DuPage County
Transportation Coordination Initiative (TCI)

FINAL
INTEGRATION STRATEGIES AND TECHNOLOGIES

January 2007

Edwards and Kelcey

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DOCUMENT REVISION HISTORY

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1.0	January, 2007	Initial release

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TABLE OF ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
AVL	Automatic Vehicle Location
CAD	Computer-Aided Dispatch
CATS	Chicago Area Transportation Study
CCTV	Closed-Circuit Television
CMAQ	Congestion Mitigation and Air Quality (Improvement Program)
CVO	Commercial Vehicle Operations
DMMC	DuPage Mayors and Managers Conference
DMS	Dynamic Message Signs
DOT	Division of Transportation
Du-COMM	DuPage Public Safety Communications
ESDA	Emergency Services and Disaster Agency
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GCM Corridor	Gary-Chicago-Milwaukee ITS Priority Corridor
GPS	Global Positioning System
HAR	Highway Advisory Radio
HOV	High Occupancy Vehicle (lane)
HRI	Highway Railroad Intersection
IDOT	Illinois Department of Transportation
IEMA	Illinois Emergency Management Agency
IEPA	Illinois Environmental Protection Agency
IFERN	Interagency Fire Emergency Radio Network
IREACH	Illinois Radio Emergency Assistance Channel
IRP	International Registration Plan
ISP	Illinois State Police
ISPERN	Illinois State Police Emergency Radio Network
ISTHA	Illinois State Toll Highway Authority
ITS	Intelligent Transportation Systems
ITSPO	Intelligent Transportation System Program Office
ITTF	Illinois Terrorism Task Force
IWIN	Illinois Wireless Information Network
LRTP	Long Range Transportation Plan
MABAS	Mutual Aid Box Alarm System
MDT	Mobile Data Terminal
MOE	Measures of Effectiveness
MPO	Metropolitan Planning Organization
NIMS	National Incident Management System
NTCIP	National Transportation Communications for ITS Protocol
PSAP	Public Safety Answering Point
RTA	Regional Transportation Authority
RTIP	Regional Transit ITS Plan

TABLE OF ACRONYMS

SAFETEA-LU	"Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users" – authorizing legislation for federal transportation programs (2005 – 2009)
SEDP	Strategic Early Deployment Plan
SEOC	State Emergency Operations Center
STIP	Statewide Transportation Improvement Plan
TEA-21	"Transportation Equity Act for the 21st Century" – authorizing legislation for federal transportation programs (1998 – 2004)
TCI	Transportation Coordination Initiative
TIMS	Traffic and Incident Management System (Illinois Tollway), Train Information Management System (Metra)
TIP	Transportation Improvement Plan
TMC	Traffic Management Center
TSC	Traffic Systems Center
USDOT	United States Department of Transportation

1. EXECUTIVE SUMMARY

1.1 Introduction

The DuPage County Transportation Coordination Initiative (TCI) Strategic Plan consists of the following documentation:

- Concept of Operations technical memorandum (which includes the stakeholder Needs Assessment technical memorandum)
- DuPage County Subregional ITS Architecture document
- ***Integration Strategies and Technologies technical memorandum***
- Implementation Plan

This Integration Strategies and Technologies document builds upon the findings in the Concept of Operations and DuPage County ITS Architecture by evaluating potential solutions to the TCI needs identified in previous steps. The ITS strategies and technologies recommended in this document are based on the four TCI focus areas:

- Arterial Operations
- Transit Management
- Traffic Incident Management
- Traveler Information

The DuPage County Transportation Coordination Initiative represents the efforts of numerous transportation stakeholders over a number of years to improve the operation and management of the transportation system in the County.

Intelligent transportation systems can be defined as "the integrated application of sensor, computer, electronics, and communications **technologies and management strategies** to provide traveler information to increase the **safety and efficiency** of the surface transportation system." Or, simply put,

People using technology in transportation to save time, lives, and money

Before intelligent transportation systems can be effectively deployed, ITS stakeholders should come together to develop a common vision for ITS. This vision statement is a key component of the TCI Strategic Plan because it provides overall direction for the identification of stakeholder needs, operational concepts, potential ITS strategies and technologies, and ultimately the final recommendations. The TCI vision is:

"Build a resilient, sustainable, technologically advanced, multi-modal transportation system that provides practical, safe, accessible and coordinated movement of people and goods throughout DuPage County and the region"

As such, the Transportation Coordination Initiative is intended to provide recommendations for the deployment of ITS technologies and operational strategies in DuPage County that can maximize the capacity of the network. These deployments should:

- Improve traffic system performance and transit services
- Reduce travel times
- Enhance incident management and coordination
- Improve traveler information services throughout the County

1.2 Needs Assessment Results

To help develop TCI recommendations, extensive stakeholder outreach and research into past studies and related efforts was conducted to identify transportation issues in DuPage County.

Stakeholder outreach consisted of a stakeholder workshop and one-on-one stakeholder interviews. The following key agencies were interviewed as part of this process:

- City of Naperville Transportation, Engineering & Development (Ted) Business Group
- Du-Comm
- DuPage County Division of Transportation
- DuPage County Office of Homeland Security and Emergency Management (OHSEM)
- DuPage County Sheriff
- DuPage Mayors and Managers Conference (DMMC)
- Glen Ellyn and Oak Brook Fire Departments (DuPage Fire Chiefs Association)
- IDOT District 1 Bureau of Traffic
- Illinois State Toll Highway Authority
- Naperville Police Department (DuPage Police Chiefs Association)
- Pace/Metra
- Regional Transportation Authority (RTA)
- Village of Lombard
- Village of Oak Brook

Findings from recent studies related to the TCI identified system deficiencies that will be addressed in the TCI recommendations. These include highway-rail intersections (HRI) with high crash rates, high collision potential, and the worst delay; corridors with the highest travel times; intersections with the lowest levels of service; high crash intersections, and transit shortcomings.

Overall, the following needs categories are defined for further consideration:

- Arterial Operational Efficiency
- Communications Infrastructure
- Data Management
- Integration of Systems
- Interagency Data Sharing

- Operational Coordination
- System Monitoring
- Transit Operations
- Traveler Information Sources

1.3 Candidate Strategies and Technologies

With the identified TCI needs as a starting point, 83 candidate operational strategies and transportation technologies, essentially potential ITS solutions, were identified which might be applied to address those needs. Those solutions will relate to the four focus areas of the Transportation Coordination Initiative: arterial operations, traffic incident management, transit management, and traveler information and data management.

For the purposes of this analysis, TCI "strategies" and "technologies" can be defined as:

- **Strategy –** a plan or method for obtaining a specific goal or result. This may or may not be dependant upon a specific technology.
- **Technology –** electronic or digital products and systems considered as a group which can be employed for obtaining a goal or result.

1.4 Prioritization

While each of the potential ITS solutions would help to address the transportation needs of DuPage County, limits on available funding, staff, and other considerations require that they be compared to determine deployment priorities. A series of criteria have been developed to evaluate and prioritize the potential ITS solutions:

1. **How well does the solution address the goals of the Transportation Coordination Initiative?**
2. **To what extent does the solution provide benefit to more than one agency?**
3. **To what degree does the solution leverage existing systems?**
4. **What is the relative level of annualized capital and ongoing operations and maintenance cost?**

By applying the criteria described above to all the identified ITS solutions, a list of potential solutions was developed (Appendix A). In addition, the TCI Steering Committee provided valuable input in identifying those candidate solutions that might provide the most benefit to DuPage County. Overall, the top-rated ITS solutions by focus area are:

<u>Arterial Operations</u>

- Emergency Vehicle Preemption (EVP) Upgrades
- Traffic Signal Timing Optimization
- Regional Traffic Signal Coordination
- System Detection
- Traffic Management Center Functionality
- Traffic Signal Controller Upgrades

- Queue Detection Systems
- Vehicle Probes
- Traffic Signal Control System Improvements
- Traffic Forecast and Demand Management Algorithms
- Closed Circuit Television (CCTV) Surveillance
- Highway Rail Crossing Notification Systems

Traffic Incident Management

- Interagency Incident Responder Work Group
- Common Essential Information Dispatch Agreements
- Multi-agency Training and Exercises
- Promote Quick Clearance Practices
- Shared CCTV Surveillance Imaging
- Media Agreements for Video Sharing
- Integrated Communications Channels

Transit Management

- Transit Trip Planning Coordination
- Transit Signal Priority
- Coordinated Multimodal Transportation Management Center
- Highway Shoulder Riding for Transit
- Transit Queue Jumping
- Active Transit Station Signs

Traveler Information and Data Management

- Compatible, Shared Base Mapping System
- Gateway Integration
- Shared Access to Atmospheric and Pavement Condition Sensors
- Existing Infrastructure Database
- Construction Information Database
- Shared Database/Map for Planned/Unplanned Events
- Alternate Route Plan Database
- Information Flow Mapping
- Corridor Action Teams
- Traffic Information Database
- Participation in 511 Services
- Traffic Accident Record System
- Dynamic Message Signs (DMS)

These are the potential ITS solutions that will be considered for inclusion in the TCI Implementation Plan.

2. INTRODUCTION

The DuPage County Transportation Coordination Initiative (TCI) Strategic Plan consists of the following documentation:

- Concept of Operations technical memorandum (which includes the stakeholder Needs Assessment technical memorandum)
- DuPage County Subregional ITS Architecture document
- ***Integration Strategies and Technologies technical memorandum***
- Implementation Plan

This Integration Strategies and Technologies document builds upon the findings in the Concept of Operations and DuPage County ITS Architecture by evaluating potential solutions to the TCI needs identified in previous steps. The ITS strategies and technologies recommended in this document will provide the basis for more detailed project definition in the TCI Implementation Plan. This document represents the next step in the systems engineering process, depicted below in Figure 1.

