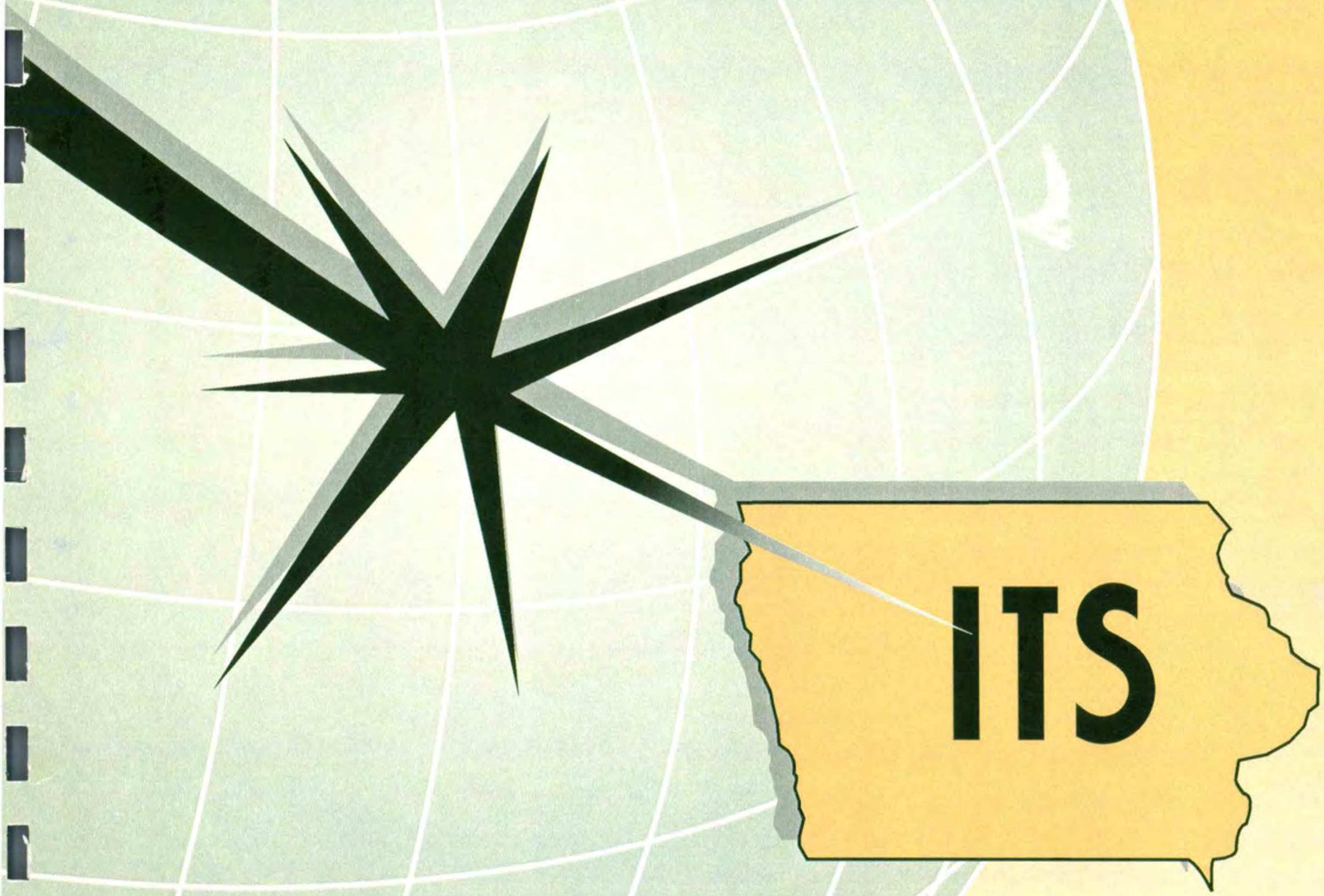
Draft Report

Iowa DOT Integrated ITS and Services Deployment Plan



April 2000

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Iowa Department of Transportation
Integrated ITS and Services Deployment Plan

Executive Summary of Final Report Recommendations

This final project newsletter serves as an executive summary of the Iowa DOT's Integrated Intelligent Transportation Systems and Services Deployment Plan.

This strategic plan will guide the implementation of ITS in Iowa. it provides a vision and a set of goals and objectives to be achieved by implementing ITS technologies. Using a defined methology, transportation problems are identified and addressed with appropriate ITS technologies. This process results in a phased set of ITS projects to be implemented throughout Iowa.

The plan also contains a proposed ITS organizational structure to support the implementation of these projects.

What is "ITS"?

Intelligent transportation systems describes a wide range of techniques that improve the safety, efficiency, and convenience of transportation systems. This is accomplished through the use of advanced technologies; including computing, communications, and information management.

Specific examples of ITS include:

- **electronic roadway sensors,** surveillance cameras, changeable electronic message signs to manage traffic and identify incidents that can snarl traffic and cause secondary accidents.
- **electronic vehicle tracking** to allow public transit and other vehicle fleet managers to monitor, dispatch and coordinate their fleets efficiently.
- **computer systems that synthesize traffic, weather, transit, and tourism information** from a wide variety of sources and provide travelers with information through the Internet, radio, television and other com munication media,
- increased **automation of commercial vehicle adminis tration** to improve compliance with regulations and to save time and money for operators and administrators.

What are the Benefits of "ITS"?

Application of ITS technologies is on the increase around the world. In many areas where ITS have been implemented, significant benefits have been observed. The US DOT has estimated that cumulative benefits of ITS will exceed costs by a ratio of 8:1.

Some documented benefits resulting from ITS are:

Freeway travel times	↓ 48%	Traffic signal stops	↓ 35%
Freeway crashes	↓ 50%	Traffic signal delays	↓ 37%
Urban freeway fatalities	↓ 10%	Bus operating costs	↓ 18%
City street travel times	↓ 15%	Bus on-time performance	↑ 23%

Why ITS in Iowa ?

There are a number of compelling reasons for Iowa to pursue the ITS projects recommended in this Strategic Plan:

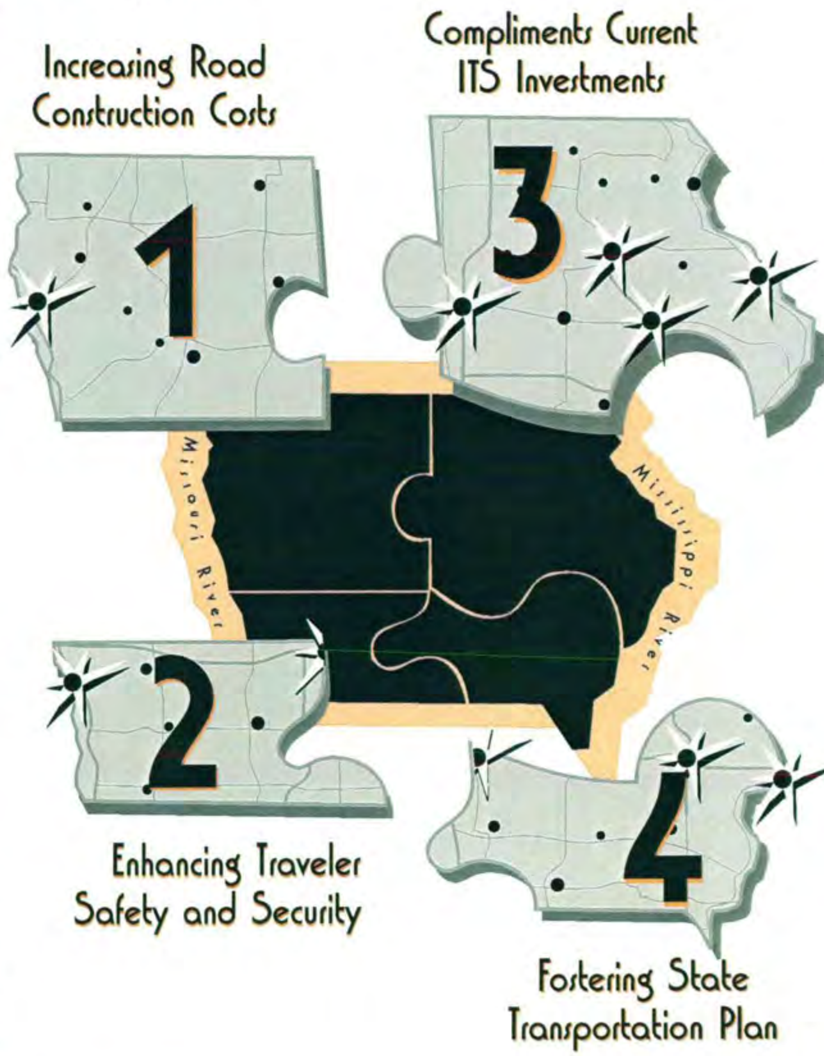
1. Can't build our way out of increasing road construction costs.

Due to the high cost of right-of-way and environmental concerns, it is no longer feasible to solve transportation problems strictly by building more roads and widening existing ones. Technology has made new approaches possible and cost-effective.

The ITS techniques recommended in this plan have proven to be cost-effective in other locations, and can enhance the performance of "traditional" transportation investments. A combined approach featuring traditional investments coupled with ITS techniques will yield the greatest cost-effectiveness.

3. Enhances current ITS investment.

ITS-related investments have been, are being, and will continue to be made by the Iowa Department ofTransportation and local and regional public transportation agencies, with or without this plan. However, without the guidance outlined in this strategic plan, ITS investments will not be as responsive to Iowa's transportation challenges as they could be and they will not achieve their full potential.



2. Addresses identified problems of safety and security.

Many of the recommended ITS techniques address the specific needs, problems and objectives that have been identified by travelers and transportation agency staff in the development of this plan. Some of the critical needs that will be addressed include roadway safety, the need for information on road and weather conditions, and improved coordination of transit services, especially in rural areas.

4. Considers State Transportation Plan

Iowa's adopted State Transportation Plan, *Iowa In Motion*, specifically outlines investments in the development of ITS. Through an extensive public input process, Iowans clearly stated that they wanted ITS related transportation investments.

Summary of Recommendations

DOT Organizational Structure

The ITS program will be led through the combined efforts of a Statewide ITS Coordinator and an ITS Deployment Committee. The committee will be composed of representatives of each Iowa DOT division and representatives from other key organizations such as the Federal Highway Administration. the primary responsibility of the coordinator and the Committee will be to program state funds dedicated to ITS and promote coordination of all ITS activities. technical support on issues will be provided by several working groups.

ITS Programming Process

Limited funding for ITS projects requires them to be prioritized. The Iowa DOT, local and regional governments, will have the opportunity to request funding for projects on an annual basis with priority given to those projects recommended for deployment in this plan. projects that include ITS elements but are not requesting dedicated ITS funds will be funded through more conventional mechanisms.

Each project sponsor application must include:

- A project description
- Identification of problems to be solved
- Identification of participant roles/responsibilities
- An estimate of project costs and requested funding amount
- An operations and maintenance plan
- An approach to evaluating the project
- A commitment to local matching funds or staff

Projects

The ITS Plan identifies a phased integrated strategy for implementing ITS in Iowa over the next ten years. Proposed projects are listed on the next two pages. Projects listed for year one are already funded and underway. Those for years 1-5 are also shown along with the estimated costs for a year 1-5 total of 51 million. Project costs for years 6-10 will be developed in future plan updates.

Six Program Areas – Proposed projects are organized into six program areas corresponding to those identified by the US DOT guide to the implementation of ITS. They are:

Program Area 1: ITS Planning, Marketing, and Administration

This program area provides a basis for future ITS deployment in Iowa. This group of projects specifically supports the preparation of a statewide communications plan and detailed ITS plans for larger metropolitan areas. It also supports the development of statewide backbone systems that will support a wide range of specific ITS projects, such as integrated information databases and wide area communications systems. Finally, this program area will implement statewide marketing and education activities that will educate and build support for ITS among a wide range of Iowa transportation stakeholders, including the general public, decision makers and local transportation operations personnel.

Program Area 2: Travel and Traffic Management

This program area supports a wide range of projects that focus on reducing traffic delay and crashes. Projects include: metropolitan area traffic management systems that will quickly identify crashes and coordinate quick clean-up, special traffic plans and procedures for major traffic incidents and special events, advanced technologies to reduce delay and improve safety in work zones, and improved coordination of traffic signals, especially those in adjacent cities.

