancy between centers
  - Consolidate staffing in off-hours
- **Estimated Cost:**
  - $500,000 per pair of centers; $20,000/year operations (highly variable)
- **Addresses identified program areas**: Traffic Management, Incident Management, Interagency Coordination, Improved Communications, Data Management Issues, Standardization, Asset Sharing & Control
- **Geographic Scope**: Regional

Regional Traffic Signal Coordination

Traffic signal coordination is a key ITS strategy that has been applied extensively throughout the United States for several years. Signal coordination has been shown to improve arterial and highway traffic flow through the use of advanced signal systems that are calibrated and coordinated within a specific region. A typical project involves communications links and integrated control strategies that enable integrated intra-jurisdictional and inter-jurisdictional traffic control.

These signal projects provide for the sharing of traffic information and control among traffic management centers and jurisdictions to support a regional control strategy. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. Traffic signal coordination ensures appropriate traffic signal progression, which enables motorists to experience less congestion and delay. Signals will need to have compatible signal timing systems and control, so older systems in some smaller urban areas may need to be upgraded to be included.

These projects can also include the use of Advanced Traffic Management Systems (ATMS) and central office software for the operation and management of arterial traffic signal systems.

- **Benefits**
  - Improved travel speeds
  - Increased safety through reduced crash risks
  - Reduced emissions from fewer vehicles idling at intersections
  - Improved transit running times
- **Estimated Cost** -
  - $350,000 for integration with other TMCs; ongoing integration as part of individual TMC operations and maintenance
  - $2,200/intersection
- **Addresses identified program areas**: Traffic Management, Incident Management, Interagency Coordination
- **Geographic Scope**: Regional, Small Urban/Rural

Regional Paratransit Coordination

Paratransit service can be greatly increased by sharing AVL information for on-demand routing. CAD/AVL systems allow transit agencies to fulfill ride requests within the same day, making transit a much more attractive option for prospective riders. Small urban and rural transit agencies that have deployed these systems have experienced dramatic growth in ridership. This is an especially valuable service in rural areas where regular transit service routes might not be accessible to residents, as several paratransit services can pool resources to reach their customers. This technology consists of paratransit call intake, scheduling and dispatch software systems, AVL, mobile data terminals, mobile communications, and other components. It has been shown to increase the number of riders that can be served with any given number of vehicles.

- **Benefits**
  - Increase range of service
  - Reduce operations cost through shared dispatch and improved routing.
  - Reduce driver paperwork
  - Improve coordination of inter-agency transit connections
- **Estimated Cost**
  - $150,000 plus $600/vehicle for system deployment; $150/vehicle/year operations and maintenance
- **Addresses identified program areas**: Interagency Coordination, Transit, Standardization, Asset Sharing & Control
- **Geographic Scope**: Regions 2A, 2B, 3, 4, 5, 7, 8, 9, Small Urban/Rural

Security Surveillance

CCTV cameras can be placed at rail platforms, on transit vehicles, and near critical infrastructure to provide security surveillance coverage or near highway or arterial intersections or areas of recurrent congestion to assist in systems operations.

Cameras can be used in metropolitan or rural areas, though data transmission requirements should be considered before implementation. In metropolitan areas, data can usually be transmitted along already established right-of-way and with existing or a small amount of new fiber optic cable. In rural areas where there are greater distances to transmit the data and a less established

communications infrastructure, the cost of transmission material may greatly increase the cost of the project and reduce its realized benefit.

Video from CCTV cameras can also be shared with other agencies to improve incident detection and emergency response that involves multiple responding agencies. Video sharing can be enabled through additional communications infrastructure as needed to connect agencies to live video feeds, or could be enabled through web-based software interfaces if available from the CCTV camera manufacturer.

Staffing levels should also be considered before implementing a security surveillance system, since the cameras are only useful if there are operators in place to view the video they provide. Some software automatically alerts operators of changes in motion patterns, mitigating the demands for staff time used for surveillance.