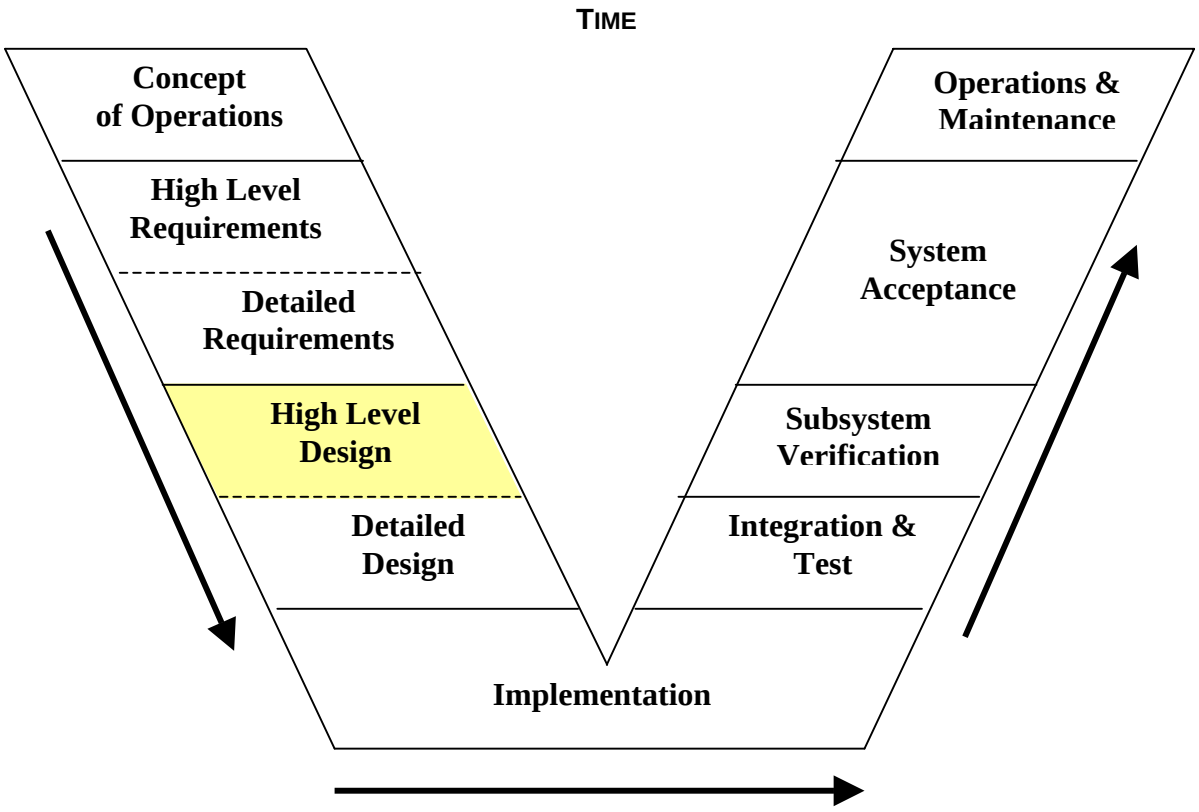

TIME
Concept of Operations
High Level Requirements
Detailed Requirements
High Level Design
Detailed Design
Implementation
Integration & Test
Subsystem Verification
System Acceptance
Operations & Maintenance

Figure 1 – "V" Diagram of Systems Engineering[1]

2.1 The Transportation Coordination Initiative (TCI)

The DuPage County Transportation Coordination Initiative represents the efforts of numerous transportation stakeholders over a number of years to improve the operation and management of the transportation system in the County. The TCI builds upon work that began in the late 1990s with the development of the "Multi-Jurisdictional Signal Coordination and Monitoring Demonstration Project" and corresponding "Guidelines for the Implementation of Multi-Jurisdictional Signal Coordination and Monitoring."[2]

The TCI is led by a Steering Committee that consists of the following organizations/agencies:

- DuPage County Division of Transportation (DCDOT)
- DuPage Mayors and Managers Conference (DMMC)
- DuPage County Office of Homeland Security and Emergency Management (OHSEM)
- Illinois Department of Transportation (IDOT)
- Illinois State Toll Highway Authority (ISTHA)
- Regional Transportation Authority (RTA)
- Chicago Metropolitan Agency for Planning (CMAP)
- City of Naperville
- Village of Lombard
- Village of Oak Brook
- Village of Downers Grov

FIGURE 6
"V" Diagram

These agencies and many others have key roles in the development of the TCI Strategic Plan, including meeting participation, document review, and funding support.

The TCI is directed at four focus areas:

- **Arterial Operations** – improvements to local and regional traffic signal control and coordination, highway-rail intersection operations, and arterial-freeway link coordination
- **Transit Management** – improvements to transit efficiency and coordination with other transportation modes
- **Traffic Incident Management** – improvements to the detection, response, and resolution of planned and unplanned incidents on the transportation system
- **Traveler Information** – improvements to the collection, processing, and dissemination of timely, useful, and accurate traveler information

It is these four focus areas that serve as the basis for operational improvements as part of this document. Each focus area is discussed in greater detail in subsequent sections.

[1] Building Quality Intelligent Transportation Systems Through Systems Engineering, Mitretek, April, 2002.
[2] Parsons Transportation Group, 2001.

2.2 Definition of Intelligent Transportation Systems (ITS)

Intelligent transportation systems can be defined as "the integrated application of sensor, computer, electronics, and communications **technologies and management strategies** to provide traveler information to increase the **safety and efficiency** of the surface transportation system." Or, simply put,

People using technology in transportation to save time, lives, and money

The most visible ITS components are the physical infrastructure that interface with the traveling public. This "intelligent infrastructure" includes the following components[3]:

- Arterial Management Systems
- Freeway Management Systems
- Transit Management Systems
- Incident Management Systems
- Emergency Management Systems
- Electronic Payment Systems
- Traveler Information
- Information Management
- Crash Prevention and Safety
- Roadway Operations and Maintenance
- Road Weather Management
- Commercial Vehicle Operations
- Intermodal Freight

In addition, emerging in-vehicle technologies are creating an "intelligent vehicle" initiative that includes the following components[4]:

- Collision Avoidance Systems
- Collision Notification Systems
- Driver Assistance Systems

In order for these intelligent transportation systems to be most effective, they must work together in an integrated manner. This less visible integration component requires various wireline and wireless communications systems to support the exchange of data between management centers, personnel, vehicles, field devices, and the traveling public.

Before this level of integration can be realized and ITS can be deployed, transportation managers must identify a framework upon which ITS should be built. This framework should:

- Identify ITS goals and objectives – a concept of how ITS will be operated;
- The various stakeholders and systems that are involved;

[3,4] USDOT ITS Joint Program Office website – Technology Overview

- The transportation services that partner agencies perform or plan to perform;
- Individual functional requirements for deployment of ITS;
- Functional links between partner agencies and the data exchanged over those links;
- Applicable standards that apply to the exchange of information; and
- Any applicable or necessary agreements between partner agencies.

Acknowledging the need for this framework before deploying ITS, in 2001 the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) developed a rule/policy that requires regions that plan to deploy ITS to develop a regional ITS architecture in order to receive Federal funding for such projects. As a result, various ITS architectures have been developed across the state and the region to provide a framework for the planning, deployment, and operation of ITS in Illinois.

There are several proven benefits to the implementation of ITS systems. These benefits are typically measured by an increase in system capacity/throughput, cost savings, increased customer satisfaction, reductions in delay/travel time, reduced energy usage/environmental impacts, and improved safety. ITS projects often provide a high return on investment, some with cost-to-benefit ratios of 20:1 or more, partly because they leverage existing infrastructure, instead of creating more infrastructure that must then be maintained.

2.3 TCI Vision

Before intelligent transportation systems can be effectively deployed, ITS stakeholders should come together to develop a common vision for ITS. This vision statement is a key component of the TCI Strategic Plan because it provides overall direction for the identification of stakeholder needs, operational concepts, potential ITS strategies and technologies, and ultimately the final recommendations.

During the project kickoff meeting held on March 23, 2006, key transportation and public safety representatives worked together to develop a vision for ITS in DuPage County. During the visioning exercise, a number of key words and phrases were considered for inclusion in the vision statement. These are:

- Coordination
- Communication
- Cooperation
- Promote true intermodal choices
- Resilient systems
- Efficient
- Safety
- Integrated
- Maintain a broader perspective
- Reliable
- Secured system
- Multi-jurisdictional integration
- Effective
- Dynamic
- Responsive
- Maintainable/sustainable
- User friendly
- Include public awareness
- National Incident Management System (NIMS)-compliant
- Simple/affordable in structure
- State of the art
- Keep it simple
- Building institutional and technological bridges

The resulting vision statement is:

> *"Build a resilient, sustainable, technologically advanced, multi-modal transportation system that provides practical, safe, accessible and coordinated movement of people and goods throughout DuPage County and the region"*

The vision statement is intended to serve as guidance for the planning and deployment of ITS in DuPage County for the next 10 years, and should be continually reevaluated to ensure that it accurately captures the needs and goals of travelers and transportation stakeholders in the region.