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Summary of Recommendations

Potential Strategies/Projects	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6-10	Total Cost (Years 1-5)
	Deployment Schedule						
1 ITS Planning, Marketing & Administration							
ITS Program & Data Administration							
❖ Iowa DOT Statewide Communications Plan (Statewide)	■						$300,000
❖ National Model Expansion (Statewide)	■						$600,000
❖ Statewide Integrated Database (Statewide)	■	■	■	■	■		$585,000
❖ Speed Processing of Crash Data (Statewide)	■	■	■	■	■		$2,000,000
ITS Plans & Studies							
❖ Quad Cities Area ITS Plan		■					$275,000
❖ Cedar Rapids Area ITS Plan			■				$275,000
❖ Sioux City Area ITS Plan			■				$275,000
❖ Waterloo/Cedar Falls Area ITS Plan			■				$275,000
ITS Marketing & Education							
❖ Statewide ITS Marketing & Education Program (Statewide)	■	■	■	■	■		$875,000
2 Travel & Traffic Management							
Metropolitan Area Traffic Management							
❖ Des Moines Area Traffic Management System		■	■	■	■		$13,455,000
❖ Council Bluffs Traffic Management System Enhancements		■	■	■	■		$2,050,000
❖ Quad Cities Area Traffic Management System						■	N/A
❖ Cedar Rapids Area Traffic Management System						■	N/A
❖ Sioux City Area Traffic Management System						■	N/A
❖ Waterloo/Cedar Falls Traffic Management						■	N/A
Metropolitan Area Incident/Event Management							
❖ Des Moines Area Incident/Event Management System		■					$90,000
❖ Council Bluffs Incident/Event Management System Enhancements		■					$50,000
❖ Quad Cities Area Incident/Event Management System						■	N/A
❖ Cedar Rapids Area Incident/Event Management System						■	N/A
❖ Sioux City Area Incident/EventManagement System						■	N/A
❖ Waterloo/Cedar Falls Incident/Event Management						■	N/A
Smart Work Zones/Portable Traffic Management Systems							
❖ Smart Work Zones/Portable TMS Pool (Statewide)		■	■	■	■		$965,000
Roadway Weather Safety/Incident Prevention							
❖ Incident Warning System (Quad Cities Pilot Project)	■	■	■	■	■		$600,000
❖ Expanded Incident Warning Systems (Statewide)		■	■	■	■		$1,235,000
❖ Automated Bridge De-icing System (Cedar Rapids Pilot)	■	■	■	■	■		$600,000
❖ Expanded Bridge De-icing Systems (Statewide)		■	■	■	■		$600,000
❖ Concept Vehicle Expansion (Statewide)			■	■	■		$450,000
Regional Traffic Signal Coordination							
❖ Expanded Des Moines Area Signal Coordination		■	■	■	■		$4,000,000
❖ Council Bluffs Regional Signal Coordination		■	■	■	■		$1,200,000
❖ Quad Cities Area Regional Signal Coordination		■	■	■	■		$2,000,000
❖ Cedar Rapids Area Regional Signal Coordination		■	■	■	■		$2,875,000
❖ Sioux City Area Regional Signal Coordination		■	■	■	■		$2,875,000
❖ Waterloo/Cedar Falls Area Regional Signal Coordination		■	■	■	■		$2,875,000
Automated Enforcement							
❖ Red Light Running Program Dubuque Pilot Project	■	■	■	■	■		$100,000
❖ Expanded Red Light Running Program (Statewide)		■	■	■	■		$635,000
Highway-Rail Operations & Safety							
❖ Highway-Railroad Safety & Delay Study (Statewide)						■	N/A
Crash Investigation Systems							
❖ Total Stations Project Expansion (Statewide)						■	N/A
3 Traveler Information							
Metropolitan Area Changeable message signs							
❖ Statewide/Metropolitan Portable CMS Pool		■	■	■	■		$1,000,000
Interactive Internet Information							
❖ ITS Weather Information on Iowa DOT Web Site (Statewide)	■	■	■	■	■		$1,034,000
❖ Expanded Internet Traveler Information (Statewide)			■	■	■		$150,000

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Program Area 3: Traveler Information

This program area focuses on providing travelers with more timely, accurate and comprehensive information on traffic and weather conditions, transit services and tourist attractions.

Example projects include roadside electronic message signs, improved coordination with commercial radio and television traffic reporters, and acceleration and enhancement of current activities to develop an integrated statewide data management/dissemination system for traveler information.

Program Area 4: Commercial Vehicle Operations

This program area supports a wide range of current Iowa DOT Motor Vehicle Division activities that focus on improving the efficiency of commercial vehicle administrative processes and improving vehicle operator compliance with regulations. Example projects include expansion of weigh-in-motion systems, which reduce delays at weigh stations and a traveler information system aimed at truck drivers.

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Summary of Recommendations

Potential Strategies/Projects	Deployment Schedule: Year 1	Year 2	Year 3	Year 4	Year 5	Year 6-10	Total Cost (Years 1-5)
Automated Telephone Traveler Information							
❖ Updated Telephone Traveler Information System (Statewide)			■	■	■		$150,000
Television & Radio Traveler Information							
❖ Broadcast Traveler Information Expansion (Statewide)			■	■	■		$150,000
Metropolitan Area Highway Advisory Radio							
❖ Statewide Metropolitan HAR						■	N/A
Rural Highway/Freeway Changeable Message Signs							
❖ Expanded Rural Highway/Freeway CMS Pool (Statewide)						■	N/A
In-Vehicle Signing/Route Guidance							
❖ In-vehicle Signage/Guidance Study (Statewide)						■	N/A
Rural Highway/Freeway HAR Pool							
❖ Rural Highway/Freeway HAR System (Statewide)						■	N/A
Traveler Information at Rest Areas							
❖ Expanded Traveler Information at Rest Areas (Statewide)			■	■	■		$150,000
4 Commercial Vehicle Operations							
Electronic Clearance/Weigh-In-Motion/LicensePlate Readers							
❖ Expanded CVO Electronic Clearance/WIM (Statewide)						■	N/A
CVO Traveler Information							
❖ Updated Commercial Vehicle Information System (Statewide)						■	N/A
5 Public Transportation Management							
Urban Area Transit AVL/Tracking							
❖ Waterloo/Cedar Falls Area Transit AVL System	■	■	■	■	■		$1,800,000
❖ Cedar Rapids Area Transit AVL System Enhancements						■	N/A
❖ Council Bluffs Transit AVL System						■	N/A
❖ Quad Cities Area Transit AVL System						■	N/A
❖ Sioux City Area Transit AVL System Expansion						■	N/A
Urban Area Transit Traffic Signal Priority							
❖ Des Moines Area Transit Signal Priority System	■	■	■	■	■		$375,000
❖ Cedar Rapids Area Transit Signal Priority System						■	N/A
❖ Council Bluffs Transit Signal Priority System						■	N/A
❖ Sioux City Area Transit Signal Priority System						■	N/A
Regional Rural/Demand Response							
❖ Statewide Regional Rural Transit Study/Model		■					$200,000
❖ Rural Transit ITS Deployment-Phase I		■	■	■	■		$3,600,000
❖ Rural Transit ITS Deployment-Phase II						■	N/A
6 EmergencyManagement							
Consolidated Urban Area EMS Communications							
❖ Quad Cities Area EMS Communications System		■	■	■	■		$125,000
❖ Des Moines Area EMS Communications System						■	N/A
❖ Omaha/Council Bluffs Area EMS Communications System						■	N/A
❖ Cedar Rapids Area EMS Communications System						■	N/A
❖ Sioux City Area EMS Communications System						■	N/A
❖ Waterloo/Cedar Falls Area EMS Communications System Expansion						■	N/A
Metropolitan EMS Pre-empting/Routing/Response							
❖ Des Moines Area EMS Traffic Signal Pre-emption						■	N/A
❖ Council Bluffs Area EMS Traffic Signal Pre-emption						■	N/A
❖ Quad Cities Area EMS Traffic Signal Pre-emption Enhancements						■	N/A
❖ Cedar Rapids Area EMS Traffic Signal Pre-emption						■	N/A
❖ Sioux City Area EMS Traffic Signal Pre-emption						■	N/A
❖ Waterloo/Cedar Falls Area EMS Traffic Signal Pre-emption						■	N/A
Rural EMS/Mayday Response							
❖ Rural EMS/Mayday Communications Plan (Statewide)						■	N/A
Total Program Cost (Years 1-5)							$50,848,750

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Program Area 5: Public Transportation Management

This program area focuses on improving the efficiency and convenience of public transit services. Example projects include traffic signals that provide extra green time to buses that are running behind schedule as well as vehicle tracking, scheduling and communications systems that allow urban and rural transit operators to provide more service, including improved connections between different rural transit systems and between rural and urban transit systems.

Program Area 6: Emergency Management

This program area focuses on reducing response time to traffic crashes and other incidents and enhancing the effectiveness of response strategies. Example projects include communications systems that allow different response agencies, such as police and fire departments from different cities, to communicate easily with one another, and traffic signals that can be preempted for emergency vehicles, providing red indications to all movements except for the one used by the emergency vehicle.

For more information on the Integrated ITS and Services Deployment Plan contact:

Office of Systems Planning
Iowa Department of Transportation
800 Lincoln Way
Ames, IA 50010
Phone: 515-239-1027
Fax: 515-233-7857
E-mail: cmarkle@max.state.ia.us

1.0

Introduction

1.1 Purpose of this Document

This report is the Iowa Department of Transportation's Statewide Integrated Intelligent Transportation Systems and Services Deployment Plan. Intelligent Transportation Systems (ITS) focus on improving the safety, efficiency and convenience of the transportation system through the application of a wide variety of information, computing and communications technologies. The Integrated ITS and Services Deployment Plan is a strategic plan for implementation of ITS throughout the state of Iowa. The plan identifies the transportation problems to be addressed; the overall vision, goals, and objectives to be achieved through ITS implementation; a phased set of specific ITS projects; and an ITS organizational structure and programming process to be followed by the Iowa Department of Transportation (Iowa DOT).

1.2 Overview of Intelligent Transportation Systems

The Need for New Solutions: Intelligent Transportation Systems

In the past, the Iowa DOT has generally addressed transportation problems by creating more infrastructure and services – building new roads, widening existing ones, adding more buses and routes. Unfortunately, these solutions can't adequately address many of the needs of travelers – for example, the need for accurate and timely information on roadway and weather conditions, especially in isolated rural highway corridors. Also, the traditional approaches to solving transportation problems are expensive and often have adverse environmental or other impacts. Intelligent transportation systems provide the Iowa DOT with tools to address problems that cannot be solved using "traditional" solutions, and a way to improve the effectiveness and stretch the financial investment associated with traditional DOT techniques, including road building and maintenance and transit service.

During development of the State Transportation Plan, Iowans stated their strong desire for what can be achieved through the implementation of ITS technologies – more real-time information, cleaner air, increased economic development, an improved quality of life, lower costs of goods, and safe transportation facilities/services. Through implementation around the country and the world, ITS techniques have reduced the number of traffic crashes, reduced delay and travel times, and provided travelers with more options and information.

A Focus on Management Through Real-Time Information

"Managing" transportation systems denotes a hands-on, oversight responsibility that has traditionally been absent in public surface transportation systems. In the case of roads and traffic signals, the basic model has been "plan it, design it, build it, and fix it when it wears out." The concept of "operating" a roadway simply did not apply – aside from toll roads, what was there to operate? You pave it and people drive on it. Although transit operations obviously entail more day-to-day "operations" than has traditionally been the case with roads, transit management tools and techniques have remained relatively antiquated and "hands-off" compared to what can be accomplished with today's technology. Aside from periodic voice radio communications, it has traditionally been a case of sending out the buses and hoping they make their stops as planned.

Intelligent transportation systems are all about improving the ***management*** of transportation systems through the application of technology. In some cases it's relatively new or "high-tech" technologies; but in many cases it involves the application of tried-and-true computing, communications and information technologies that have been widely deployed elsewhere, but that have not traditionally been used in the operation of public transportation systems.

Intelligent transportation systems focus on ***information*** – providing transportation agencies the information they need to operate their systems in an efficient, responsive manner based on what is actually happening ***now***, and providing travelers with the information they need to make smarter choices, like avoiding congested areas or using transit.

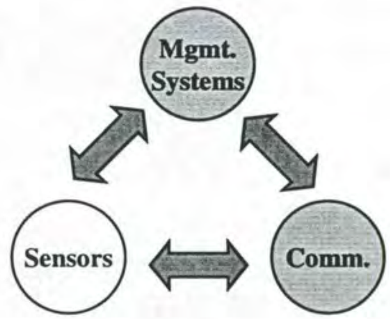
Given such a broad conceptual definition, there are obviously many possible examples of ITS applications. One example of the way in which ITS uses information to allow transportation operators to manage transportation systems is "freeway/incident management" systems. Using vehicle detectors, closed-circuit television cameras, changeable electronic roadside message signs and radio traffic information broadcasts, allows freeway operators to monitor conditions in real-time, quickly identify congestion and crashes, and take quick and appropriate actions to manage those situations. These actions may include alerting travelers of conditions, coordinating detours, or coordinating emergency management and/or law enforcement response. In the case of transit, sensors on-board the buses, coupled with sophisticated computer programs and advanced communications between the bus and the dispatch center, can allow buses to be operated in a flexible manner, detouring off-route to pick up extra passengers without compromising their fixed schedules. These types of transit systems can serve lower density areas more efficiently than conventional fixed-route service.