- **Benefits**
  - Faster incident detection and response
  - Improved traffic monitoring
  - Increased security surveillance
- **Estimated Cost**
  - $4,000 (in-vehicle) - $20,000 (outdoor)/camera deployment; $2,000/camera/year operations and maintenance
- **Addresses identified program areas:** Incident Management, System Security
- **Geographic Scope**: Statewide, Regional, Small Urban/Rural (data can be used Statewide)

Smart Cities

Smart Cities refers to the application and use Internet-of-Things (IoT) sensors and technology to connect components across a city to derive data and improve the lives of citizens and visitors. This includes data collected from citizens, devices, and assets that is processed and analyzed to monitor and manage transportation systems, as well as other systems such as power plants, water supply networks, and other community services. Smart Cities integrate Information and Communication Technology (ICT), and various physical devices connected to the IoT network to optimize the efficiency of city operations and services and connect to citizens.

The USDOT has recently supported the deployment of Smart Cities applications throughout the United States through a Smart Cities Challenge in 2016 and 2017. Additional information on the effort and cities that participated can be found at: https://www.transportation.gov/smartcity.

- **Benefits**
  - Various project benefits depending on scale and scope of deployment
- **Estimated Cost**
  - Variable, dependent on scope and scale of smart cities deployment
- **Addresses identified program areas:** Incident Management, Traffic Management
- **Geographic Scope**: Regional, Small Urban/Rural

Statewide ITS Teams

This solution refers to teams of statewide ITS professionals that will lead initiatives for the adoption and expansion of ITS applications throughout the state (see Section 10.4). These initiatives can include the following:

Interagency Operations Library

Access to a centralized, password-protected operational information website encourages agencies to share information and coordinate activities and ensure that they have access to updated information. A centralized operations information resource allows different agencies to be aware of conditions and actions outside of its jurisdiction and allows for better coordination in overlapping agencies. This secure website would be for data that is too sensitive for the public or information that would be of use only to operations professionals. The information would be of a more static nature than real-time traffic information. Potential categories of data to be shared include:

- Interstate Alternate Route Database – a database containing links to alternate route plans for sections of Interstate Highways in Illinois
- Incident Response Plans – plans defining the roles and responsibilities of agencies and individuals for incident or emergency response
- Special Events Plans – plans defining the responsibilities of agencies and traffic management techniques to be used for planned events
- Evacuation Plans - Plans identifying evacuation routes, roles and responsibilities for transportation agencies, and methods to provide traveler information during an evacuation of metropolitan areas
- ITS Infrastructure Database – a GIS-based database of all ITS infrastructure and equipment in Illinois, for use in both operations and ITS planning
- Geographic Information System (GIS) Databases – common locational databases for use by agencies across Illinois
- Construction Planning and Scheduling Tools – a scheduling system to coordinate construction planning between jurisdictions

While a new website could be developed to serve this purpose, this functionality can also be incorporated with other websites that have secured information for individual users, such as the GCM Gateway website. With Gateway being used by regions throughout Illinois, agencies that are connected to the system would have ready access to this central library through secure, dedicated channels.

- **Benefits**
  - Decrease operations cost of multiple websites or databases
  - Better operational coordination between agencies
  - Better data sharing between agencies
  - Better management and coordination of ITS initiatives and equipment
  - Better planning for future projects and activities

- **Estimated Cost** – $250,000 for development of new website library, $25,000/year operations for a new website; $50,000 to $170,00 for database development, $5,000 to $20,000 per year for database maintenance
- **Addresses identified program areas:** (varies with information housed) Traffic Management, Incident Management, Interagency Coordination, Data Management, Commercial Vehicle Operations, Construction & Maintenance, Standardization, System Security, Multi-Modal Coordination, Asset Sharing & Control
- **Geographic Scope:** Statewide

ITS Design Guidelines/Quantity Purchase Agreements

This project would develop design standards in the development and implementation of ITS components in Illinois for use by local agencies that have started deploying ITS. These design guidelines would provide some level of standardization between local projects which could lead to integration between statewide, regional, and local systems. The guidelines would also assist agencies as they develop design plans for technologies with which they might not have much experience. Standard details and specifications would be collected into a single manual to be used by IDOT staff around the state.

Standard design guidelines and requirements would also enable IDOT to make quantity purchases of equipment for several regions or regional transportation agencies. Individual unit prices will be reduced if the same equipment or parts are purchased in a large number, saving IDOT and other agencies money.