2.4 TCI Goals and Objectives

As traffic volumes and congestion grow, it has become evident that the physical infrastructure of the roadway system in DuPage County has a practical limit. As such, the Transportation Coordination Initiative is intended to provide recommendations for the deployment of ITS technologies and operational strategies in DuPage County that can maximize the capacity of the network. These deployments should:

- Improve traffic system performance and transit services – past studies in DuPage County have demonstrated that signal timing optimization and signal coordination can improve travel speeds and reduce delays.
- Reduce travel times – improvements to signal control systems in the last decade have kept average arterial travel times in DuPage County in check; these improvements will need to continue to keep pace with ever increasing traffic volumes.
- Enhance incident management and coordination – incidents account for at least half of non-recurring travel delay in urban areas[5]; improvements in traffic incident management (TIM) coordination between transportation agencies and emergency responders can result in reduced response times and thus reduced driver delay.
- Improve traveler information services throughout the County – through improved data collection, storage, processing, sharing, and dissemination, travelers in DuPage County can make better, more informed decisions.

Above all, recommendations resulting from the TCI should provide discrete objectives and actionable projects that will support these goals.

[5] Traffic Incident Management on Highways, Rutgers University

3. NEEDS ASSESSMENT RESULTS

Before TCI recommendations can be developed, a needs assessment must be conducted to determine deficiencies and problem areas on the DuPage transportation network. This section reviews the results of the stakeholder outreach process and issues raised in the past studies and related efforts mentioned in the DuPage TCI Concept of Operations. These critical stakeholder needs will serve as the basis for the TCI recommendations.

3.1 Identification of Stakeholder Needs

Input from project stakeholders is critical to the success of the TCI. To fully engage the different agencies and organizations that have a stake in the TCI, the Project Team conducted a project kickoff meeting, stakeholder workshop, and a series of one-on-one interviews with key stakeholders. The results of these outreach activities are described in detail in the Concept of Operations. In addition, a Traffic Incident Management (TIM) Work Group has been formed to bring together representatives from the transportation and emergency management areas to tackle problems related to traffic incidents in a coordinated manner. These outreach activities, as well as other tools like a project website and a newsletter, have also provided a chance to keep stakeholders updated on the progress of the TCI project.

Table 1 provides a summary of the results of the first project stakeholder workshop held on April 27th, 2006. Improved arterial operations, increased traveler information, and enhanced traffic incident management were identified as the key transportation needs for DuPage County.

Focus Area	Identified Needs	Total Votes
Arterial Operations	Improve interagency coordination	28
Traveler Information	Better real-time traffic conditions	26
Arterial Operations	Reduce congestion (recurring, incidents)	23
Traffic Incident Management	Coordination between emergency and transportation agencies	18
Arterial Operations	Improve operations support	9
Other	Provide interoperability between agencies	8
Traveler Information	Improve sharing of construction data (locations, durations)	7
Transit	Design for transit	6
Other	Communications infrastructure	5
Other	Increase public awareness	5
Transit	Improve transit access (station lots, park & ride lots)	4
Traveler Information	Improved media coordination	2
Transit	Improve transit performance (on-time arrival, multi-modal transfers)	2

Table 1 – Summary of Needs from DuPage TCI Stakeholder Workshop I

Individual interviews with key stakeholders further highlighted the top issues that transportation and public safety agencies face, including the physical location of particular trouble spots, as well as ways that new strategies and technologies might address these needs. Below is a sample of the issues raised:

- Leverage existing infrastructure to collect more traffic data (City of Naperville)
- Continue to improve interagency communication for incident response (Du-Comm)
- Improve the collection and distribution of traveler information, especially incident information (e.g., work zones, crashes) (DuPage County DOT, RTA, Village of Lombard)
- Increase transportation system monitoring capabilities (DuPage County OHSEM)
- Improve coordination at incident sites (DuPage Police and Fire Chiefs' Associations)
- Continue to coordinate between agencies for transportation project planning (DMMC, Village of Oak Brook)
- Improve planning for incident response (DuPage County Sheriff)
- Improve traffic flow between expressways/tollways and arterials (IDOT, ISTHA)
- Faster data collection at incident sites (DuPage Police Chiefs' Association)
- Enhance multi-modal coordination (Pace/Metra)
- Increase funding and support for transportation improvements (Downers Grove)

During its initial meetings, the DuPage County TIM Work Group has also developed a listing of top traffic incident management issues:

- Interdisciplinary training
- Integrated expressway/arterial incident management
- Radio interoperability
- Vehicle detector and CCTV video data sharing
- Preplanned dynamic detour routing system for critical routes and key transportation system junctions

3.2 Findings from Related Efforts and Past Studies

Numerous studies have been developed in the recent past that highlight critical transportation issues in the county (see the TCI Concept of Operations). These studies focus on four areas: highway rail intersections, travel demand management, crash history, and public transportation management. As described in the TCI Concept of Operations, a number of specific geographic problem areas have been identified and will provide the basis for TCI project recommendations.

3.3 Conclusions

Needs identified by TCI stakeholders through project outreach and investigation of past efforts can be classified into the following nine needs categories:

- **Arterial Operational Efficiency** – provide methods to reduce the traffic congestion and travel time delay at key intersections

- **Communications Infrastructure** – improve communications links between different agencies, both center-to-center and center-to-field
- **Data Management** – develop resources for effective data collection and storage
- **Integration of Systems** – support interoperability and consolidation of management functions between different agencies
- **Interagency Data Sharing** – create methods and protocols for agencies to exchange pertinent, useful data across jurisdictional boundaries
- **Operational Coordination** – improve coordination between various agencies for effective utilization of resources – especially between transportation agencies, emergency services, and construction and maintenance agencies
- **System Monitoring** – enhance the surveillance capabilities of traffic and incident management agencies to reduce incident response times
- **Transit Operations** – improve the viability of transit use through the application of ITS technologies and arterial traffic management strategies
- **Traveler Information Sources** – increase the prevalence, attractiveness, and awareness of traveler information in DuPage County

The Concept of Operations provides further detail about the specific needs identified through project outreach, which will be addressed further in Section 4.

During a meeting of the TCI Steering Committee on October 11th, 2006, the committee reviewed the needs categories in detail and participated in a prioritization exercise to guide the development of potential strategies and technologies to address these issues. The top needs, as identified by the committee, are arterial operations efficiency, transit operations operational coordination, system monitoring, and traveler information sources. These priorities will play a factor in the development of TCI solution evaluation criteria, discussed further in Section 5.

4. CANDIDATE STRATEGIES AND TECHNOLOGIES

With the identified TCI needs as a starting point, the following sections describe candidate operational strategies and transportation technologies (ITS solutions) which might be applied to address those needs. These solutions will relate to the four focus areas of the Transportation Coordination Initiative: arterial operations, traffic incident management, transit management, and traveler information and data management.

For the purposes of this analysis TCI "strategies" and "technologies" can be defined as:

- **Strategy –** a plan or method for obtaining a specific goal or result. This may or may not be dependent upon a specific technology.
- **Technology –** electronic or digital products and systems considered as a group which can be employed for obtaining a goal or result.

4.1 Past, Continuing, and Planned ITS Initiatives

Before proposing new ITS solutions, it is important to review initiatives that may relate to the identified TCI needs. This will highlight current successes that the TCI might build upon, eliminate duplication of efforts, and identify integration opportunities.

4.1.1 REGIONAL INITIATIVES

A number of regional agencies have deployed (or plan to deploy) ITS solutions across the Chicago Region, including in DuPage County. Described in detail in the Northeastern Illinois ITS Deployment Plan Update (2005), summarized in the TCI Concept of Operations, and listed individually in Table 2, many of these projects could have direct bearing on potential ITS projects in DuPage County.

4.1.2 INITIATIVES WITHIN DUPAGE COUNTY

In addition to ITS initiatives led by regional stakeholders, a number of agencies within DuPage County have deployed (or plan to deploy) ITS projects on a local or county-wide scale (see Table 3). Also described in further detail in the TCI Concept of Operations, these initiatives will play a factor in the evaluation of potential ITS solutions in Section 5. These existing projects, and the projects resulting from this study, will address transportation issues associated with the four TCI focus areas: arterial operations, traffic incident management, transit management, and traveler information and data management.

4.2 Arterial Operations

The goal of arterial operations systems is to provide a safe, reliable and efficient transportation network of arterial roads to the travelers. This entails various operational, maintenance and construction strategies and technologies that enable the transportation agencies towards achieving this goal. Only the strategies and technologies that could be deployed by the various departments of transportation involved in the TCI initiative were considered relevant for this project. Candidate ITS solutions for improving arterial operations are listed in the following subsections.