Management Systems and Integration

Transportation management systems are the basic component of any ITS program or effort. The integration of management systems is quite frequently the end goal of an ITS program or effort. Management systems and the integration of systems can be thought of as:

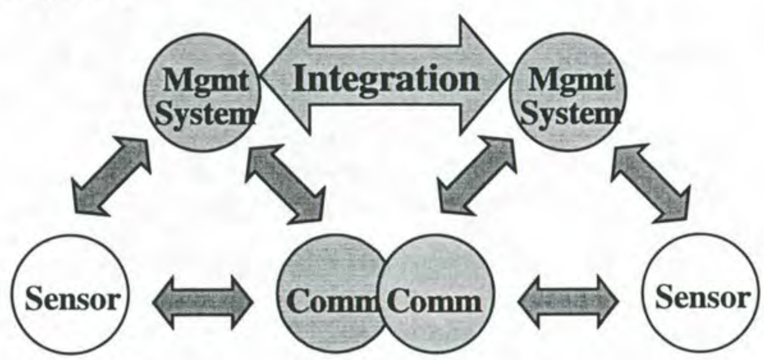
- *Management Systems* – are a functional combination of software, computers, communications and sensors that serve a particular function. For example, a traffic signal control system is comprised of loops in the road, signal lights (sensors), communications lines connecting the sensors, the controller cabinet, a control center, and the computers and software that provide operational control of the signal. Figure 1-1 displays the three components of a system.

Figure 1-1: Components of a Management System



- *Integration* – is the tying together of two or more separate computerized management systems. By tying systems together, data, information, and even control can be exchanged or shared between systems. Figure 1-2 represents the integration of two systems. Integration can occur at many different levels. For example, a business may choose to integrate its payroll and invoicing systems to speed the billing process. Continuing the traffic signal control example, two separate signal systems can be integrated to allow the sharing of signal status and timing plans.

Figure 1-2: Integration of Management Systems



1.3 Why is an ITS Plan Needed?

The Iowa DOT has already successfully begun to implement a wide range of ITS applications. However, this statewide ITS deployment is needed in order to increase the effectiveness of the Iowa DOT's ITS investments, through the following:

1. Linking Solutions to Real Reported Problems – As part of the process to develop the statewide ITS plan, regional transportation agency staff, as well as representatives of law enforcement and emergency services, identified specific problems and how they can be addressed through ITS deployment. Linking the Iowa DOT's ITS investments with real problems ensures that the program will be responsive, maximizes the potential for the public to realize benefits, and provides justification for funding.

2. Promoting Information Sharing and Interconnections – Having an overall strategy, a multi-faceted integrated plan for ITS throughout the state, helps bring parties together and focus efforts that may otherwise not be as coordinated as they could be. This can lead to unnecessary duplication of effort and individual system components that may not connect to one another.

3. Promoting Federal Funding Potential – In many cases, the ability to demonstrate how a specific investment will advance broader objectives and contribute to the effectiveness of other investments enhances the competitiveness for federal ITS funding.

4. Promoting Awareness and Support among the Public, Decision-makers, and Technical Staff – Much of ITS is still new to the public, decision-makers and others who influence resources, and the technical staff that must design, build, operate and maintain these systems. As a result, the benefits and justification for ITS investments are not fully appreciated and investments are not well-supported. The process to develop the statewide ITS plan, and the resulting plan itself, help build awareness and subsequent support for ITS. Also, the plan includes projects that will specifically focus on education and support building.

5. Ensuring Contribution to Overall Vision and Realization of Goals and Objectives – The statewide ITS plan identifies the "big picture" for ITS investment and using the plan to direct resources will help ensure that individual, unrelated ITS projects contribute to that big picture.

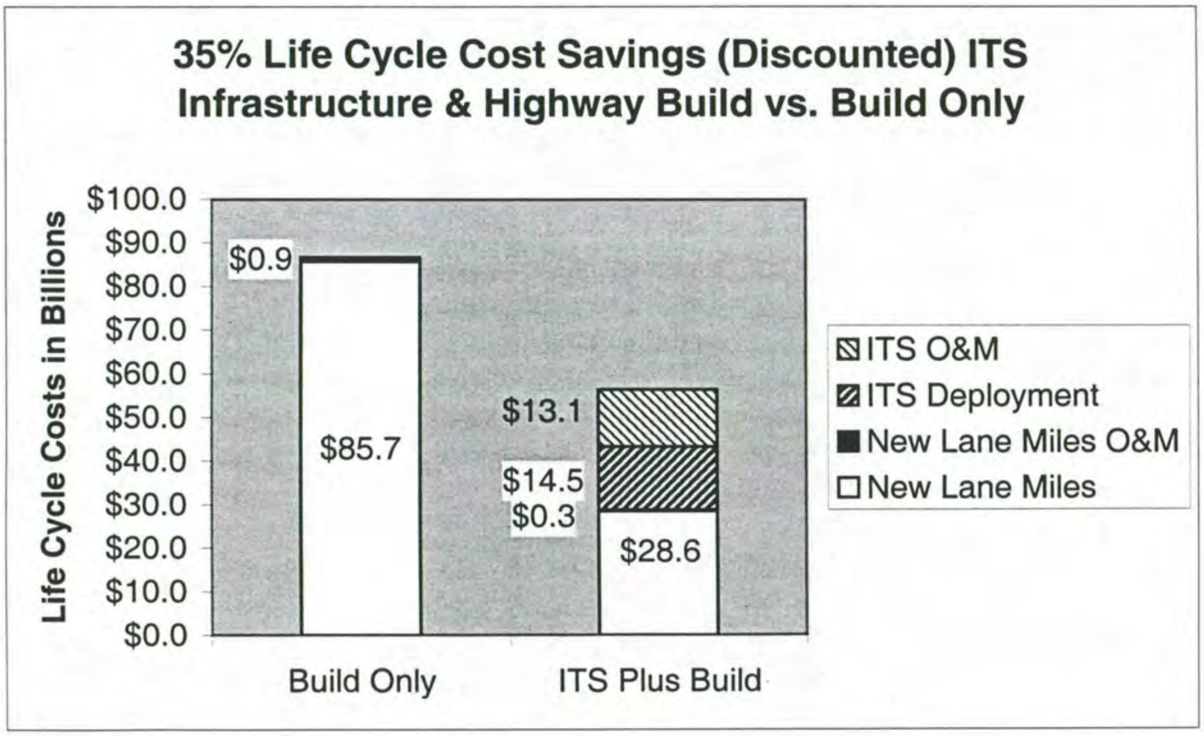
6. Providing a Tool for Prioritizing and Programming ITS Investments – As familiarity with and demand for ITS projects increases, the statewide ITS plan can be used to help evaluate and select from among competing project funding requests.

1.4 The Benefits of an ITS Program

Travel demand in the United States is expected to increase by roughly 30 percent over the next 10 years while, at current growth rates, the expected additional lane miles are projected to accommodate only two thirds of the growth. Federal, state and local government agencies will strive to meet future demand for capacity in the most efficient manner possible. A recent article in the Institute of Transportation Engineers (ITE) Journal[1] compared the projected cost of meeting the 10-year demand for capacity in urban areas throughout the United States using two alternative methods: 1) adding capacity through highway construction only, and, 2) adding capacity through both additional lane-miles and deployment of ITS. The authors concluded that the approach that incorporated ITS deployment substantially reduces the need for new roads and would save taxpayers 35 percent or approximately $30 billion dollars.

The savings are illustrated in the following graph.

Figure 1-3: Long Term Benefits of ITS



[1] Peters, Joseph, Michael McGurrin, Dwight Shank and Melvyn Cheslow. "An Estimate of Transportation Cost Savings from Using Intelligent Transportation System (ITS) Infrastructure." ITE Journal, November 1997.

For a transportation agency implementing an integrated ITS system, dollars saved in infrastructure improvements is one of the most important benefits. At the same time, an integrated intelligent transportation system can be expected to almost immediately improve the level of service provided to the traveling public in the following ways:

- Reduction in delay and congestion
- Reduction in incident and response times
- Reduction in travel times
- Improved air quality
- Reduction in fuel consumption
- Reduction in the number of crashes
- Improved capacity

2.0

Past and Current ITS Activities

The Iowa DOT has been involved in a number of ITS activities over the last several years, including participation in professional organizations and their activities, participation in ITS site visits, and through the planning and implementation of specific ITS projects. These activities, along with a description of how existing activities have been considered in the development of the statewide ITS plan, are summarized below.

2.1 Past and Continuing Iowa DOT ITS Initiatives

Professional Organizations and Associated Activities

Throughout the Iowa DOT, various individuals have participated in the Intelligent Transportation Society of America (ITS America) activities, including attendance of annual conferences and participation on committees. ITS America is a national organization whose mission is to foster public/private partnerships to increase the safety and efficiency of surface transportation through the application of advanced technologies. ITS America was mandated by Congress in 1991 to coordinate the development and deployment of intelligent transportation systems in the United States. Recently, Iowa joined with several other Midwestern states to create "Heartland ITS," the equivalent of a state chapter of ITS America. Through Heartland ITS, the Iowa DOT will continue to pursue a prominent role in ITS organizations.

ITS Site Visits

In conjunction with specific ITS projects over the years, the Iowa DOT and local transportation staff have made several visits to sites to view operational ITS projects. One of the more major visits involved the state transportation commission and included a two-day visit to Minneapolis, sponsored in part under the FHWA "ITS Scanning Tour" program.

ITS Projects

Over the past few years, the Iowa DOT has been involved in a wide range of ITS projects, cutting across modes and functional areas. This involvement includes two major technology development and demonstration efforts funded in part through federal grants. These efforts are the Foretell project and a partnership in the development of a traveler information system prototype in Branson, Missouri.

Table 2-1, on the following foldout pages, summarizes many current Iowa DOT ITS initiatives being pursued.

Table 2-1: Current ITS Initiatives in Iowa

Project Title	Status
Travelers' Safety and Security	
1. Traveler Web Site	In Operation
2. Traveler Weather Information at Rest Areas	In Operation
3. Automatic Weather Observation System (AW	In Operation
4. Weather Information for Surface Transportat ip with Test	Under Development
5. Combining Geographic Information Systems Location Analysis System (ALAS)	Under Development
6. Traveler Telephone Hotline	In Operation
7. Advanced Technology Maintenance Vehicle	Testing Phase
Emergency Services/Incident Management	
1. Officer Information Manager (OIM)	On-going
Commercial Vehicle Services	
1. Automated Oversize/Overweight Permit Appl	In Operation
2. Weigh-in-Motion (WIM) Interstate Ramp Sca	In Operation
3. Automated Mileage and Stateline Crossing O	Operational Test Complete
4. Bar Coding International Registration Plan (I	In Operation
5. Automated Title Application and Issuance	Operation with limited carriers
6. Automated Fuel Tax Reporting	Under Development
7. Driver License Bar Coding/Magnetic Stripe	On-going
8. Inspection Selection Systems & P.C. Miler	In Operation
9. Performance and Registration Information Sy (PRISM)	On-going
10. Mobile Digital Radios	Installing
11. Pen-Based Computers	In Operation
12. License Plate Readers tions)	On-going
13. Bar Code Readers rds	In Operation
14. Bridge Embargo Information on Internet	In Operation
15. WIM (Mainline) Interstate Scales	In Operation
16. Electronic Screening	Under Review
17. Direct Connection to SAFER	Under Review
18. Electronic Submission of IRP Renewals/Suppl	Under Development
Tourism and Traveler Information Services	
1. Permanent Highway Advisory Radio (HAR)	In Operation

Public Traveler/Public Mobility Services			
1.	Des Moines Bus Schedules/Routes		In Operation
2.	Des Moines Vanpool/Carpool		In Operation
3.	Global Positioning System (GPS) Transit Veh		In Operation
4.	Other Transit Agency Schedules		In Operation
5.	CAMBUS On-line Route Information		In Operation
6.	Cedar Rapids CAD/AVL		In Operation
7.	Cedar Rapids Automated Run-cutting		In Operation
8.	Cedar Rapids On-board Surveillance		Under Development
9.	Des Moines CAD/AVL		In Operation
10.	Iowa City Interactive Route Information Kios		In Operation
11.	Iowa City On-line Route Information		In Operation
12.	Sioux City CAD/AVL		Under Development
13.	Waterloo CAD		In Operation
14.	Ames On-line Route Information		In Operation
15.	Ottumwa/Region 15 CAD/AVL		Under Development
16.	Region 8 CAD/AVL		Under Development
17.	Region 10/Johnson County CAD/AVL		Under Development
Infrastructure Operations and Maintenance			
1.	Metropolitan Area Changeable Message Signs		In Operation
2.	Rural Area Changeable Message Signs		In Operation
3.	Portable, Automatic, Changeable Message Sig for Road Construction Projects		Pilot Project Complete
4.	Daily Road Construction Updates for Ames to		Pilot Complete
5.	Rural Interstate Safety and Traveler Informatic		
6.	Traffic Management Strategies for Merge Area		
7.	Des Moines Traffic Signal System Coordinatic		Under Design
8.	ITS Standards Dev./Nat. Transp. Communic. I'		On-Going
9.	Telemetric Automatic Traffic Recorder Systen		In Operation
10.	Automated Turning Movement Data Collectio		In Operation
11.	Automated Road Inventory Data Collection Pr		Under Development
12.	Automatic Classification and Weigh-in-Motio	RP locations	In Operation

MVD = Motor Vehicle Division
CTRE = Center for Transportation Research and E
DSM Metro = Des Moines Metropolitan Transit
SHRP = Strategic Highway Research Program
IDED = Iowa Department of Economic Developme

2.2 Relationship to Recommended Projects

Past and current Iowa experience with ITS was considered at several steps throughout the process to develop the statewide ITS plan. The resultant recommended projects reflect, and in many cases are closely tied to, these past and current activities. Past and current initiatives were considered throughout the process, but were especially important during four specific activities, as described below.