- **Benefits**
  - Standardize maintenance and operations
  - Provide opportunity for joint procurement
  - Reduce design costs for local agencies
  - Expand understanding of ITS across the state
- **Estimated Cost**
  - $200,000 for initial deployment, no operations costs (variable depending on focus of guidelines), bulk purchase costs will be dependent on equipment order
- **Addresses identified program areas**: Standardization
- **Geographic Scope**: Statewide

ITS Outreach/Public Education

While ITS is in the process of being mainstreamed into traditional transportation projects, it is still seen as a niche service that may not apply to many transportation activities. ITS outreach and education would seek to spread greater knowledge of the benefits ITS can provide and how it can be used in different areas such as transportation planning and programming, construction, transit, or law enforcement. This strategy would promote the benefits of ITS to a variety of groups, from high-level decision makers to operations staff to the general public. This would make more people aware of ITS resources that may be used to address applicable issues. Possible outreach sources include seminars/workshops, newsletters, public service commercials, or a benefits webpage.

- **Benefits**
  - Promotes cost-effective solutions
  - Expand awareness of potential resources
- **Estimated Cost**
  - $30,000-$200,000 (highly variable, dependent on outreach)
- **Addresses identified program areas**: ITS Outreach/Public Education
- **Geographic Scope**: Statewide

Standardization of ITS Transit Initiatives

This initiative involves the IDOT Department of Public Transportation (DPT) working with agencies throughout the state as well as transit ITS vendors to develop a standard statewide specifications package that could be used for any small or medium size transit ITS procurement. The development of these standards would save money and resources for individual agencies and create the potential for agencies to pool their resources and buy parts in large quantities at reduced prices. It also creates the potential for statewide transit data sharing. MetroLink in the Quad Cities and the Champaign-Urbana Mass Transit District have conducted similar recent joint initiatives.

- **Benefits**
  - Standardize maintenance and operations
  - Provide opportunity for joint procurement
  - Reduce design costs for local agencies
- **Estimated Cost**
  - $150,000 for initial deployment, no operations costs (variable depending on focus of guidelines)
- **Addresses identified program areas**: Transit, Standardization
- **Geographic Scope**: Statewide

Training

Operations personnel need training in order for them to effectively use the resources they have available to fit the needs of different circumstances. Training can be provided to operators to address a number of needs identified. This training can draw on already existing programs and manuals to provide proven, up-to-date information. These different training programs would be offered to appropriate IDOT personnel and other agencies around the state. Areas for training include:

- **Configuration Management:** training on the configuration management process to be applied to planning, installation, and operating equipment and systems
- **Incident Management:** training in the National Incident Command Structure offered by the Illinois Emergency Management Agency
- **Security/Emergency Management Training:** training on how transportation agencies fit into large-scale emergencies, including HAZMAT response training offered by the Illinois Terrorism Taskforce

- **Special Events Management:** training to instruct operations staff on how to use tools that to manage traffic for planned events of limited duration, such as National Highway Institute courses or FHWA special events manuals
- **Work Zone:** training to increase work zone safety and efficiency based on lessons from USDOT's Work Zone Mobility Program
- **ITS Planning Integration:** training for planners and engineers of how ITS can be integrated into a projects lifecycle

    - **Benefits**
        - Increase safety and preparedness
        - Reduce secondary accidents
        - Reduce lane closure time
        - Improve coordination between transportation and response personnel
    - **Estimated Cost**
        - $3,000-$10,000 per training class of 20 individuals; $30,000-$70,000 to develop training
    - **Addresses identified program areas**: Traffic Management, Incident Management, Interagency Coordination, Transportation Safety, Standardization, System Security
    - **Geographic Scope**: Statewide, Regional

Statewide Communications Center/Station One Upgrade

Illinois DOT has already developed a central notification system to address communications during emergencies. Upgrades of IDOT's existing emergency radio/phone service, Station One, can be implemented to have it serve as a Central Office Communications Center. Data from a statewide traveler information system would be available for viewing at the center. The center would also be connected with the State Emergency Operations Center (SEOC) to provide transportation information and support in case of emergencies. Additional communication devices can be used to make the Station One system more robust and ensure that it operates at peek effectiveness.