Regional ITS Project (*Agency*)	Related TCI Needs Category								
	Arterial Operational Efficiency	Communications Infrastructure	Data Management	Integration of Systems	Interagency Data Sharing	Operational Coordination	System Monitoring	Transit Operations	Traveler Information Sources
Illinois Tollway									
IPASS	X			X	X		X		X
Highway Emergency Lane Patrol (HELP)						X			
Traffic and Incident Management System (TIMS)	X		X	X	X	X	X		X
Optical fiber network		X		X	X				
Dynamic message signs (DMS)	X			X		X			X
CCTV cameras	X				X	X	X		X
Non-intrusive vehicle detectors	X			X	X		X		X
Road weather information system (RWIS) stations				X	X		X		X
Queue detection systems	X			X	X	X	X		X
Illinois Dept. of Transportation (expressways)									
Emergency Traffic Patrol (ETP)						X			
District One ComCenter				X	X	X	X		X
Traffic Systems Center (TSC)	X		X	X	X	X	X		X
Optical fiber network		X		X	X				
Expresway vehicle detectors	X			X	X		X		X
Ramp meters/ramp gates	X			X	X	X			
Dynamic message signs (DMS)	X			X		X			X
CCTV cameras	X				X	X	X		X
Road weather information system (RWIS) stations				X	X		X		X
Highway advisory radio	X			X		X			X
Gateway Traveler Information System			X	X	X				X
511 Traveler Information			X						X
Pace									
Bus Rapid Transit/Express Bus Routes	X					X		X	
TM&O Improvements (DuPage-Cook Corridor)	X			X	X	X	X	X	X
Transit Vehicle Automated Vehicle Location (AVL)	X					X	X	X	
Intelligent Bus System (IBS)	X		X			X	X	X	X
Automated Passenger Counter (APC) System			X		X		X	X	
Transit Signal Priority (TSP)	X			X		X		X	
BusInfo			X		X			X	X
Transit Management Center	X		X	X	X	X	X	X	X
GPS mobile data terminals	X					X	X	X	
Transit Operations Decision Support System (TODSS)	X					X		X	X
Metra									
Consolidated Control Facility		X		X		X	X	X	
Train Information Management System (TIMS)			X		X			X	X
Visual Paging System					X				X
Regional Rideshare Program						X		X	
Regional Transportation Authority									
Transit Hub			X		X				X
Interactive kiosks									X
Trip Planner									X
Active Transit Station Signs									X
Parking Management Guidance System	X				X				X
Travel Information Center									X
Regional Transportation Asset Management System (RTAMS)			X		X				X

Table 2 – Current Regional ITS Initiatives

DuPage County ITS Project (*Agency*)	Related TCI Needs Category								
	Arterial Operational Efficiency	Communications Infrastructure	Data Management	Integration of Systems	Interagency Data Sharing	Operational Coordination	System Monitoring	Transit Operations	Traveler Information Sources
City of Naperville TED Business Group									
Multi-jurisdictional traffic signal control	X			X		X			
Dynamic message signs (DMS)	X			X		X			X
CCTV cameras	X				X	X	X		X
Arterial vehicle detectors	X			X	X		X		X
Emergency Vehicle Premption System	X			X		X			
Automated Rail Crossing Enforcement System	X						X		
DuPage County Division of Human Services									
Transit Vehicle Automated Vehicle Location (AVL)	X					X	X	X	
GPS mobile data terminals	X				X			X	
DuPage County Division of Transportation									
Multi-jurisdictional traffic signal control	X			X		X			
Emergency Vehicle Premption System	X			X		X			
Pedestrian countdown signals									X
Arterial vehicle detectors	X			X	X		X		X
Dynamic message signs (DMS)	X			X		X			X
CCTV cameras	X				X	X	X		X
Environmental sensors	X				X		X		
DuPage County Web-based Traffic Accident Record System			X		X				
Traffic Signal Inventory			X		X				
DuPage County Office of Emergency Management									
Emergency Operations Center (EOC)				X	X	X	X		X
DuPage Co. Construction Information Database			X		X	X			X
Dynamic message signs (DMS)	X			X		X			X
Highway alert radio	X					X			X
Interoperable Emergency Communication Systems		X		X	X	X			X
Mobile Operation Center				X	X	X	X		
Various Emergency Management Databases (e.g., CILM)			X	X	X	X			
Public Safety Agencies									
Emergency Vehicle Automated Vehicle Location (AVL)	X					X	X		
Computer-aided dispatch					X	X			
Illinois Dept. of Transportation (arterials)									
Interconnected traffic signal systems	X	X		X		X			
Dynamic message signs (DMS)	X			X		X			X
CCTV cameras	X				X	X	X		X
Arterial vehicle detectors	X			X	X		X		X
Municipalities									
Speed Signs (Downers Grove)	X						X		X
Red Light Running Enforcement (Naperville, Aurora)	X						X		
County and Regional Construction Advisories (Lombard)			X		X	X			X
Parking Data Monitoring (Downers Grove)	X		X		X		X		X
EVAC System (Village of Oak Brook)							X		
Infrastructure Database (only Village of Lombard)			X		X				
Municipal Vehicle Automated Vehicle Location (AVL)	X					X	X		
Dynamic Message Signs (DMS)	X			X		X			X
CCTV Cameras	X				X	X	X		X

Table 3 – Current DuPage County ITS Initiatives

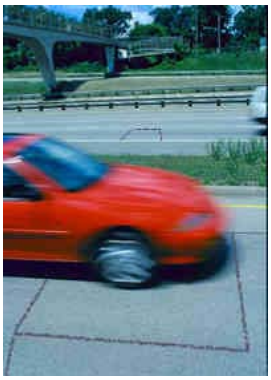
4.2.1 STRATEGIES

- **Maintenance Decision Support Systems (MDSS) –** This provides real-time winter weather information, numerous winter weather treatment options and a road condition prediction model. This system is currently being developed by AASTHO and has been tested by some state DOTs.
- **Traffic Forecast and Demand Management Algorithms –** These include intelligent algorithms and processing capabilities of historical/real-time travel related data for forecasting roadway network performance.
- **Rail Operation Coordination –** Operational coordination between rail authorities and transportation agencies can help in determining the train arrival times at highway rail intersections (HRI), helping to mitigate traffic flow disruptions.
- **Traffic Signal Timing Optimization –** For a variety of reasons (e.g., lack of dedicated staff), many traffic signal systems do not get retimed frequently enough to keep abreast of changing traffic conditions. Establishing a program to revisit signal timing plans once every three years would provide an enhanced level of performance. Specific cases where major changes have occurred would, of course, be eligible for retiming on an ad hoc basis as well.

4.2.2 TECHNOLOGIES

For the purposes of this analysis, technologies for arterial operations can broadly be classified into three categories: 1) traffic surveillance; 2) traffic signal control; and 3) operations.

Traffic Surveillance



- **System Detection** – Installation of vehicular detection, and associated communications infrastructure, to support monitoring of the transportation network. This could involve inductive loops, non-invasive detection, or other methods for measuring traffic flow, speed, vehicle classification, etc. at predetermined locations.
- **Vehicle Probes** – Public or private vehicles that can be identified electronically can be used to measure travel times between various points on the roadway network. Probe vehicles provide real-time traffic information for estimating travel times, detecting incidents, and providing congestion information to travelers. As an example, cell phones or IPASS toll transponders may be used as probes.
- **Closed Circuit Television (CCTV) Surveillance** – CCTV surveillance uses cameras to monitor traffic on freeway and arterial routes. It is mostly used for system monitoring but may also be used for incident detection and response. At present, IDOT and ISTHA have deployed a network of CCTV cameras on their routes. DuPage County is also currently planning on deploying CCTV surveillance at some key intersections within the county.
- **Road Weather Information Systems (RWIS)** – These are effective devices for providing real-time weather conditions to traffic operators and travelers.

- **Pavement Condition Sensors** – Like RWIS, pavement condition sensors can be installed on traffic signal approaches, bridge decks and strong vertical and horizontal curve sites. These sensors can be monitored remotely to detect pavement and subsurface temperatures, the presence of moisture, and icy road conditions. These include hydroplane detection systems, bridge deck sensors and auto-deicing systems.
- **Vehicle-mounted Pavement Sensors -** A number of publicly and privately owned vehicles routinely travel over the same county roads and bridges as part of their daily operation. Infrared sensors can be installed on these vehicles to continually sample pavement temperature while the vehicle is moving. This information can then be associated with the GPS coordinates of the vehicle taken at the same time the temperature readings occurred. Using this strategy, an agency can monitor the condition of their entire roadway and bridge network during the cold months of the year.
- **Speed Monitoring** – This technology monitors the real-time travel conditions and predicts a safe travel speed. This can be used in variable travel speed limit zones.
- **Queue Detection Systems** – Highway networks (arterials and expressways) typically have specific locations that routinely experience congested traffic conditions. Detection equipment can be installed at these sites to record when these situations occur. This information can then be used for a variety of studies: to warn motorists (in real time) who are approaching these areas so they can divert or not be surprised, to provide trucking agencies with probability statistics they can use to calculate the impact of delays on increased operating costs, reduced productivity, and inability to meet just-in-time delivery requirements. DuPage County and the Illinois Tollway have begun to investigate these systems for improved interchange operations.

Traffic Signal Control

- **Traffic Management Center Functionality** – A traffic management center is the focal point for operating and monitoring arterial traffic signal systems. It brings together the components, programs, and strategies that comprise traffic signal control. It links various elements of signal control such as traffic sensors, closed circuit video equipment, etc., enabling decision makers to operate the traffic signal system with real-time data. The IDOT District One Division of Highways and ISTHA have operations control centers for arterial and freeway control systems which provide service in the region. DuPage County DOT, the City of Naperville, and other municipal agencies in the County are currently looking into this technology as a viable option.
- **Emergency Vehicle Preemption (EVP) Upgrade** – EVP is a means of altering the operation of a traffic signal to give preferential treatment to an emergency vehicle. Various technologies can be used to give emergency vehicles priority treatment at traffic signals when they are responding to an emergency call. These can range from strobe devices that cause a signal to be pre-empted when the emergency vehicle approaches to fully integrated systems that cause the pre-emption to occur from a trip plan that is implemented through a central processor. IDOT, DuPage County, and other municipal agencies have EVP installed on their traffic signals. These are generally accessed by fire, EMS, and some police vehicles. This solution area would provide EVP at intersections that do not yet have this functionality, and would include the upgrading of existing EVP deployments in the county to support higher security, transit signal priority, etc.