Problems Identification

As described in Section 3.0, the development of the statewide ITS plan began with identification of problems to be addressed through ITS deployment. This process featured a survey of transportation staff throughout the state, interviews with Iowa DOT staff, and a review of documentation, including the Des Moines and Omaha/Council Bluffs ITS early deployment plans. As part of this process, existing ITS and related activities were inventoried, and the potential relationship between existing and possible future projects was discussed. This input later was utilized during the identification of projects.

Project Identification

The process to identify potential future ITS projects began with the generation of a "master list" intended to include, to the extent possible, all potential project types and activities. This list was then cross-referenced to the list of existing ITS activities; and a determination was made as to whether existing activities are sufficient to advance objectives and address identified problems, or whether expansion of those existing activities or creation of additional activities was warranted. As noted above, input from transportation stakeholders and Iowa DOT personnel regarding their existing and potential future ITS activities, as well as ITS plans, were also utilized in these determinations.

In many cases, as described in Section 6.0, recommended projects constitute expansion or enhancement of existing activities. For example, several traveler information projects provide funding to support expansion of the Foretell weather information project and funding for continuation and expansion of the Concept Maintenance Vehicle and Officer Information Management System projects has been recommended. Also, several recommended future ITS projects support and enhance integration and coordination activities that are already taking place with the context of current ITS activities. For example, the Rural/Regional Transit Feasibility Study/Implementation Model will incorporate lessons learned from the current pilot implementation in Ottumwa, an ongoing project that has already provided valuable lessons learned and spurred interest within the transit community.

In addition to supporting existing ITS activities, many of the recommended future projects support the implementation of projects identified in the Des Moines and Omaha/Council Bluffs early deployment plans, but which have not yet been initiated.

Project Evaluation and Prioritization

Existing ITS activities were explicitly considered in two ways during the evaluation and prioritization of potential ITS projects. First, as described in Section 6.1, the criteria "extension of proven Iowa winner" was used, along with many other factors, to rank competing ITS strategies. The intention was to provide advantage to those projects that have already been proven successful in Iowa, or that build upon resources – including existing investments and development of staff expertise – that have already been acquired. Second, existing projects were taken into account after the initial project prioritization had been made, through a series of meetings with stakeholders throughout the state.

Like the first set of meetings that provided input relative to the need for certain ITS projects, the second set of meetings provided stakeholders an opportunity to influence the relative priority and timing of recommended projects. Existing ITS activities, and the preparedness of Iowans to proceed, were key factors considered in these discussions and determinations.

System Architecture Development

System architecture is an essential component of a comprehensive ITS plan. A system architecture illustrates the systems, subsystems, data flows and end users that make up an integrated ITS. The objective of a system architecture is to provide a blueprint, to show how individual projects fit together.

The effort to develop a statewide system architecture—a high-level blueprint or "map" of ITS activities in Iowa—began with the development of an existing architecture, based on the inventory that was conducted. Later, as development of the full system architecture continued, existing ITS projects and elements were carried forward and placed in their appropriate position in relation to the recommended future ITS architecture elements. Many of the linkages identified in the architecture will be considered, on a functional level, in the Iowa DOT Statewide Communications Plan, a project funded in Year 1 of the ITS program.

3.0

Problem Identification and Prioritization

This section describes the process followed to identify and synthesize transportation problems throughout Iowa and to preliminarily consider ITS strategies that can help address those needs. The process to identify, evaluate and select recommended specific ITS projects is discussed elsewhere, in section 6.0.

The problems identification and prioritization process included four major components: three separate major stakeholder involvement/needs assessment activities and one major workshop with the project steering committee to review and prioritize the results of the needs assessment and to identify and prioritize strategies. The ranked list of specific transportation problems that was produced through this process provided the basis for finalizing the DOT's ITS vision statement, goals and objectives (see Section 4.0), and provided the overall direction for the subsequent identification, evaluation and recommendation of specific ITS projects. The problem identification and prioritization process is summarized graphically in Figure 3-1.

Each of the four major components of the problem identification and prioritization process is described in the sections that follow.

3.1 Statewide ITS Stakeholder Survey

A survey was mailed to approximately 800 individuals across Iowa, representing city, county, regional, state and federal transportation agencies and users of the transportation system, including law enforcement and emergency management, commercial vehicle operators, and private transportation consultants. The purpose of the survey was two-fold: to inform stakeholders about the development of the statewide ITS plan; and to solicit their input on transportation problems and potential solutions. One hundred and sixty-five (165) of the approximately 800 surveys were returned, a response rate of slightly over 20 percent. A copy of the survey is included in Appendix F.

The survey included four sections, two focusing on transportation problems and two focusing on solutions. The problems-oriented part of the survey asked respondents to rank a list of problems on a scale of 1-5, with 1 being "not a problem" and 5 being "very significant problem," and asked them to write in what they felt were the top five transportation problems. The solutions-oriented part of the survey asked respondents to rank the priority of a list of "ITS User Services," a high-level categorization of potential ITS strategies, on a scale of 1-5, with 1 being "very low priority" and 5 being "very high priority," and to write in up to five of their top ITS projects/ideas. The results in each of these areas are discussed in the sections that follow.

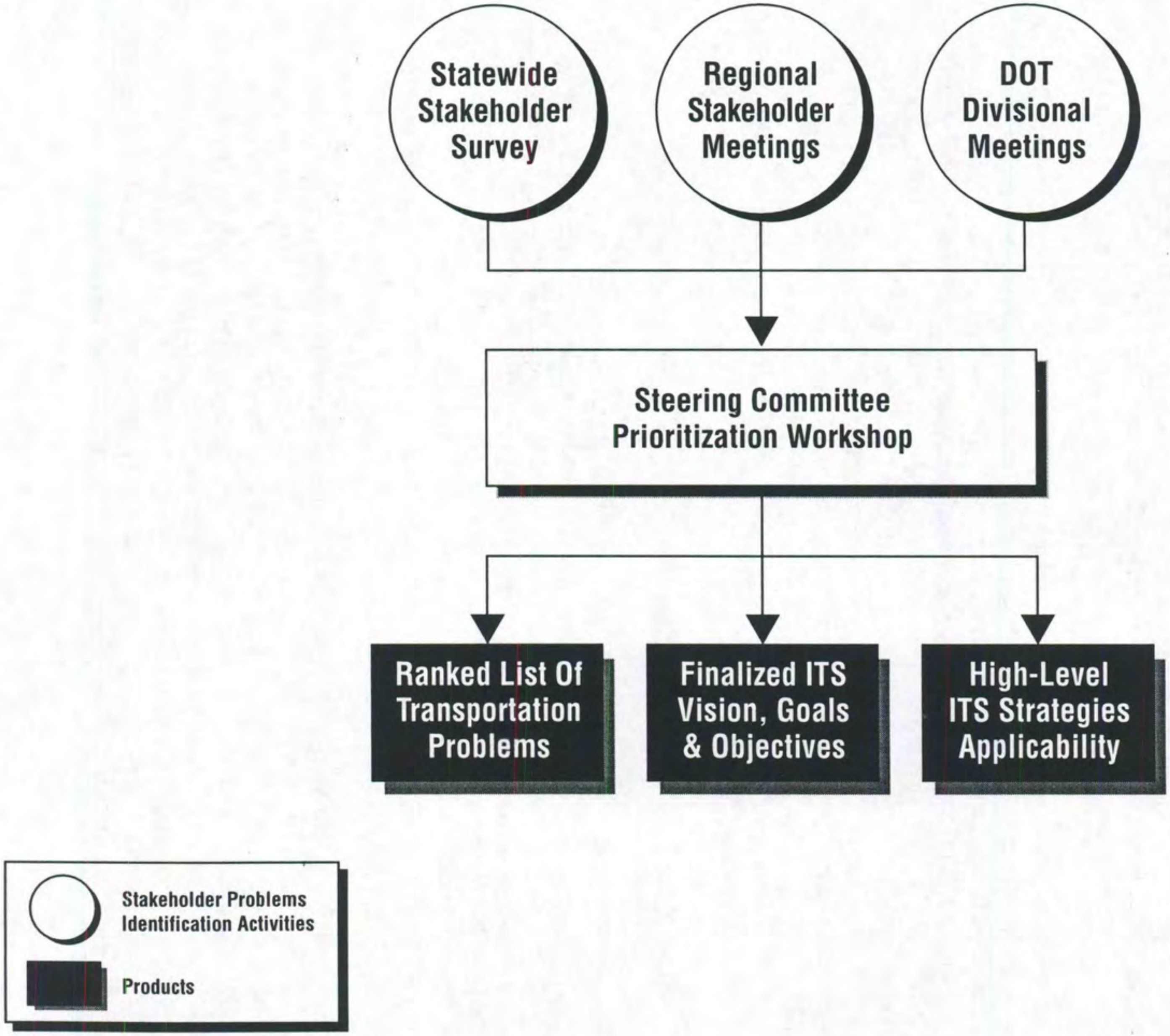


Figure 3-1
Problems Identification and Prioritization Process

Transportation Problems (Interpretation of Survey Results)

Table 3-1, on the following page, presents the results of the ranking of transportation problems. One of the most significant findings is that none of the problems were identified as anything more severe than a "general problem" (a score of less than 2.5). None of the problems were ranked, on average, as "significant" or "very significant." Most of the problems listed (26 of 44) were rated as "occasional" problems. Overall, the problems ranking is fairly undifferentiated, i.e., there are no abrupt "drop-offs" in the rankings, which range from 3.2 to 1.6 in fairly uniform increments. The top 10 problems generally pertain to roadway congestion and safety.

Table 3-2 presents the results of the write-in of the top five transportation problems, aggregated into categories. Highway congestion and safety-related problems were by far the most frequently cited, with "congestion on major city streets," "rail related congestion and safety" and "construction work zone safety and congestion" the three most frequently cited.

Transportation Solutions

Table 3-3 presents the results of the ranking of "ITS User Services," which are general categories of ITS solutions or applications. Table 3-3 indicates that the perceived need for ITS solutions is broad, but not particularly acute. Twenty-five of the 30 user services were rated as "needed"--a middle choice between "not needed" and "very highly needed"--with average scores ranging from 2.5 to 3.4, out of a possible 5.0. This pattern is somewhat consistent with the results of the problems ranking (Table 3-1), where nearly all of the problems were acknowledged as concerns, but none were identified as being more than an "occasional" or "general" problem, with average scores ranging from 1.8 to 3.2, out of a possible 5.0. In terms of the relative priority of the ITS solutions, Table 3-3 indicates that safety related ITS applications are seen as the most needed. Nine of the top ten ranked ITS solutions pertain to safety, including incident management, emergency response and collision avoidance. ITS applications related to efficiency and convenience, including traveler information, electronic payment and transit applications, scored slightly but consistently lower than the solutions that directly impact safety.