    - **Benefits**
        - Increase security preparedness
        - Improve coordination between transportation and response personnel
    - **Estimated Cost**
        - $100,000-$300,000 for additional integration; $50,000-$200,000 for additional communications equipment; $10,000-$30,000 for Operations and Maintenance
    - **Addresses identified program areas**: Traveler Information, Traffic Management, Interagency Coordination, Improved Communications, Data Management, System Security, Asset Sharing & Control
    - **Geographic Scope**: Statewide

Third Party Traveler Information Applications

Third party traveler information applications refer to a wide variety of mobile data applications that are available to the general public to improve the efficiency of traveling within and across a region. These include applications such as Google Maps, Waze, and HERE that the general public can access with smartphone technology to determine live traffic conditions and access efficient travel routes. These can also include social media sources, such as Twitter and Facebook, as a means of traveler information dissemination.

As these applications have become widespread in use and adoption, public transportation agencies have the opportunity to integrate data from these applications into their own traveler information systems. This type of integration can improve the overall quality of traveler information provided to travelers from sites such as Travel Midwest (https://www.travelmidwest.com/lmiga/home.jsp) available within the Chicago region. This integration can also reduce the amount of field-based infrastructure required to detect the presence of traffic and congestion along roadways.

- **Benefits**
  - Increased accuracy of traveler information
  - Reduced amount of infrastructure required for traffic detection
- **Estimated Cost**
  - Variable, depending on the amount of integration performed
- **Addresses identified program areas**: Traveler Information, Traffic Management, Data Management
- **Geographic Scope**: Regional, Statewide

Traffic Data Archive

Agencies collect a large amount of traffic data in their daily operations. This data can be archived for future analysis of traffic patterns and to measure the effects of changes to the transportation system. In order to maximize the uses of stored data across the state, archival standards should be developed so that data is easily retrieved and used by systems developed outside of a particular metro area. This would allow analysis developed in one part of the state to quickly and easily be used in other parts of the state. This would lead to usage of historic travel time comparisons and near time travel predictions used or planned in Northeastern Illinois to be used in other metropolitan areas in the state.

- **Benefits**
  - Standardized traveler information format
  - Easier ability to develop travel time prediction algorithms
  - Comparison of current versus past travel times
- **Estimated Cost**
  - $70,000-$100,000 for archive standardization; $500,000 for travel-time prediction development, $50,000 for Operations and Maintenance
- **Addresses identified program areas**: Traveler Information, Data Management, Standardization
- **Geographic Scope**: Statewide, Regions 1-9

Traffic Signal Preemption / Priority

This solution encompasses a variety of roadside systems that provide warnings to drivers based on data collected from roadside sensors and other ITS equipment combined into one localized system. This includes the following types of systems that are described in the sections below:

- Emergency Vehicle Traffic Signal Preemption
- Freight Signal Priority
- Transit Signal Priority

Emergency Vehicle Traffic Signal Preemption

Through the installation of sensors on traffic signals at intersections, emergency vehicles with special emitters can trigger the signal controller to alter the intersection timing. This gives the emergency vehicle a green light and intersecting traffic a red light, reducing accidents at intersections and increasing response time. This technology can be based on optical or sound sensors. When applying these technologies, agencies should consider the inclusion of signal preemption security components to combat the growing prevalence of illegal preemption emitters.

- **Benefits**
  - Reduce emergency response time
  - Reduce intersection collisions
- **Estimated Cost**
  - $10,000/intersection capital cost, $500/vehicle for emitting device; $200/intersection/year operations & maintenance (negligible maintenance on emitting device)
- **Addresses identified program areas:** Traffic Management, Incident Management
- **Geographic Scope:** Regional

Freight Signal Priority

The same technology used for emergency vehicle preemption can be used with heavy commercial vehicles to extend the green phase to allow the commercial vehicle to make it through an intersection. Emitters on trucks can trigger a sensor at an intersection to extend the green phase of a light and improve the operational efficiency of freight movement on specific arterial signalized corridors. This ability would have lesser priority than emergency vehicle preemption and would not let commercial vehicles change the color of a light, only request that an existing green signal be extended.

- **Benefits**
  - Reduce travel time for commercial
  - Reduce idling time for commercial vehicles / reduced air pollution
- **Estimated Cost**
  - $10,000/intersection capital cost, $500/vehicle for emitting device; $200/intersection/year operations & maintenance (negligible maintenance on emitting device)

- **Addresses identified program areas:** Commercial Vehicle Operations, Traffic Management, Interagency Coordination, Asset Sharing & Control
- **Geographic Scope:** Regional

Transit Signal Priority

The same technology used for emergency vehicle preemption can be used with transit vehicles to extend the green phase to allow the transit vehicle to make it through an intersection. Emitters on a bus can trigger a sensor at an intersection to extend the green phase of a light. This ability with transit vehicles would have lesser priority than emergency vehicle preemption and would not let transit vehicles change the color of a light, only request that an existing green signal be extended. This would improve schedule adherence for buses and make them more reliable for transit customers.