- **Advance Signal Warning Devices** – Advance warning devices can have various functionalities ranging from detecting vehicles that are approaching a signalized intersection at a rate of speed too high to stop safely, and then extending the green signal to avoid collisions to flashing beacons for warning travelers of imminent signal indication change. The DuPage County DOT is currently looking into this technology for future deployment in the region.
- **Bicycle and Pedestrian Safety Systems** – Pedestrian safety systems can help protect pedestrians and bicyclists by alerting vehicles and pedestrians/cyclists of each other's presence. This can be done by automatically activating in-pavement lighting or flashing beacons to alert drivers as pedestrians enter crosswalks. Highway-rail crossing systems can actively monitor the status of highway rail intersections and warn pedestrian of incoming trains (including second arriving trains) as well as control pedestrian access gates. Other systems include countdown pedestrian traffic signals, and pedestrian detectors that extend the 'Walk' phase for pedestrians needing more time to cross a street. The City of Naperville has deployed these systems at locations within the county.

- **Traffic Signal Controller Upgrades** – Upgrading a traffic signal controller increases the functionality of an intersection, allows coordination with adjacent intersections, and supports advanced control technologies (e.g., "closed loop," adaptive) to better utilize the capacity of the intersection.
- **Traffic Signal Control System Improvements** – Various traffic signal hardware and software modifications can be made to improve system throughput and overall efficiency. In concert with timing optimization efforts described above, these system improvements included centralized signal control, closed loop signal control, and adaptive signal control.
- **Regional Traffic Signal Coordination** – Integration, coordination, and optimization of traffic signal timing plans and ramp meter signal timing plans across jurisdictional boundaries. DuPage County DOT and other municipal DOTs are currently exploring this technology.
- **Lane Use Signals -** Active signals which indicate the current status of each roadway lane. These are mostly used in operation of reversible lanes.

Operations

- **Maintenance Vehicle Automatic Vehicle Location (AVL) System** – AVL can be deployed on maintenance and construction vehicles for tracking maintenance work progress and assisting in dispatch. Having a central collection point for vehicle location data can enable multiple end users to access this information for a variety of purposes. IDOT has deployed this for its maintenance operations in the region.

- **Maintenance Scheduling Systems** – Maintenance scheduling software is used for monitoring manholes, signals, lights etc. for generating and prioritizing work orders. Advanced work zone scheduling systems have the additional functionality of being able to link construction information databases so that work zones on neighboring jobs do not lead to conflicts in local or regional traffic flow.
- **Smart Work Zone Management Systems** – These systems include various applications like dynamic message signs, advanced vehicle intrusion systems, and speed monitoring systems. These can be used for enhancing work zone safety, efficiency and traveler information.
- **Automated Railroad Crossing Enforcement Systems** – These include cameras installed at highway-rail intersections (HRI) to record vehicles that are in violation of the warning signals of an approaching train. At present, the Naperville Police and the Village of Wood Dale have deployed these systems in their jurisdictions.

- **Red Light Running Enforcement Systems** – Red light violation monitoring systems include cameras deployed at intersections to record vehicles violating the red light. At present, IDOT is developing procedures and reviewing the equipment needed for the program's deployment in the City of Naperville and other municipalities that are planning red light running enforcement systems.
- **Highway Rail Crossing Notification System –** This is an advanced highway rail information system for notification of highway rail crossing blockages. All rail crossings in the County can be remotely monitored and automatically posted on a shared website. This enables agency dispatchers to advise emergency responders in order to minimize their travel times during incident calls. This system could also include dynamic signs on approaches to the HRI locations to alert motorists of blockages.

4.3 Traffic Incident Management (TIM)

According to the FHWA, traffic incident management is defined as a planned and coordinated program process to detect, respond to, and remove traffic incidents and restore traffic capacity as safety and quickly as possible. The various strategies and technologies which can be considered for addressing the various TIM needs and issues for the DuPage County TCI initiative are given below.

4.3.1 STRATEGIES

- **Dynamic Detour Computer Model –** Computer models can be developed that enable an agency to quickly design detours when road closures occur (both planned and unplanned). These models have information embedded in each link that is automatically retrieved as the detour is designed. This embedded information can include details about hospitals, school zones, restrictive turn radii at intersections, rail crossings, bridge size and weight restrictions, pavement load restrictions, and any other relevant information that can be used as criteria for selecting a link or restricting a link from being included in a detour route. This information can also be used to quickly generate call lists to notify key individuals about the sudden increase in traffic that will occur in front of their

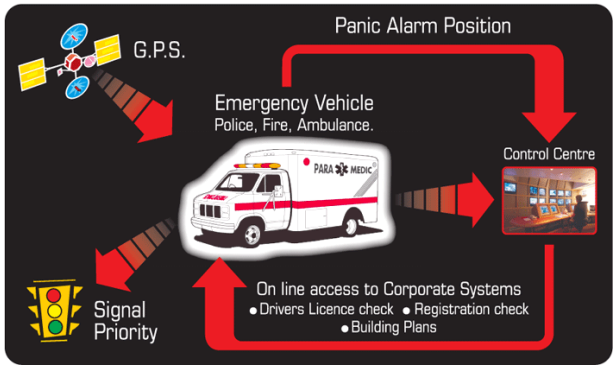
facilities such as school crossing guards, fire stations, or employers who have distribution facilities or large shift change populations.

- **Promote Quick Clearance Practices –** Cars with minor damage left blocking a lane of traffic substantially increase congestion around an incident area. Drivers of these vehicles often do not want to move their vehicles out of harm's way because they think it will alter the police report or their ability to collect insurance. Lake County is already supporting changes in state law to allow local enforcement to move cars with minor damage. Quick Clearance protocols also are in place in DuPage County for certain periods of the day. However, this strategy would develop crash clearance standards that responding agencies would agree to.
- **Common Essential Information Dispatch Agreements –** Emergency response agencies need to agree on what essential dispatch information they need and then provide training to call center workers and dispatchers to insure that accurate and complete information is transmitted for each incident. This can also entail integration of CAD systems across various agencies in order to facilitate information dispatch across them.
- **Shared CCTV Surveillance Imaging –** Several County agencies have or plan to have CCTV surveillance equipment in place. Interagency sharing access to these images (authorized through signed agreements with clearly identified access rights) enables greater utility from these cameras and expands the reach of all agencies that participate in the program.
- **Interagency Incident Responder Work Group –** An informal County-promoted work group for identifying needs and opportunities for improvements that relate to highway incident activities. These work groups can often produce creative, low-cost solutions to recurring problems that impede their work. They can also develop recommendations for improving policies, equipment, and procedural changes.
- **Multi-agency Training and Exercises –** Training for the National Incident Management System (NIMS) and other topics can be conducted. A variety of stakeholders should be included so that interagency coordination can be discussed. This will allow participants to gain an understanding of what other agencies need and how they can work together for a common goal.
- **Media Agreements for Video Sharing –** Transportation agencies can explore partnerships with media sources to share traffic information, especially traffic camera video. For example, transportation agencies could provide television stations with roadway camera feeds (e.g., ISTHA and NBC5) and those stations could provide traffic helicopter video to incident responders.

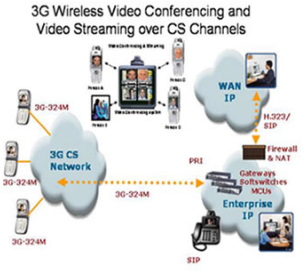
4.3.2 TECHNOLOGIES

- **Small-scale DMS Devices –** Small dynamic message signs can be installed at key points along the highway network. These locations include alternate route decision points, advance notification sites for locations that are routinely congested, advance notification for known fog areas, blind approaches to traffic signals or rail crossings, frequent special event sites, and other locations where timely information needs to be given to motorists.

- **GPS Fire Hydrant Location System –** Portable (e.g., hand held computer) units can be used to quickly locate the nearest fire hydrant by using GPS coordinates and a database of hydrant locations.
- **Computer Aided Dispatch and Emergency Vehicle AVL –** By equipping response vehicles with AVL, dispatchers can track the progress of vehicles and use real-time information to provide en-route guidance to help them reach their destination in the shortest possible time.



- **Improved Crash Scene Data Collection Tools –** There are several systems available that allow law enforcement to virtually reconstruct a crash site based on multiple digital images of the site. Taking photos and doing some of the investigation off-site significantly reduces the time that lanes must be closed.
- **Acoustic Intersection Crash Detectors –** Special acoustic detectors that are designed to sense vehicle crash noises can be installed at high crash rate locations to alert emergency dispatchers quickly when crashes occur. These can be coupled with CCTV to confirm when incidents have occurred.
- **Wireless CCTV-equipped Ambulance Service –** Mobile CCTV systems in ambulances and police vehicles can enable these responders to get remote technical support from experts at hospital emergency rooms, bomb squads, multi-lingual translators, hazmat experts, etc. Currently, the Illinois Tollway has deployed a limited number of wireless CCTV-enabled vehicles and is interested in expanding such systems in future.
- **Mesh Network Communication System –** Mesh networks can be used to establish robust communications between multiple agencies. These networks are dynamically established and quickly "heal" when a node goes down. These networks can be used for a variety of transactions such as bus priority treatment, maintenance vehicle mobile data terminals, remote sensor monitoring, posting messages on traveler information devices, and many other applications.
- **Countywide Wireless Internet Service –** Wireless high speed or broadband service can be effective means for communicating current conditions, accessing common databases, mass emailing urgent messages, and sharing CCTV images from remote surveillance equipment.