In the write-in portion of the solutions-oriented part of the survey, a large number of solutions were identified, cutting across a wide range of issue areas. Table 3-4 lists the responses. Most of the established ITS applications were cited. In the area of highways/interstates, proposed solutions include freeway management (vehicle detectors, ramp meters, CCTV), Rural Mayday, and call boxes/incident reporting. Solutions relating to I-235 in Des Moines appeared frequently. In the category "major city streets," proposed solutions included signal interconnection/coordination, coordination across jurisdictions, remote signal monitoring, and construction/maintenance coordination. In the "traveler information" category, proposed solutions included weather, pavement, and incident information provided through highway advisory radio, the Internet, variable message signs, dynamic speed warning signs, cable television and telephone. In the "transit" area, automatic vehicle location systems were mentioned, along with a number of non-ITS, policy-oriented ideas. Finally, in the "commercial vehicles" area, proposed solutions focused on credentialing, electronic pre-clearance, road and regulatory information, over-height sensors, and rail crossing safety.

Table 3-1: User Needs Survey Problems Ratings

Problem Area	Problem	Average Rating	Number of Responses
Travel Conditions (For Major City Streets)	Congestion (Recurring - rush hour traffic)	3.2	154
Travel Conditions (For Highways)	Safety	3.0	164
Travel Conditions (For Highways)	Construction and Maintenance Projects	2.9	166
Travel Conditions (For Major City Streets)	Safety	2.8	151
Travel Conditions (For Major City Streets)	Construction and Maintenance Projects	2.8	153
Travel Conditions (For Highways)	Weather	2.8	163
Information for Travelers	Notification of Major Crashes	2.7	153
Travel Conditions (For Major City Streets)	Weather	2.7	148
Information for Travelers	Lack of Road Condition Information	2.6	157
Travel Conditions (For Highways)	Congestion (Recurring - rush hour traffic)	2.7	160
Information for Travelers	Lack of Adequate Alternate Routes	2.6	152
Information for Travelers	Updates for Travelers	2.5	148
Travel Conditions (For Major City Streets)	Travel Time (Unexpected Delays)	2.6	148
Public Transit Service	Travel Time	2.5	130
Information for Travelers	Lack of Weather Condition Information	2.5	154
Travel Conditions (For Major City Streets)	Seasonal Congestion	2.5	142
Travel Conditions (For Major City Streets)	Emergency Response Time	2.5	142
Public Transit Service	Schedule and Route Information	2.5	133
Travel Conditions (For Highways)	Emergency Response Time	2.4	155
Commercial Vehicle Operations	Hazardous Materials Routing Information	2.4	80
Travel Conditions (For Highways)	Seasonal Congestion	2.4	156
Travel Conditions (For Major City Streets)	Access to Interstates/Freeways	2.3	144
Commercial Vehicle Operations	Hazardous Materials Response Procedures	2.3	80
Commercial Vehicle Operations	Time Spent on Regulatory Matters	2.3	74
Travel Conditions (For Major City Streets)	Unfamiliar Users/Tourists	2.4	148
Commercial Vehicle Operations	Lack of Roadway Conditions Information	2.3	75
Travel Conditions (For Highways)	Travel Time (Unexpected Delays)	2.3	159
Travel Conditions (For Major City Streets)	Congestion (Non-recurring - stalled vehicles)	2.2	145
Public Transit Service	Appropriate Stop Locations	2.2	130
Information for Travelers	Lack of Travel Time Information	2.2	149
Public Transit Service	Bus Shelter Conditions	2.2	132
Travel Conditions (For Highways)	Finding Help When Needed	2.2	155
Travel Conditions (For Highways)	Unfamiliar Users/Tourists	2.1	158
Commercial Vehicle Operations	Oversize/Overweight Permitting	2.1	79
Travel Conditions (For Major City Streets)	Finding Help When Needed	2.1	145
Travel Conditions (For Major City Streets)	Personal Security	2.1	145
Commercial Vehicle Operations	Time Associated with Vehicle Inspections	2.0	74
Travel Conditions (For Highways)	Access to Interstates/Freeways	2.0	156
Travel Conditions (For Highways)	Air Pollution	2.0	156
Travel Conditions (For Highways)	Personal Security	2.0	156
Public Transit Service	Safety/Security	1.9	133
Travel Conditions (For Major City Streets)	Air Pollution	1.9	143
Travel Conditions (For Highways)	Congestion (Non-recurring - stalled vehicles)	1.9	155
Commercial Vehicle Operations	Time Spent at Weigh Stations	1.8	71

1. Not a problem
2. Occasional Problem
3. General Problem
4. Significant Problem
5. Very Significant Problem

Table 3-2: User Needs Survey Problem write-ins

General Area	Problem Identified	Frequency
Travel Conditions (For Highways)	Construction Work Zone Safety and Congestion	12
	Lack of Access to Major/Four-lane Highways in Rural Areas	10
	Recurring Congestion and Roadway Design (I-235 in Des Moines metro area)	10
	Lack of Funding for Rural/Secondary Roadway Maintenance	10
	General Congestion on Interstates in Larger Cities	9
	Saftey and Congestion on City Bypasses	6
	Insufficient Winter Maintenance on Rural Highways/Interstates	5
	Inadequate Bridge Access Across Mississippi River (I-74 in the Quad Cities metro area)	5
	General Safety on Rural Highways	4
	Non-recurring Congestion and Incident Clearance (I-235 in Des Moines metro area)	4
	Inadequate Access/Turn Lane Design on Rural Highways	4
	Rural Roadway Maintenance Concerns	3
	Expressway Intersection Safety in Rural Areas	3
	Urban Sprawl (primarily in western Des Moines metropolitan area)	3
	Slow Emergency Response Time on Interstates and Rural Highways	3
	Operational Problems (Interstate 29 in Sioux City)	2
	General Congestion (Interstate 80 between Des Moines and Davenport)	2
	Interstate Speed Limits Too Low	2
	Inadequate Design Standards for Rural Highways	2
	Alternate Routing during Traffic Incidents/Crashes	2
	Icing on Elevated Interstates (I-380 in Cedar Rapids metro area)	2
	Lack of Highway Speed Limit Consistency	2
	Lack of Resources for Incident Management	1
	Snow Plow Safety and Driver Awareness	1
	Roadside Vegetation Maintenance along Freeways	1
	Low Bridge Clearances on Older Urban Highways	1
	Damage to Secondary Roads During Alternate Routing	1
	Crashes with Animals in Roadways	1
	Safety at Interstate Weave Zones	1
	Poor Air Quality Due to Congestion (Quad Cities metropolitan area)	1
	General Need for Highway Improvements	1
	Operational Problems at Rural Intersections	1
	Need for Pavement Management System on Primary and Secondary Highways	1
	Need for Paved Shoulders for Bicycles on Rural State and County Highways	1
	Interstate Fatalities	1
Travel Conditions (For Major City Streets)	General Congestion on Major City Streets	30
	Rail Traffic Causing Congestion and Safety Concerns	20
	Access and Roadway Design Problems in Major Cities	11
	Congestion on Major Highways within Cities	7
	Failure to Drive According to Road Conditions	7
	Lack of Funding for and Condition of Local Roadways and Bridges	7
	Special Event Traffic in Des Mones, Iowa City, and Ames	5
	Slow Emergency Response Time	5
	Inadequate Traffic Signal Coordination	4
	Failure to Obey Rules of the Road	2
	Need for Emergency Vehicle Signal Preemption Systems	2
	Lack of Bicycle and Pedestrian Safety/Infrastructure Planning	2
	Lack of Corridor Traffic Management (I-235 and parallel roads in Des Moines metro area)	1
	High Crash Rates at Intersections	1
	Overuse of Ttraffic Signals Impeding Traffic Flow	1
	Unprotected Residential Intersections with Poor Sight Distance	1
	Lack of Parking in Downtown Des Moines	1

Traveler Information	Poor Route Signage	6
	Lack of Reliable Real-time Weather and Road Condition Information	5
	Need for Incident Management Detection/Confirmation and Use of Alternate Routes	3
	Lack of Updated General Traveler Information	3
	Lack of Information on Construction Work Zones	2
	Need for Advanced Notice of Delays and Alternate Routes	2
	Unfamiliar Users/Tourists Need Local Information	1
Public Transit Service	Inadequate Public Transit for the Elderly and Blind	8
	Lack of Intercity Bus and Rail Transportation	3
	Lack of Adequate Transit Vehicle Tracking Systems (AVL)	3
	Congestion Affecting Transit Schedule Adherence	2
	Need for Transit Vehicle Maintenance and Performance Tracking	2
	Transit Dispatching Problems	2
	Lack of Transit Route/Schedule Information	2
	Inadequate Transit and School Vehicle Coordination	1
	Limited Hours of Service	1
	Lack of Transit Funding	1
	Lack of Ride Sharing Information	1
	School Bus Safety	1
	Lack of Transit Coverage to Employment Centers	1
	Bus Stop Safety on Two-lane Streets	1
	Lack of Access to Public Transportation in Rural Areas	1
Commercial Vehicle Operations	Faulty Equipment/Overweight Commercial Vehicles Damaging Roadways	4
	Lack of Adequate Emphasis on Railroad/Intermodal Service	3
	Increased Commercial Traffic and Vehicle Size	2
	Construction Harms Commercial Operations	2
	Hauling of Hazardous Materials	1
	Inconsistent Speed Limits for Commercial Vehicles Nationally	1
	Commercial Vehivle Driver Fatigue	1
	Need for Driver Education on Sharing the Road	1
	Lack of Commercial Vehicle Parking Areas	1
	Congestion at Weigh Station Scales	1
	Need for Seamless Border Operations/Credentials Clearance	1
	Farm Machinery on Roadways	1
General	Speeding in Iowa	8
	Safety	4
	DWI Enforcement	2
	Inefficient Government Bureaucracy	2
	Uncoordinated Construction Activities	2
	Lack of Cooperation with Other States to Obtain Federal Funding	1
	Need for Better Motor Vehicle Crash Data Reporting	1
	Airport Fares Too High at Quad City International Airport	1
	Environmental and Archeological Law Constraints	1
	Interstates Act as Barriers to Growth of Cities	1
	Inadequate Communication Network	1
	Not Enough Use of Transportation Data	1
	Economic Development Concerns	1
	Pavement Markings Not Withstanding Wear	1
	Lack of Regional Cooperative Planning Efforts	1
	Three-lane Roadways are a Bad Design Option	1

Table 3-3: User Needs Survey User Service Rankings

Problem Area	Problem	Average Rating	Number of Responses
Commercial Vehicle Operations Services	Hazardous Material Incident Response	3.7	142
Emergency Management Services	Emergency Vehicle Management	3.6	173
Travel and Transportation Services	Highway-Railroad Intersection	3.4	169
Travel and Transportation Services	Incident Management	3.4	170
Emergency Management Services	Emergency Notification and Personal Security	3.4	172
Advanced Vehicle Safety Systems	Intersection Collision Avoidance	3.4	165
Advanced Vehicle Safety Systems	Vision Enhancement for Crash Avoidance	3.3	163
Advanced Vehicle Safety Systems	Longitudinal Collision Avoidance	3.2	164
Travel and Transportation Services	Traffic Control	3.2	171
Advanced Vehicle Safety Systems	Lateral Collision Avoidance	3.1	163
Travel and Transportation Services	Enroute Driver Information	3.0	169
Advanced Vehicle Safety Systems	Safety Readiness	3.0	164
Advanced Vehicle Safety Systems	Pre-crash Restraint Deployment	2.9	163
Commercial Vehicle Operations Services	On-board Safety Monitoring	2.8	136
Travel and Transportation Services	Route Guidance	2.7	169
Commercial Vehicle Operations Services	Commercial Vehicle Administrative Processing	2.7	130
Commercial Vehicle Operations Services	Freight Mobility	2.7	130
Travel Demand Management	Demand Management and Operations	2.6	166
Public Transportation Operations Services	Personalized Public Transit	2.7	160
Electronic Payment Services	Electronic Payment Services	2.6	155
Commercial Vehicle Operations Services	Automated Roadside Safety Inspections	2.6	133
Public Transportation Operations Services	Public Travel Security	2.6	159
Travel Demand Management	Ride Matching and Reservation	2.5	167
Public Transportation Operations Services	Public Transportation Management	2.6	160
Travel and Transportation Services	Traveler Service Information	2.5	167
Travel Demand Management	Pre-trip Travel Information	2.5	166
Commercial Vehicle Operations Services	Commercial Vehicle Electronic Clearance	2.5	130
Public Transportation Operations Services	Enroute Transit Information	2.3	156
Travel and Transportation Services	Emissions Testing and Mitigation	2.2	168
Advanced Vehicle Safety Systems	Automated Vehicle Operations	1.9	162