Transit signal priority studies are currently being conducted in the Chicago area by Pace Suburban Bus.

- **Benefits**
  - Reduce emergency response time
  - Reduce intersection collisions
  - For transit, increases schedule adherence/decreases late arrivals
- **Estimated Cost**
  - $10,000/intersection capital cost, $500/vehicle for emitting device; $200/intersection/year operations & maintenance (negligible maintenance on emitting device)
- **Addresses identified program areas:** Traffic Management, Interagency Coordination, Transit, Asset Sharing & Control
- **Geographic Scope:** Regional

Traffic Signal System Upgrades

Traffic signal system upgrades are an easy, low-cost way to improve traffic flow in a city. Many municipalities have not updated signal timing systems to adjust for changes in population or traffic patterns. Signal upgrades could decrease congestion at key intersections and signal timing could be coordinated along important routes.

- **Benefits**
  - Reduced congestion
- **Estimated Cost**
  - $1,500 to $2,000 per intersection; there would not be any annual maintenance for these timing upgrades, though the timing will need to be periodically reviewed and updated
- **Addresses identified program areas**: Traffic Management, Transportation Safety
- **Geographic Scope**: Regions 1-9

Work Zone Enhancements

This ITS solution encompasses the following two different types of work zone enhancements that are described in the sections below:

- Work Zone ITS Enhancements
- Corridor Action Teams

Work Zone ITS Enhancements

Work zones are a major point for congestion and for crashes. Work zone safety has become a priority for IDOT and the Illinois Tollway. A number of steps can be made to increase work zone safety and make travel through work zones a more pleasant experience for drivers, including several outlined in the Comprehensive Highway Safety Plan. Some of these initiatives include the following:

- **Queue Detection** – alerts operators when a line entering a work zone has reached a designated length, signaling that countermeasures should be implemented
- **Speed Photo Enforcement** – images of vehicles traveling faster than the speed limit are sent to enforcement officers to verify for citations
- **Dynamic Merge Systems** – instructs drivers on when to merge to reduce crashes and tension caused by uncontrolled merging
- **Portable Traffic Management Systems** – uses equipment such as cameras, speed detectors, and message displays to collect traffic data from work zones, display real time traffic information to travelers, and communicate with a central control facility
- **Travel Times through Work Zones** – displays travel times through a work zone on a changeable message board to inform travelers how long it is taking motorists to travel through the zone
- **Work Zone Best Practices** – a study of strategies used throughout the country to identify the most effective methods for addressing work zone issues
    - **Benefits**
        - Increase safety in work zones
        - Increases traveler information as they enter work zone
        - Decreases congestion and pollution at work zones
    - **Estimated Cost:**
        - Portable Traffic Management System - $90,000/unit, $9,000 annual operations and maintenance
    - **Addresses identified program areas**: Traveler Information, Traffic Management, Data Management, Commercial Vehicle Operations, Transportation Safety, Construction & Maintenance
    - **Geographic Scope**: Statewide, Districts 2-9

Corridor Action Teams

This project would coordinate ITS and operations resources between agencies within and outside of Illinois to minimize the disruption caused by road construction. This concept was successfully tested in the Chicago-Gary area, where agencies from Illinois and Indiana

regularly met to update each other on changes to various construction projects or and what efforts are underway to keep traffic moving. These teams would not duplicate the efforts of construction coordination meetings but look at ways to support transportation through construction zones through public information, increased motorist assistance patrols, or detour coordination. The information exchanged and agreements reached allow operations staff to prepare for changes in traffic in their jurisdictions.

- **Benefits**
  - Reduced congestion in work zones and on alternate routes
  - Increase safety in work zones
  - Efficient use of existing resources
- **Estimated Cost**
  - $30,000 per year per team developed
- **Addresses identified program areas**: Traveler Information, Traffic Management, Incident Management, Interagency Coordination, Transportation Safety, Transit, Outreach/Public Education, Multi-Modal Coordination, Asset Sharing & Control
- **Geographic Scope**: Regional, Small Urban/Rural