- **Integrated Communications Channels –** Use common frequency radio (e.g., EMnet, IREACH) so that responders on the scene can communicate directly with each other.
- **Interagency Video Conferencing System –** Videoconferencing equipment at key operation centers enables multiple agencies to monitor and interact during critical circumstances. This equipment significantly expands the effectiveness of the Incident Command System used by emergency response agencies because it places the users in their base of operations where they can be most effective.

- **Co-located Emergency and Traffic Management Center** – By sharing a common facility, emergency dispatchers and traffic managers can better coordinate operations and information sharing. Having a single facility for both functions could also result in cost savings, both during deployment and for ongoing maintenance.
- **Incident Site Traffic Signal Control Override** – The use of "police panels" and similar devices can allow trained police officers to override traffic signal timing/phasing when the intersection becomes an incident site. Such technologies are accessible without opening the controller cabinet, allowing quick, direct access.

4.4 Transit Management

Transit management entails various operational, maintenance and security related activities for providing a safe and reliable public transportation service for meeting the transportation needs of the region. Only the strategies and technologies that involve local transit services (e.g., paratransit) or those that overlap both public transportation and arterial operations are considered in this study. A few of these strategies and technologies that are pertinent to the study are listed below.

4.4.1 STRATEGIES

- **Highway Shoulder Riding for Transit –** This strategy allows buses to travel on the shoulders of expressways and arterials under certain conditions to bypass congested traffic. This strategy requires that shoulders are wide enough and strong enough to support buses.
- **Transit Queue-Jumping –** This strategy involves utilizing dedicated right of way and signal timing adjustments to provide transit vehicles priority through congested intersections. Detection is usually at/near the stopline and a specially-inserted phase is called to serve the bus while adjacent traffic is held a few seconds at a red.
- **Transit Signal Priority –** This initiative centers on giving special treatment to transit vehicles at signalized intersections. In essence, vehicles and signal controllers are equipped with technology that forces a traffic signal to be held green (or made green earlier than scheduled) so that a bus may pass through an intersection. TSP is the greatest opportunity for ITS coordination with Pace. Some issues include signal system coordination across jurisdictions and current Opticom emergency signal preemption technology.

- **Arterial/Bus Rapid Transit –** A more comprehensive, larger-scale form of transit signal priority, arterial and bus rapid transit (ART/BRT) apply a number of enhancements to improve transit efficiency within a dedicated corridor. These enhancements can include TSP, shoulder riding, and transit queue jumping throughout a corridor (instead of just individual intersections), as well as major infrastructure modifications like separate transit lanes. Under BRT, transit vehicles are generally physically separated from the regular flow of traffic; ART applies the measures described above without dedicated pavement.

4.4.2 TECHNOLOGIES

- **Upgrade Paratransit Scheduling Software –** Transit agencies can upgrade their paratransit scheduling software to increase efficiency through dynamic scheduling and demand responsive service, etc.
- **Coordinated Multimodal Transportation Management Center** – This technology involves combining traffic signal operations with transit dispatching operations under one co-located operations center. Regions across the nation have had great success in sharing resources and infrastructure to achieve better operations through collocation.
- **Active Transit Station Signs –** Install active transit station signs at bus terminals to tell passengers the estimated time of next bus arrival. CTA already uses these at some of their elevated train stations. RTA has deployed these at O'Hare and Midway Airports, but do not have any current plans of deploying this technology in DuPage County.

- **Electronic Fare Collection Systems** – These systems include the use of smart cards or other forms of electronic transaction methods for transit fare payment. This enables faster passenger loading, thereby increasing the efficiency and mobility of the transit systems. These systems can also be used for collecting data on passenger loading patterns, which can be used for transportation planning purposes.
- **Transit Operation Decision Support Systems (TODSS)** – These are systems designed to support dispatchers and others in real-time operations management in response to incidents, special events, and other changing conditions in order to improve operating speeds, reduce passenger wait times, and restore service when disruptions occur.
- **Transit Trip Planning Coordination** – This technology includes systems that provide custom transit trip itineraries and other tailored transit information services. For DuPage County this technology is being pursued by RTA's kiosks as well as the web based transit trip planner. Although there are no current plans for locating any kiosks in DuPage County, the RTA has yet to select all the sites for the next round of kiosk deployments and the county could become a candidate. Furthermore, there is a great opportunity to coordinate with the RTA to provide DuPage tourist/shopping/dinning information through these kiosks as well.

4.5 Traveler Information and Data Management

The goal of traveler information systems is to gather the available information about travel conditions, process it, and provide it to the traveling public in a timely and efficient manner. Data management refers to information storage, fusion, and retrieval systems supporting access to distributed heterogeneous data. The various strategies and technologies for collecting, storing, and disseminating traveler information are listed below. At present, many other initiatives are being undertaken for addressing the traveler information and data management issues at a regional level. For this study, only the strategies and technologies that can be deployed at a sub-regional level are considered. A few of these that should be considered are as follows:

4.5.1 TRAVELER INFORMATION AND DATA MANAGEMENT STRATEGIES

- **Shared Performance Measurement Recording System –** Performance measures are very useful for refining operations, developing justification for procurements, allocating resources, and establishing priorities for expenditures. Examples of these measures include crash statistics, historical sensor output statistics, link travel times, rail crossing closure statistics, vehicle mix statistics and many others.
- **Standardization of Traffic Data Format –** Participating agencies can standardize the traffic data reporting format they use, or at least agree on common information they collect, to allow for future integration into a common database.
- **Corridor Action Teams –** This would supplement sharing of construction information between agencies. A multi-agency team including representatives from a variety of transportation agencies would meet monthly to share information on construction projects including closures and lane changes.
- **Compatible, Shared Base Mapping System –** If agencies within the county use the same base mapping system and then plot their features in different layers, many opportunities for cross linking of data emerge automatically.
- **Shared Access to Atmospheric and Pavement Condition Sensors –** Nearly every agency in the county has need for current and historical weather information. Many agencies collect specific information in various forms. By pooling this information in a shared database/website, all agencies can benefit, and perhaps even lower their operating costs.
- **Information Flow Mapping –** Detailed diagrams can be drawn to show routine transactions that occur between one agency and all the other agencies with whom they interact. These diagrams identify the type of information transmitted, the format (or method) by which the transaction occurs, and the direction of the information flows. Each of these flows can then be translated into detailed work procedures for the agency operators to use as reference and for training purposes.
- **Gateway Integration –** As a regional collection point for traffic data, the Gateway Central Hub provides DuPage County agencies with a tool for accessing information that can enhance their day-to-day operations. Integration with the Gateway Traveler Information System will also allow traffic data collected by agencies in DuPage County to be added to the regional database, and its associated traveler information sources (e.g., GCM Travel website, IDOT's Traffic Alert emails).
- **Shared Database/Map for Planned/Unplanned Events –** Details about planned events that cause lane restrictions such as road work, maintenance operations, utility operations, building construction/demolition, and special events is very useful to many stakeholders. A system can be developed that produces a protocol for reporting these events to a web based database and then automatically posts this information on a website map for easy access. This could involve a certain level of integration with local emergency dispatch centers' CAD systems for near real-time incident reporting.
- **Areas of Influence Diagrams –** If cooperating agencies draft Areas of Influence Diagrams for each traveler information device (DMS, HAR, etc.) that is available to them, both within their own jurisdiction or with their neighboring agencies, they can establish a quick and reliable method for getting messages posted upstream of major incidents.

- **Configuration Management –** In order to efficiently manage a technology project over its entire life cycle, it is important to make sure that different parts of a system remain compatible as parts are replaced and updated. Configuration management provides a process for operations staff to go through to ensure that these changes are made and other involved parties are aware.

4.5.2 TRAVELER INFORMATION TECHNOLOGIES

Traveler information can be broadly classified into either pre-trip or en-route information. Below are examples of each:

Pre-trip Traveler Information

- **Internet** – This includes developing web pages that provide information about the highway and transit services and travel conditions for the region. The information can be both static and real–time, thus providing information before travelers start their trips. The web pages can show information about the current travel conditions, weather conditions, construction information, route planning, transit schedules and video feed from the cameras deployed along the transportation network. This can also be used for providing secure information channels for various organizations for sharing information. At present, this is provided at a regional level in Gary-Chicago-Milwaukee corridor through www.GCMtravel.com website. However, little information is provided for the arterial roads in DuPage County.
- **Participation in 511 Services** – Services like 511 Telephone Advisory and Automated Trip Planning Service are already in use in many parts of the country. These provide current travel information for trip planning purposes. In the near future, 511 Traveler Information Service will be provided by IDOT at a regional and statewide level. In addition, the RTA Travel Information Center (TIC) currently collects static route, schedule and fare information from the three RTA Service Boards, and uses it to provide information over the phone to travelers in the RTA six-county region.
- **Interactive Traveler Information Kiosks** – These can allow travelers to access information about real-time traffic and incident data, vehicle route planning, transit schedules, weather information, special event information and other yellow page services. These are generally deployed in areas of high traveler volumes e.g. transit rest stops etc. RTA is at present looking at various other centers for their deployment. However, they do not have any plans of deploying them in DuPage County.
- **Media** – Various media sources like TV, cable, print etc. can be used to broadcast both static and real-time information to the public. These can also be used to increase the public awareness of various traveler information sources available in the region. e.g., College of DuPage radio station and other local TV and radio channels can be used for broadcasting location specific travel and incident information.