1. Not needed
2. Somewhat needed
3. Needed
4. Highly needed
5. Very highly needed

Table 3-4: User Needs Survey Solutions Write-Ins

Category	Idea/Suggestion
Travel Conditions (For Highways)	Implement ramp metering on interstates (Ex: I-235 in Des Moines) Utilize CCTV cameras for surveillance along interstates (Ex: I-235 in Des Moines and I-380 in Cedar Rapids) Provide integrated corridor traffic management of freeways and parallel streets (Ex: Des Moines) Build longer entrance/exit ramps on interstates Initiate safety improvements of interstate "weave zones" (Ex: I-80 and I-380 intersection near Iowa City) Use more signalization at expressway and interstate intersections Locate road surface condition sensors on highways Promote construction of more "Super two" design highways in rural Iowa Implement a rural Mayday system linked with EMS Use call boxes or reliable incident detection devices on shoulders of highways Help rural areas fund roads that are safer for the high speeds Utilize special emergency vehicle access gates onto interstates (Ex: Council Bluffs) Create more interstate highway access (Ex: West Des Moines) Set realistic speed limits on highways Use steam generated by cities to heat elevated highways prone to icing. (Ex: Cedar Rapids) Area-wide Traffic Management Center in Council Bluffs-Omaha area Utilize bridge and surface sensing for ice and snow (Ex: Nevada and Cedar Rapids)
Travel Conditions (For Major City Streets)	Improve traffic signal coordination (Ex: Des Moines) Utilize emergency resonse patrols (Ex: Des Moines) Utilize access management and more turn lanes on major roadways Implement emergency vehicle preemption systems (Ex: Dubuque and Des Moines) Install wider lanes and paved shoulders for bicyclists Provide pedestrian sidewalk enhancements Stress a statewide focus on coordination of signal timing/traffic response systems across boundaries Install remote monitoring of signals at all public works, fire, and police facilities Install monitoring of major roadways for traffic and incident detection (Ex: Cedar Rapids and Des Moines) Install brighter traffic signals and "smart" signs Use devices to alert drivers to pedestrian crossings ahead Install sensors on bridges to warn of congestion (Ex: Mississippi River in the Quad Cities) Use advanced signaling and traffic calming Implement emissions testing on vehicles Provide an advanced parking information system (Ex: Des Moines) Coordinate construction between freeways and major arterials
Information for Travelers	Develop a traveler information system/service utilizing various transportation data for trip planning Use highway advisory radio (HAR) for travel, weather, and construction information Provide more or improved traveler information at rest areas along interstates Provide real-time information on a statewide web page (Ex: road reports or plowing schedules for larger cities) Use variable message signs (VMS) for incident notification, construction information, and special events Utilize driver information, service patrols, and better arterial signal coordination during the I-235 reconstruction Supply advanced weather information in rural areas and for transit riders Create a better advanced road conditions and real-time construction update system Use dedicated trailblazer signs for incident and special event routing Provide early warning of upcoming trains to allow motorists to select an alternate route Use roadside warning devices that address driver behavior (Ex: Speed does not match roadway geometry) Provide base maps for trip planning, vehicle routing, and emergency response where all data is integrated Utilize a cable television channel dedicated to travel times, transit information, and airline updates Provide a better telephone information system for weather, road conditions, construction zones, and detouring Use vehicles with electronic signs to help direct traffic around incidents Utilize the ICN for roadside traveler information Establish more RWIS sites in each county, with information shared over the Internet Better utilize Iowa DOT radio towers and communication network for traveler information Provide better forecasting of winds and pavement/air temperatures prior to storms
Public Transit Services	Investigate possibility of high speed rail in Iowa (Ex: Chicago, IL-Quad Cities-Des Moines-Omaha) Utilize signal preemption to help maintain transit schedules Utilize AVL technology for city transit vehicles Improve availability of transit information to the public Improve AMTRAK routing through Central Iowa Promote car and van pooling more aggressively Support light rail-based suburban transit networks (Ex: Des Moines and Iowa City-Cedar Rapids) Provide tax credits for people who use mass transit and/or carpool Promote and provide incentives for all alternative transportation modes (Ex; bicycles, walking, and transit) Improve highway communication between school vehicles for safety Utilize school bus route planning Improve/promote school bus safety Utilize global positioning system (GPS) technology on rural transit for emergencies

Commercial Vehicles	Promote use of electronic clearance and electronic administrative processes Support improvement of railroad freight travel for less reliance on trucking Use reflective tape on rail cars (to detect trains in motion) for improved safety at rail crossings Provide road and regulatory information to commercial operators through satellite or cellular communication Make commercial vehicle engines bigger Expand 4-lane commercial highway system (Ex: Cherokee) Utilize pen-based laptops in commercial enforcement vehicles for crash reporting Use overheight sensors for commercial vehicles (Ex: Quad Cities) Provide more grade separation and signals at rail crossings Utilize advanced railroad sensing at busy rail crossings (Ex: Quad Cities) Expand the use of weigh-in-motion (WIM) to promote safety and efficiency
General	Standardize all state ITS projects Make improvements in winter snow and ice removal Utilize a cafeteria approach to implementing technology Require all auto makers to install GPS on all new vehicles Ensure that rural issues of ITS are not ignored Utilize collision avoidance systems Recognize needs of a diverse, aging population Support improvement of alternate fuel sources Provide funding for maintenance and infrastructure before ITS Conduct more frequent traffic counts statewide Make drivers more responsible for their driving Expand GIS applications at regional planning (RPA) level Promote use of advanced vehicle guidance systems Improve communication between EMT and hospital doctors Invest more money in Iowa's transportation system Study/implement car-animal collision avoidance systems Promote "sharing the road" in drivers education Promote more aggressive speed detection and enforcement Promote E-911 for cell phones Improve driver education for elderly and young drivers to reduce accidents Utilize an air quality notification system in some areas (Example: Quad Cities) Allow local officials to utilize federal funds for advanced technologies without prequalifying vendors Automate ticketing of motorists for speeding and other traffic violations Address road marking visibility problem more aggresively to ensure year-round visibility Involve more county-level economic development people in transportation decisions Intergate statewide AVL and AVM with all levels of government Utilize AVL for public maintenance vehicles Tie land use to trip generation and transportation modeling by proactively using GIS to track development Continue developing and testing rural smart zones Share as much information with the public as available Conduct an international literature search to identify world ITS technologies Further development of the Condition Assessment Reporting System (CARS) Use central dispatch centers for emergency messages in metropolitan areas Improve pavement monitoring during weather conditions Initiate intersection collision avoidance systems at intersections with high crash rates, fatalities, and injury Statewide development of sign management and pavement management systems Utilize a snow plow warning system to avoid collisions in bad winter weather conditions Better utilize traffic data to forecast and establish improvement priorities Find a faster way to get crash data into the state database Speed up the state construction schedule Safety commission should make it mandatory to have lights at all hard surface railroad crossings

3.2 Regional Stakeholder Meetings

Meetings were held with city, county and regional transportation agency staff during March and April 1999, at four locations throughout the state, with representatives from agencies in that region of the state invited to attend: Storm Lake, Waterloo, Iowa City and Des Moines.

The purpose of the meetings was two-fold: to inform participants about the statewide ITS plan and to solicit their input on transportation problems and potential solutions. At each geographic location, three separate sessions were held, focusing on traffic management, incident management and transit. Typically, between three and 10 individuals participated in each session, plus members of the Iowa DOT project team and consultant team.

Tables 3-5, 3-6 and 3-7 summarize the input from both the regional stakeholder meetings and the meetings with Iowa DOT divisional staff. A list of agencies represented at the meetings (many more were invited) and a summary of each individual regional stakeholder meeting are included in Appendix G.

3.3 Iowa DOT Divisional Meetings

Separate meetings were held with staff from each Iowa DOT division. Approximately 50 DOT staff participated in the eight meetings. (A second meeting was held with the Maintenance Division to reach additional non-headquarters staff.)

The format of the meetings was very similar to the regional stakeholder sessions, and included a summary of the statewide ITS plan development process and purpose, and input from the DOT staff regarding transportation problems and ITS solutions. Tables 3-5, 3-6 and 3-7 summarize the input from both the Iowa DOT divisional staff and regional stakeholder meetings.

3.4 Steering Committee Prioritization Workshop

A workshop was held with the ITS Plan Steering Committee on May 12-13, 1999, to present the results of the needs assessment component of the statewide ITS plan development effort, finalize a ranking of transportation problems, and for preliminary discussion of the applicability of various specific ITS strategies or applications. An additional purpose of the workshop was to evaluate and identify projects for deployment immediately, in the first year of the ITS program. The portion of the workshop focusing on "immediate term" projects, and the remainder of the project identification and evaluation process, are described in section 6.0. This section focuses on the problem ranking and strategies discussion portions of the workshop.

Table 3-5: Regional Stakeholder and Divisional Meetings – Summary of Problems

- Safety concerns for rural/regional transit drivers and passengers
- Inefficiencies in rural/regional transit service (e.g. lack of connectivity, redundancies)
- Congestion and delay on signalized urban arterials (not widespread)
- Emergency vehicle safety and delay at signalized intersections
- Slippery pavement conditions
- Maintenance of traffic and safety along I-235 during construction
- Lack of formal, multi-jurisdictional, multi-agency incident management plans and procedures
- Inadequate work zone safety
- Snow and ice control
- Commercial vehicle administration and processing inefficiencies
- Driver awareness of traffic signals on high speed roadways, especially in rural areas
- Inadequate dissemination of traveler information by the media
- Conflicts between motorized vehicles, bicycles and pedestrians
- Inadequate coordination of construction/maintenance information sharing among agencies, including EMS
- Inadequate construction/maintenance information to travelers
- Increasing need for railroad overpasses and impacts to EMS response
- Inefficient EMS response and long times due to inefficiently defined jurisdictional boundaries
- Incidents and major delays on high-volume bridge crossings
- Narrow shoulders on urban interstates (hinders incident response and clearance)
- Crashes at low overpasses
- Inadequate weather information for travelers
- Aging population and greater safety concerns
- Travelers don't know where they are when they report a crash or congestion
- Need for real-time transit arrival time information
- Transit delays at signalized intersections (and impact on on-time performance)

Table 3-6: Regional Stakeholder and DOT Divisional Meetings – Summary of Suggested Solutions

- A standardized implementation model, and set of technologies, for regional/rural transit operators, including automatic vehicle location, mobile data terminals, computer-aided scheduling and dispatch, consolidated dispatching, electronic fare payment, automated passenger counters, vehicle monitoring and coordinated transfers.
- Traffic signal coordination, within and across jurisdictions
- Emergency vehicle traffic signal preemption
- Pavement sensors and warning signs
- Traffic management and incident management strategies for I-235 during reconstruction, including surveillance cameras, vehicle detectors, changeable message signs, highway advisory radio, coordinated route detours supported by arterial street improvements, service patrols and coordinated incident management
- Formalized, multi-disciplinary and multi-agency incident management plans in major urban areas
- Use of changeable message signs, highway advisory radio and other information dissemination techniques in conjunction with work zones
- Expansion of the maintenance concept vehicle demonstration
- Continuation of Motor Vehicle Division projects to streamline commercial and private vehicle administrative processes and accident reporting
- Advance, "active" (e.g., linked to signal controller) warning signs for signals with high-speed approaches
- More formalized arrangements with the media to communicate traveler information, including incidents and construction/maintenance
- Consolidation of planning and programming data
- Consolidation of traveler information
- Railroad sensors tied to adjacent traffic signals
- Railroad detector information provided to EMS dispatchers
- Revision of EMS response boundaries and dispatch methods
- Surveillance, vehicle sensors, and warning signs at high-volume bridge crossings (e.g., I-74)
- Warning devices for low overpasses
- Supplemental roadway markers to support vehicle location (e.g., 1/10-mile markers with route and direction)
- Transit arrival time information on the Internet, by phone, and/or with station signs
- Highway advisory radio and/or kiosks for tourist information

Table 3-7: Regional Stakeholder and DOT Divisional Meetings – Summary of Challenges

- Lack of ITS "champions" at the local level and at the DOT
- Lack of a clearly articulated DOT ITS role (especially in information dissemination and traffic management centers), policy and program
- Need to integrate the various ITS activities of the DOT
- Lack of ITS expertise among local implementers and at the DOT
- Lack of adequate funding for implementation
- Uncertainty and lack of funding for operations and maintenance
- ITS is often a tough sell without significant congestion and delay
- Ensuring data security and controlling access to electronic information
- Need for marketing of ITS, emphasizing real benefits to decision-makers and to end users
- Providing information to travelers without access to "high tech" (e.g., Internet)
- Need to integrate ITS activities into traditional activities (i.e., "mainstream")
- Need to attract public sector interest and leverage resources
- Ownership of traveler information and rights to sell it
- Need a justifiable approach to balancing investment across modes and throughout the state, especially rural/urban

Summary of Problem Identification Activities

The workshop began with a review of the results of the stakeholder survey and reports from the Iowa DOT divisional meetings and regional stakeholder meetings. In addition to the information presented in sections 3.1 through 3.3, the following set of overall observations, developed by the consulting team based on the sum total of input from the survey and meetings, was presented to the steering committee for consideration:

1. Safety is the single most important issue overall. Specific examples include incident management and work zone safety.