En-Route Information Systems

- **Dynamic Message Signs (DMS) –** Electronic signs that can be programmed to provide traveler information on a variety of topics such as incidents, construction and lane

closures, special events and congestion. At present, IDOT, DuPage County DOT and a few municipalities like City of Naperville have deployed portable DMS on the arterial street network for providing traveler, incident and construction information to the drivers. IDOT is also deploying permanent arterial DMS in the region.

- **Highway Advisory Radio (HAR) –** These are used to broadcast information about traffic and travel conditions, detour information, weather reports, etc. using a short-range radio frequency. At present, IDOT has deployed HAR on its expressway road network within the region. Lake County, in cooperation with ISTHA, uses HAR for arterial travel information.
- **Electronic Blank-Out Signs** – Electronic blank-out signs are used to provide special purpose information to motorists and are designed to not be visible to motorists unless activated. A typical application is part-time turn restrictions at intersections.
- **Trailblazer Signs –** these are used on diversion routes to guide drivers to the closest entrance to the freeway along the alternative routes.
- **Changeable Speed Advisory Signs –** These have been used in some countries for slowing traffic under adverse conditions. They can be linked to the weather information systems which determine the travel conditions to automatically display the safe traveling speeds.

- **Flashing Beacon Signs –** These consist of either a static message board or a blank out message and flashing beacons that can be remotely activated. These can include the animal warning systems which detect animal movement and provide an advisory to the travelers ahead of the danger zone.
- **Parking Management Guidance System** – Expansion of the current system installations at the Mokena and Tinley Park Metra facilities that monitor parking lot occupancy and transmit the information to roadside display signs as well as to the Illinois Transit Hub. These systems could also be deployed by municipalities in DuPage County to give highway travelers the chance to divert to transit.

4.5.3 DATA MANAGEMENT TECHNOLOGIES

Once transportation data (e.g., traffic volumes, construction schedules, incident information, transit arrival times) has been collected, it must be stored and formatted for use in the traveler information sources listed above. The following are potential data management technologies for DuPage County:

- **Traffic Information Database** – A centralized data source that allows different agencies to be aware of conditions and actions outside of its jurisdiction and allows for better coordination in overlapping agencies (traffic video feed, HRI status, rail operations status etc.) The Illinois Gateway serves as the regional traveler information collection and

distribution hub for NE Illinois and the Illinois Transit Hub is the transit information service provider for RTA in the region. A DuPage County Hub would serve as a Subregional traffic data collection point.

- **Alternate Route Plan Database** – Database that would aid in coordination between regional and statewide agencies by providing access to alternate route, incident management, or emergency response plans through a secure Internet website. This solution needs to be dynamic and should allow multiple users to enter/view the data simultaneously.
- **Traffic Data Archive** – A centralized data source that allows an agency to access archived traffic data (e.g., tube counts, intersection turn movement counts, traffic signal timing plans, traffic video feed). CMAP and its partner agencies are currently developing this concept.
- **Existing Infrastructure Database –** A database that would provide geographic information on existing infrastructure. Typically this information would not be stored on a per-corridor basis but rather by individual agencies. Some existing municipal GIS databases include centerline files with locations of fire hydrants, sanitary lines, jurisdictional boundaries, parcels, street signs, trees, street lights, water lines, traffic signals, and other various points of interest. DuPage County has an existing traffic signal inventory. CMAP has a comprehensive GIS traffic signal database for the six-county region. The Regional Transportation Asset Management System (RTAMS) provides planning and financial information on the transportation system in Northeastern Illinois. RTAMS allows users to access transit and Tollway asset data through an interactive map.
- **Construction Information Database** – A centralized data source for construction information would assist motorists plan their trips accordingly and keep neighboring agencies aware of changes in traffic flow, increased traffic along alternate routes, and lane restrictions in nearby jurisdictions. A map-based graphical user interface (GUI) would be an efficient way for providing updated information to the public and sharing this information between various agencies.
- **Atmospheric and Pavement Condition Historical Database –** Weather impacts travel for emergency response vehicles. It is also a major cause of incidents. Tracking both atmospheric and pavement weather data (both real time and historical) has many uses for operations, planning and research activities.
- **Traffic Accident Record System** – This is an initiative to bring traffic accident data from constituent municipalities, the DuPage Sheriff's Office and the County Division of Transportation into one central traffic accident database.

5. PRIORITIZATION

While each of the 83 potential ITS solutions presented above would help to address the transportation needs of DuPage County, limits on available funding, staff, and other considerations require that they be compared to determine deployment priorities. This section will present a series of criteria that have been developed to evaluate and prioritize the potential ITS solutions. The resulting high priority ITS solutions will then be further developed in the TCI Implementation Plan.

5.1 Candidate Strategy/Technology Prioritization Criteria

The following is the list of criteria that will be used for ITS solution prioritization. The overall goal of these criteria is to determine the potential ITS solutions that will bring about the greatest benefit(s) with the limited resources that transportation agencies have available.

1. **How well does the solution address the goals of the Transportation Coordination Initiative?** The TCI is intended to improve traffic system performance and transit services, reduce travel times, enhance incident management and coordination, and improve traveler information services throughout the county. Through stakeholder outreach, the key identified transportation needs concern arterial operations efficiency, transit operational efficiency, operational coordination, system monitoring, and traveler information sources, as shown below in Table 4.

Needs Categories	Votes
Arterial Operational Efficiency	12
Communications Infrastructure	1
Data Management	0
Integration of Systems	0
Interagency Data Sharing	0
Operational Coordination	5
System Monitoring	5
Transit Operations	6
Traveler Information Sources	5

Table 4 – Summary of Prioritized Needs as Determined by the TCI Steering Committee (Oct. 11, 2006 Meeting)

2. **To what extent does the solution provide benefit to more than one agency?** Any solution that can address the need(s) of more than one agency should be given precedence.
3. **To what degree does the solution leverage existing systems?** There already have been substantial ITS investments in DuPage County and Northeastern Illinois. Potential ITS solutions should be examined to see if they would take advantage of these existing operating systems and enhance their utility.
4. **What is the relative level of annualized capital and ongoing operations and maintenance cost?** With the limited level of funds available for TCI deployments, potential

ITS solutions that are more cost-effective should be given a priority. This should be inclusive of the base capital cost, implementation cost, maintenance, and operations costs.

5.2 Criteria Application

By applying the criteria described above to all the ITS solutions listed in Section 4, a prioritized list of potential solutions can be developed. Using scores ranging from 0 (does not meet the criteria) to 4 (meets the criteria to a high degree) for each of the four prioritization criteria, each of the potential solutions was rated by the Project Team. These ratings were then totaled, with Tables 5-8 showing the top-rated (top 35%) ITS solutions for each focus area. A complete listing of scores for each potential solution can be found in Appendix A.

At a meeting of the TCI Steering Committee (January 12, 2007), each of the candidate ITS solutions were presented and described to the committee. They were discussed, debated, and, in some cases, modified to better match the needs of the county. Committee members were then invited to identify the top 20 candidate solutions from their perspective. Votes were tabulated, and the top-rated solutions (top 15%) are reflected in the tables below (shaded items). Most of the top-rated committee solutions were identified in the prioritization process described above, while others (Co-located Emergency and Traffic Management Center, Active Transit Station Signs, Participation in 511 Services, Traffic Accident Reporting System, and Dynamic Message Signs) were added to the tables.

These tables identify those potential ITS solutions that will be considered for inclusion in the TCI Implementation Plan.

Arterial Operations
Emergency Vehicle Preemption (EVP) Upgrades
Traffic Signal Timing Optimization
Regional Traffic Signal Coordination
System Detection
Traffic Management Center Functionality
Traffic Signal Controller Upgrades
Queue Detection Systems
Vehicle Probes
Traffic Signal Control System Improvements
Traffic Forecast and Demand Management Algorithms
Closed Circuit Television (CCTV) Surveillance
Highway Rail Crossing Notification Systems

Table 5 – Prioritized Arterial Operations ITS Solutions

Traffic Incident Management
Interagency Incident Responder Work Group
Common Essential Information Dispatch Agreements
Multi-agency Training and Exercises
Promote Quick Clearance Practices
Shared CCTV Surveillance Imaging
Media Agreements for Video Sharing
Integrated Communications Channels
Co-located Emergency and Traffic Management Center

Table 6 – Prioritized Traffic Incident Management ITS Solutions

Transit Management
Transit Trip Planning Coordination
Transit Signal Priority
Coordinated Multimodal Transportation Management Center
Highway Shoulder Riding for Transit
Transit Queue Jumping
Active Transit Station Signs