2. Traffic congestion and the need for traveler information (traffic, weather, attractions) were noted by many stakeholders.

3. Transit concerns were enthusiastically and well-articulated in meetings with transit agency staff, and it appears that many of the agencies have been discussing ITS applications on a regional or even state level. However, transit problems and issues did not rate highly among the general stakeholder audience.

4. Railroad crossings were identified as a concern by many stakeholders. Specific problems include delays and safety concerns associated with increased rail traffic, especially on the Union Pacific line, delays for emergency vehicles, and lack of coordination with adjacent traffic signals.

5. Many stakeholders, including Iowa DOT staff, expressed uncertainty regarding the short-and long-term agency roles in ITS planning, deployment, and operation. These concerns can be interpreted as further justification for completing a statewide ITS plan.

Group Prioritization of Problem Areas

A composite, or "master" list of transportation problem areas were identified and committee members were asked to rank the importance of the problems. Each member of the steering committee and each member of the consultant team were given a total of 40 points to use to rank the importance of the various problems. Each participant was given four votes worth four points each, four votes worth three points each, four votes worth two points each, and four votes worth one point each. Participants were free to allocate their points in any manner, e.g., they could choose to put all of their points on a single problem, or spread them out in any manner. Scores were tabulated separately for the steering committee, the consultant team and for the two groups combined (committee plus consultants). The results are shown in Table 3-8.

Consultant scores were tabulated separately in order to provide an outside, national perspective without skewing the overall rankings. Note that the problems in Table 3-8 are listed in order from most important to least important, based on the steering committee rankings.

Table 3-8: Prioritization Workshop - Final Transportation Problems Ranking

Problem	Steering Committee Score	Steering Committee Rank	Consultants Score	Consultants Rank	Combined Score	Combined Rank
Safety / Crashes - Highways	35	1	27	1	62	1
Construction and Maintenance - Highways	23	2	23	2	46	2
Personal Security - Highways	21	3	2	12	23	4
Lack of Road Conditions Information	16	4	2	12	18	6
Construction and Maintenance - Streets	15	5	3	10	18	6
Safety / Crashes - Streets	14	6	10	3	24	3
Roadway Surface Conditions - Highways	13	7	10	3	23	4
Personal Security - Streets	12	8	0	15	12	10
Roadway Surface Conditions - Streets	8	9	8	5	16	8
Railroad Crossings - Streets	7	10	8	5	15	9
EMS Response Time - Streets	7	10	1	14	8	13
Lack of Weather Conditions Information	7	10	0	15	7	15
Recurring Congestion - Streets	7	10	0	15	7	15
Travel Time - Highways	7	10	0	15	7	15
Travel Time - Streets	6	15	0	15	6	19
Lack of Rural Transit Coordination	6	15	6	8	12	10
Lack of Adequate Alternate Routes	4	17	3	10	7	15
Integration of Data	4	17	4	9	8	13
CVO Time Spent on Regulatory Matters	4	17	0	15	4	20
Lack of Multi-modal Traveler Information	3	20	7	7	10	12
CVO Time Spent at Weigh Stations	3	20	0	15	3	21

Group Prioritization of Applicable ITS Strategies

As a means to stimulate thinking regarding potential ITS projects, the applicability of a wide range of potential ITS strategies to specific types of transportation problems were reviewed, focusing on those problems ranked as most important in the preceding Steering Committee ranking exercise. Participants ranked the importance of the various strategies, using the same point system as in the previous problem ranking exercise. Table 3-9 presents the results. As described in Section 6.0, a much more thorough process to identify all potentially relevant strategies, and to evaluate them on numerous criteria, was performed following the workshop as part of the project development process.

Table 3-9: Prioritization Workshop Preliminary Strategies Ranking

Strategy	Steering Committee Score	Steering Committee Rank	Consultants Score	Consultants Rank	Combined Score	Combined Rank
Freeway Service Patrols	32	1	5	8	37	1
Interactive Traveler Information / Web Site	25	2	2	16	27	3
Roadside Traveler Information Dissemination	18	3	14	1	32	2
Advanced Incident Management Detection and Reporting	16	4	5	8	21	8
Consolidated EMS Communications	16	4	1	20	17	10
Portable Traffic Management Systems	16	4	10	4	26	5
TV and Radio Broadcast Traveler Information	15	7	7	6	22	6
Freeway Network Surveillance	14	8	13	2	27	3
Automated Enforcement	13	9	2	16	15	11
Mayday Support	11	10	11	3	22	6
Weather and Pavement Sensing	11	10	8	5	19	9
ISP / Internet-Based Route Guidance	10	12	0	34	10	14
Advanced Maintenance Technologies and Vehicles	9	13	1	20	10	14
Automated Telephone Traveler Information	6	14	0	26	6	16
Coordinated Incident Management Response and Clearance	6	14	6	7	12	12
ITS Plans and Studies	6	14	5	8	11	13
Integrated Transportation Management / Autonomous and Dynamic Route Guidance	5	17	0	26	5	17
Automated Weighing / Weigh-In-Motion	4	18	0	26	4	19
Vehicle Fleet Administration	4	18	0	26	4	19
Hazardous Materials Management / Electronic Commerce	3	20	3	14	6	16
In-vehicle Signing	3	20	0	26	3	23
Railroad Operations Coordination	3	20	0	26	3	23
Roadside CVO Safety	3	20	0	26	3	23
Roadway Construction Coordination System	3	20	0	26	3	23
Transit Vehicle Location	3	20	0	26	3	23
Accident Investigation Technologies	2	26	0	26	2	33
Advanced Freeway Traffic Control / Ramp Metering	2	26	2	16	4	19
Detour Planning	2	26	1	20	3	23
CVO Routing	1	29	0	26	1	32
Driver Visibility Improvement	1	29	0	26	1	32
International Clearance Technology	1	29	1	20	2	31
Advanced Street Traffic Control / Signal Coordination	0	32	5	8	5	17
Emergency Response Operations / Signal Preemption	0	32	3	14	3	23
Interjurisdictional Signal Coordination	0	32	1	20	1	32
Intersection Safety Warning	0	32	3	14	3	23
Lateral Safety Warning	0	32	4	12	4	22
Personalized / Demand-Response Transit Operations	0	32	2	16	2	35
Street Network Surveillance	0	32	4	12	4	19
Traffic Network Performance Evaluation	0	32	1	20	1	32

4.0

Program Goals and Objectives

This section establishes the high-level direction for the Iowa DOT's ITS program through: 1) vision statement; 2) program goals and objectives; 3) identification of Iowa DOT ITS roles; and 4) high-level investment "portfolio".

4.1 Vision Statement

This working statement will serve as an overall vision for the deployment of ITS technologies and related institutional arrangements in Iowa during the next 10 years. This statement provides a framework to guide the statewide ITS deployment and will be updated as necessary to reflect the needs of the Iowa DOT ITS efforts. Following is a general working statement for Iowa's ITS efforts.

The vision for the state of Iowa is one of enhanced transportation, mobility, efficiency, productivity and safety through the use of user-friendly ITS technologies and systems.

This vision is an integrated approach to solving transportation problems and begins with cooperation between multiple agencies across the state to plan and implement advanced ITS technologies. The vision seeks to improve the use of existing infrastructure and expand the choices for users and operators. The vision encompasses transportation problems that can be effectively addressed with the resources available in Iowa and applies to all single and multi-modal users who travel within and through the state.

4.2 Goals and Objectives

These goals and objectives are based on the overall themes identified in the *Iowa in Motion* State Transportation Plan and have been developed to support the vision statement that describes the desired use of ITS technologies in Iowa. The overall goals of the Iowa DOT Integrated ITS and Services Deployment Plan are:

- Safety
- Preservation
- Efficiency
- Economic Development
- Balance

Specific objectives are listed below by goal.

Goal: Safety
Objectives

- Increase traveler knowledge of road/weather conditions and subsequent number/severity of crashes caused by road/weather conditions.
- Improve the medical response time for vehicle crashes and other emergencies.
- Improve response to hazardous material emergencies.
- Reduce motor carrier safety violations.
- Minimize at-grade railroad crossing accidents.
- Reduce the number of safety-related moving violations.
- Reduce the number/severity of crashes caused by driver error/fatigue.
- Improve safety/security for pedestrians, cyclists and transit users.

Goal: Preservation
Objectives

- Improve the availability, quality and convenience of rural public transportation.
- Improve the availability, quality and convenience of urban public transportation.
- Improve the ways the existing infrastructure is managed and maintained.
- Reduce motor vehicle emissions and improve air quality.
- Reduce the overall growth rate of vehicle miles traveled.

Goal: Efficiency
Objectives

- Reduce incident response and clearance time and subsequent vehicular delay.
- Improve traffic management and peak period flow to reduce delays for travelers/ commuters.
- Support telecommuting opportunities to reduce commuting congestion in urban areas.
- Provide opportunities for intermodal connections.
- Increase throughput for all modes.
- Improve traveler knowledge of congestion and delays through improved trip coordination, pre-trip route selection, and traveler information.

Goal: Economic Development
Objectives

- Reduce shipping and delivery delays and subsequent cost of fleet operations.
- Increase traveler knowledge of tourism.
- Improve access to and from rural communities for travel, goods, services and information.
- Increase direct employment through new ITS industry.

Goal: Balance
Objectives

- Provide balance between urban and rural communities.
- Provide balance between preservation and expansion.
- Provide balance between economic development and quality of life.
- Provide balance among transportation modes.
- Provide balance between benefits and costs.

4.3 Overall Program Direction

In addition to the vision statement and goals and objectives, two additional concepts were developed to help provide high-level structure and direction to the overall ITS program. These concepts are "Iowa DOT ITS Roles" and "ITS Activities Portfolio."

Iowa DOT ITS Roles

In the course of identifying specific ITS goals and objectives, and later in identifying specific projects, it became evident that the Iowa DOT will play several major roles relative to ITS. These roles are summarized in Table 4-1. A well-rounded ITS program will support the ability of the Iowa DOT to function in each of capacities identified in Table 4-1. In addition to helping to define what the Iowa DOT intends to accomplish through their ITS program, these roles can be used, as the program develops, as a check to ensure that sufficient structure has been developed and resources allocated in each of these major areas of activity.

Table 4-1: Iowa DOT ITS Roles

DOT ITS Role	Summary
Educator	The Iowa DOT will promote understanding of ITS applications and benefits to the general public, elected officials and other policy and decision-makers, and transportation technical staff, including conducting training and technology-transfer activities.
Innovator	The Iowa DOT will investigate and develop recommended practices relative to new ITS technologies, techniques and institutional arrangements.
Implementer/Operator	The Iowa DOT will implement and operate ITS systems.
Partner	The Iowa DOT will help support, financially and through education, technology transfer and planning/analysis support, deployment of ITS systems by local and regional transportation agencies.

ITS Activities "Portfolio"

The "Balance" ITS program goal and objectives described in Subsection 4.2 indicate that the Iowa DOT will balance the ITS program across modes, between urban and rural areas, etc. An additional concept, the ITS Activities "Portfolio," has been developed to indicate that the Iowa DOT will also balance its ITS investments among research, deployment, and planning/support activities. This concept is illustrated graphically in Figure 4-1.

The total area represented in each of the major areas of activity shown in Figure 4-1 on the following page (e.g., research, deployment and planning/support) reflects, generally, the size of the investment and the extent of activity associated with each of the three basic ITS activity areas. Planning and other support activities, including education and marketing, are critical and provide the foundation for the entire program. The greatest proportion of the Iowa DOT's ITS investment will be made in the area of deployment – the implementation and operation of proven, well-established ITS technologies throughout the state. The leading edge of the overall Iowa DOT ITS program, a relatively small but very important sector of activity, is represented at the top of the investment pyramid, and includes research of new technologies, techniques and institutional arrangements.