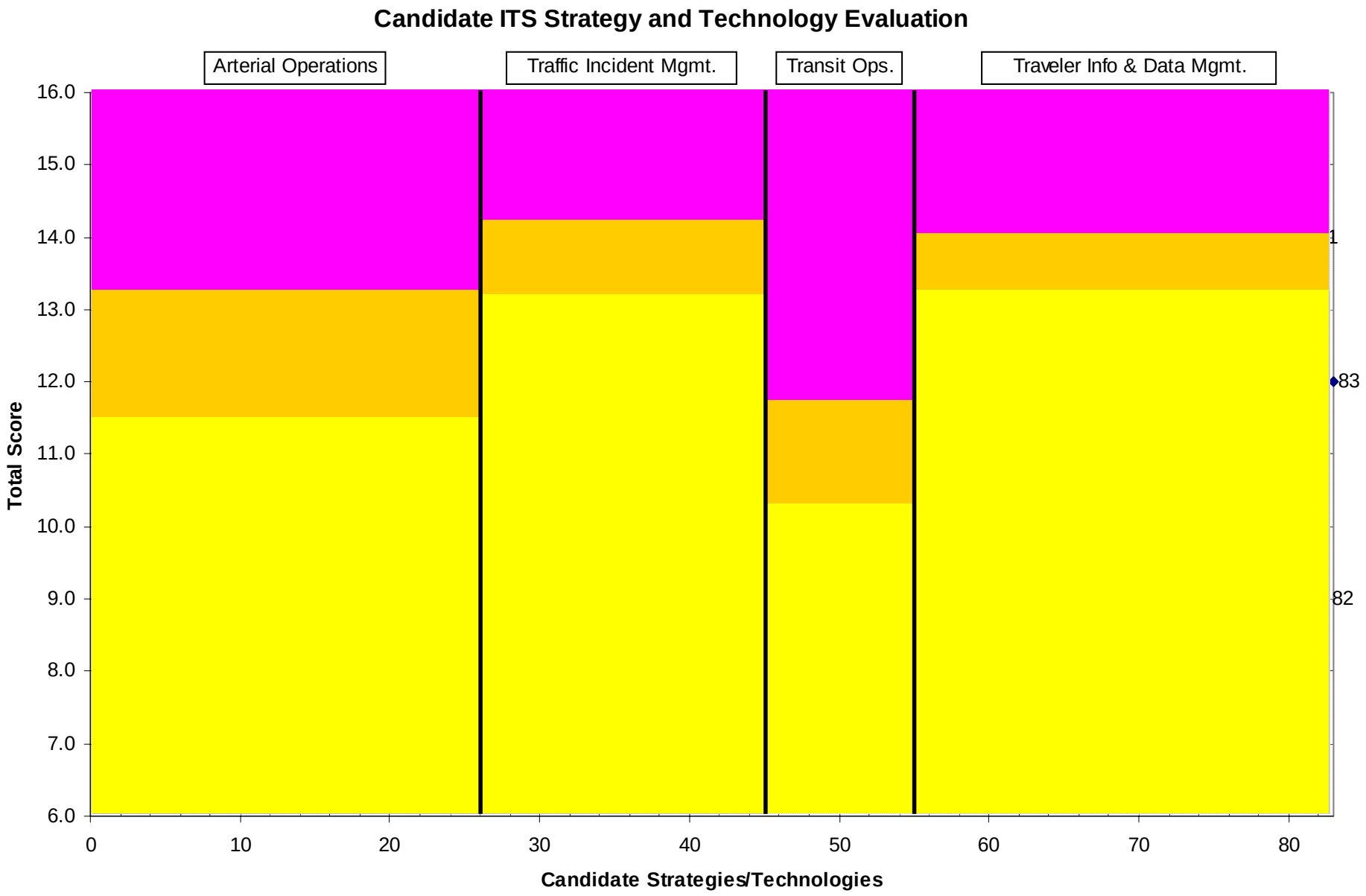
Table 7 – Prioritized Transit Management ITS Solutions

Traveler Information & Data Management
Compatible, Shared Base Mapping System
Gateway Integration
Shared Access to Atmospheric and Pavement Condition Sensors
Existing Infrastructure Database
Construction Information Database
Shared Database/Map for Planned/Unplanned Events
Alternate Route Plan Database
Information Flow Mapping
Corridor Action Teams
Traffic Information Database
Participation in 511 Services
Traffic Accident Record System
Dynamic Message Signs (DMS)

Table 8 – Prioritized Traveler Information & Data Management ITS Solutions

APPENDIX A

No.	Candidate ITS Solutions (Strategies & Technologies)			TCI Goals	Benefit to Multiple Stakeholders	Leverage Existing Systems	Low Annualized Captial and Ongoing O & M Costs	Totals
1	Arterial Operations	Strat.	Maintenance Decision Support Systems (MDSS)	3	3	2	2	10
2			Traffic Forecast and Demand Management Algorithms	3	4	2	3	12
3			Rail Operation Coordination	3	3	2	3	11
4			Traffic Signal Timing Optimization	4	4	4	3	14
5		Technologies	System Detection	4	4	3	3	13
6			Vehicle Probes	4	3	3	3	12
7			Closed Circuit Television (CCTV) Surveillance	4	3	2	3	12
8			Road Weather Information Systems (RWIS)	3	3	2	3	11
9			Pavement Condition Sensors	3	3	2	3	11
10			Vehicle-mounted Pavement Sensors	2	2	1	2	8
11			Speed Monitoring	4	3	2	2	11
12			Queue Detection Systems	4	3	2	3	12
13			Traffic Management Center Functionality	4	4	4	2	13
14			Emergency Vehicle Preemption (EVP) Upgrades	4	3	4	4	14
15			Advance Signal Warning Devices	2	2	2	3	9
16			Bicycle and Pedestrian Warning Systems	2	2	2	3	9
17			Traffic Signal Controller Upgrades	4	4	3	3	13
18			Traffic Signal Control System Improvements	3	3	3	2	12
19			Regional Traffic Signal Coordination	4	4	3	3	14
20			Lane Use Signals	2	2	2	3	9
21			Maintenance Vehicle AVL System	2	1	2	3	8
22			Maintenance Scheduling Systems	3	1	2	3	8
23			Smart Work Zone Management Systems	3	2	1	3	8
24			Automated Railroad Crossing Enforcement Systems	3	2	2	2	9
25			Red Light Running Enforcement Systems	4	2	3	2	11
26			Highway Rail Crossing Notification Systems	3	3	3	3	12
27	Traffic Incident Management	Strategies	Dynamic Detour Computer Model	4	4	1	2	11
28			Promote Quick Clearance Practices	4	4	2	4	14
29			Common Essential Information Dispatch Agreements	4	4	3	4	14
30			Shared CCTV Surveillance Imaging	4	4	2	3	14
31			Interagency Incident Responder Work Group	4	4	3	4	15
32			Multi-agency Training and Exercises	4	4	3	4	14
33			Media Agreements for Video Sharing	4	4	2	4	13
34		Technologies	Small-scale DMS Devices	3	3	2	3	10
35			GPS Fire Hydrant Location System	2	2	2	3	9
36			Computer Aided Dispatch and Emergency Vehicle AVL	3	3	2	2	10
37			Improved Crash Scene Data Collection Tools	3	3	2	2	10
38			Acoustic Intersection Crash Detectors	3	2	2	2	9
39			Wireless CCTV-equipped Ambulance Service	2	1	2	2	6
40			Mesh Network Communication System	2	3	2	2	9
41			Countywide Wireless Internet Service	2	3	2	2	9
42			Integrated Communications Channels	4	4	3	3	13
43			Interagency Video Conferencing System	2	4	2	3	11
44			Co-located Emergency and Traffic Management Center	4	4	3	2	13
45			Incident Site Traffic Control Override	3	2	3	4	12
46	Transit Operations	Strat.	Highway Shoulder Riding for Transit	3	2	3	3	10
47			Transit Queue Jumping	3	2	3	3	10
48			Transit Signal Priority	4	2	3	3	12
49			Arterial/Bus Rapid Transit	3	2	2	1	8
50		Technologies	Upgrade Paratransit Sheduling Software	2	2	2	3	8
51			Coordinated Multimodal Transportation Management Center	3	4	3	2	12
52			Active Transit Station Signs	3	2	2	3	10
53			Electronic Fare Collection Systems	3	2	2	2	9
54			Transit Operation Decision Support Systems (TODSS)	3	3	2	2	10
55			Transit Trip Planning Coordination	4	3	3	2	12
56	Traveler Information & Data Management	Strategies	Shared Performance Measurement Recording System	3	4	2	3	13
57			Standardization of Traffic Data Formats	3	4	3	4	13
58			Corridor Action Teams	3	4	3	4	14
59			Compatible, Shared Base Mapping System	4	4	3	4	15
60			Shared Access to Atmospheric and Pavement Condition Sensors	4	4	3	3	14
61			Information Flow Mapping	3	4	2	4	14
62			Gateway Integration	4	4	4	4	15
63			Shared Database/Map for Planned/Unplanned Events	4	4	3	3	14
64			Areas of Influence Diagrams	3	4	3	4	13
65			Configuration Management	3	3	3	4	12
66		Technologies	Internet	3	4	3	3	13
67			Participation in 511 Services	3	4	3	3	12
68			Interactive Traveler Information Kiosks	3	3	3	2	11
69			Media	3	2	3	4	12
70			Dynamic Message Signs (DMS)	4	3	3	2	11
71			Highway Advisory Radio (HAR)	3	3	2	2	10
72			Electronic Blank-Out Signs	3	3	2	3	11
73			Trailblazer Signs	4	3	2	3	12
74			Changeable Speed Advisory Signs	3	2	2	3	9
75			Flashing Beacon Warning Signs	3	2	3	3	11
76			Parking Management Guidance Systems	3	2	2	3	10
77			Traffic Information Database	4	4	3	3	14
78			Alternate Route Plan Database	4	4	3	3	14
79			Traffic Data Archive	4	4	3	3	13
80			Existing Infrastructure Database	4	4	3	3	14
81			Construction Information Database	4	4	3	3	14
82			Atmospheric and Pavement Condition Historical Database	2	3	2	3	9
83			Traffic Accident Record System	4	3	3	3	12


Candidate ITS Strategy and Technology Evaluation
Arterial Operations
Traffic Incident Mgmt.
Transit Ops.
Traveler Info & Data Mgmt.
Total Score
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
0
10
20
30
40
50
60
70
80
Candidate Strategies/Technologies
1
83
82