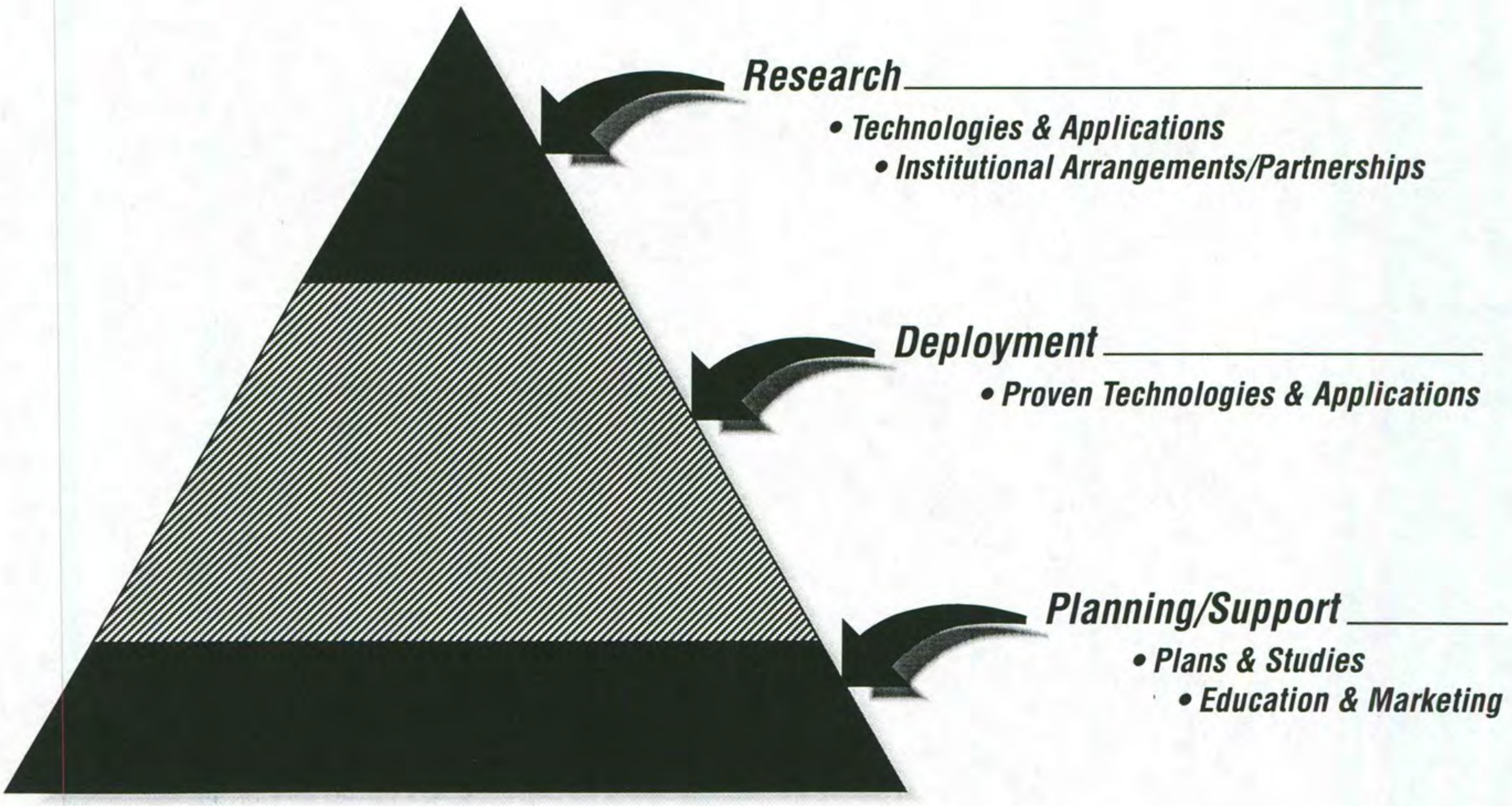


Figure 4-1
ITS Activities "Portfolio"

BRW, Inc., January 2000

5.0

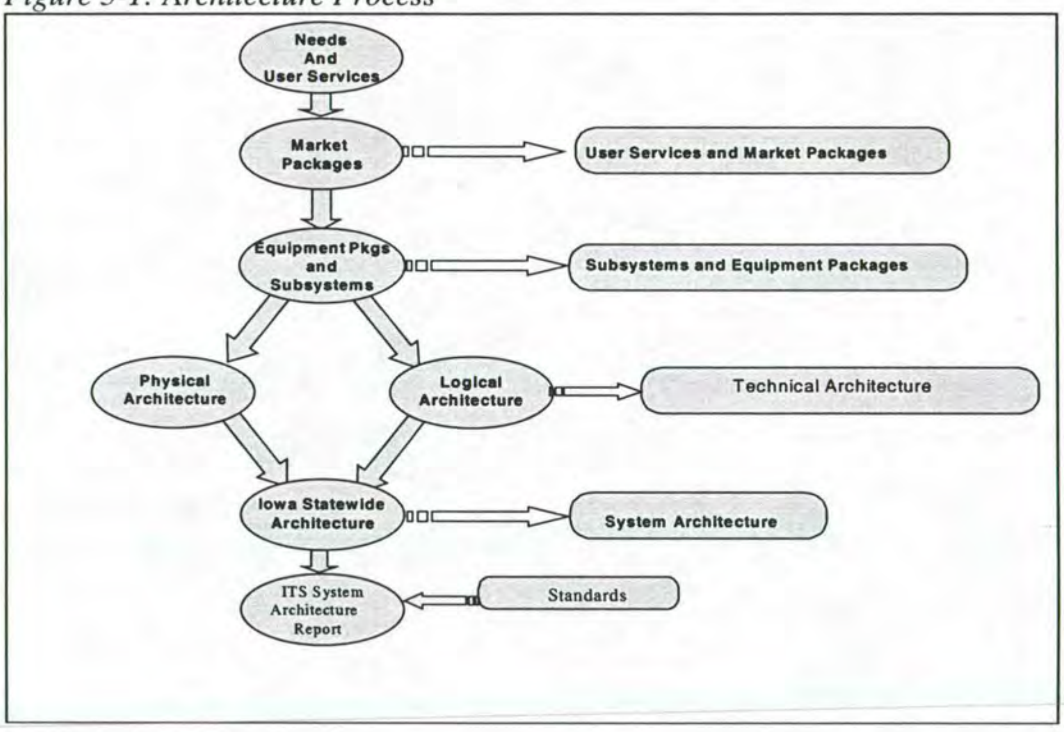
Statewide System Architecture

5.1 Introduction

One of the critical steps in developing the Iowa Statewide ITS Plan is the development of a "system architecture." A system architecture describes the "big picture" for statewide ITS deployment in terms of individual components (i.e. subsystems) that will perform the functions necessary to deliver the desired services. The architecture provides a "road map" for system development. It describes what is to be deployed, but not how those systems are to be deployed. A system architecture defines how components and subsystems will interface with each other, the functions to be performed by those subsystems, and the data flows among subsystems.

The process used to develop a system architecture for the region is based on the National ITS Architecture, developed by the United States Department of Transportation (U.S. DOT). This process provides a structured approach to developing an ITS Architecture for the Iowa Statewide ITS Plan that is based on addressing local needs and is consistent with the National ITS Architecture. This process is shown in Figure 5-1 below.

Figure 5-1: Architecture Process



This chapter highlights the critical components of the Iowa Statewide ITS System Architecture. Detailed system architecture is presented as a separate document titled "Iowa Statewide ITS Plan System Architecture." Reference is made to this document in several areas of this chapter. For more detail on the following subsections, this document may be referenced.

5.2 Identification of ITS User Services

User services have been selected based on local needs and problems. A mapping process was used to associate user services with local needs and problems identified during the workshops. The user services are prioritized and include a number of highest, high, and priority services that have not been identified through workshops, the user needs survey, and discussions of particular interest to Iowa. The reason these types of services have been listed is because, if these services are successfully implemented, they would directly address local needs throughout Iowa. The architecture describes a long term, 10-year view, and one of its main objectives is to ensure that all of the potential ITS elements and their linkages are included. For this reason, it is important to include even those services that are not seen as viable for implementation, or are deemed highly applicable in the short term. Details on the mapping process and the mapping tables are available in the Iowa Statewide ITS Plan System Architecture Report.

User Services Mapped for the Iowa DOT Statewide ITS Plan

Table 5-1, on the following page, presents the User Services identified for the Iowa DOT Integrated ITS and Services Deployment Plan based on local needs and problems. The user services are grouped by similar function into general categories or "bundles."

Table 5-1: Iowa DOT Statewide ITS Plan User Services

Iowa Statewide Plan Highly Applicable User Services	
User Service Bundle	**User Services**
Travel and Transportation Management	• Pre-trip Travel Information • Enroute Information • Route Guidance • Traveler Services Information • Traffic Control • Incident Management
Public Transportation	• Enroute Transit Information • Personalized Public Transit
Commercial Vehicle Operations	• Hazardous Material Incident Response
Emergency Management	• Emergency Notification and Personal Security • Emergency Vehicle Management
Advanced Vehicle Safety Systems	• Longitudinal Collision Avoidance • Lateral Collision Avoidance • Intersection Collision Avoidance • Vision Enhancement for Crash Avoidance • Safety Readiness • Pre-crash Restraint Deployment • Automated Vehicle Operation
Iowa Statewide Plan High Priority User Services	
User Service Bundle	**User Services**
Travel and Transportation Management	• Travel Demand Management
Iowa Statewide Plan Priority User Services	
User Service Bundle	**User Services**
Travel and Transportation Management	• Ride Matching and Reservation • Highway-Rail Crossing Safety
Public Transportation	• Public Transportation Management
Commercial Vehicle Operations	• Commercial Vehicle Electronic Clearance • Automated Roadside Safety Inspection • Commercial Vehicle Administrative Processes • Commercial Fleet Management

User Services Not Mapped for the Iowa Statewide ITS Plan

The following is a list of those user services not mapped to any needs identified in the Iowa DOT Integrated ITS and Services Deployment Plan. These user services are, in no particular order:

- Support Emission Testing and Mitigation
- Enhance Public Travel Security
- Provide Electronic Payment Services
- Facilitate On-board Safety Monitoring

These four user services, since they were not identified as critical, were not pursued under the Iowa DOT Integrated ITS and Services Deployment Plan.

5.3 Identification of ITS Market Packages

The use of market packages is a concept introduced in the National ITS Architecture. Market packages can be defined as a collection of equipment capabilities that satisfy a market need and are likely to be deployed as a group. Another way to think of market packages is as groupings of functions that are needed to deliver user services. For example, the market package "network surveillance" provides one of the critical functions for the user service "provide pre-trip travel information." Where user services typically describe "what" is to be deployed, market packages are more technology dependent and define "how" the services are to be provided. While the National ITS Architecture provides a basic set of market packages from which to select, this list is not intended to be prescriptive. Where the need arises, market packages can be added, deleted, and/or modified to fit a specific local preference or existing legacy system. Using the National ITS Architecture as a reference, concentrating on Iowa Statewide ITS Plan specific needs and learning from projects being deployed throughout the country, a comprehensive list of market packages can be prepared. Market packages allow an introduction to defining a preliminary architecture.

As with user services, a "standard set" or "master list" of market packages has been defined in the National ITS Architecture. All 60 of these market packages (version 2.0 National ITS Architecture) were considered for their applicability to identified Iowa Statewide ITS Plan user services. Using the same mapping and prioritization ranking process that was used for the needs, and user services, the mapping exercise allowed the identification of the highest, high, and priority market packages.

Details on this mapping process and the mapping table are available in the Iowa Statewide ITS Plan System Architecture Report. Definitions of the selected Iowa Statewide ITS Plan market packages (e.g., those found to be applicable to the identified user services) are also defined in the same report.

Market Packages Mapped for the Iowa Statewide ITS Plan

Table 5-2, located on the following pages, presents the Iowa DOT Integrated ITS and Services Deployment Plan's highest, high, and priority market packages.

Table 5-2: Iowa DOT Statewide ITS Plan Market Packages

Iowa Statewide ITS Plan Highly Applicable Market Packages	
Market Package Category	**Market Packages**
Advanced Traffic Management Systems (ATMS)	• Network Surveillance • Probe Surveillance • Surface Street Control • Freeway Control • HOV Management • Traffic Information Dissemination • Regional Traffic Control • Incident Management System • Traffic Prediction and Demand Management • Electronic Toll Collection • Virtual TMC Smart Probe Data • Parking Facility Management • Reversible Lane Management • Road Weather Information System
Advanced Public Transportation Management (APTS)	• Transit Vehicle Tracking • Transit Fixed Route Operations • Demand Response Transit Operations • Transit Passenger and Fare Management • Transit Security • Transit Maintenance • Multi-modal Coordination • Transit Traveler Information
Advanced Traveler Information Systems (ATIS)	• Broadcast Traveler Information • Interactive Traveler Information • Autonomous Route Guidance • Dynamic Route Guidance • ISP Route Guidance • Integrated Transportation Management/Route Guidance • Yellow Pages and Reservation • Dynamic Ridesharing • In-Vehicle Signing
Advanced Vehicle Safety Systems (AVSS)	• Vehicle Safety Monitoring • Driver Safety Monitoring • Longitudinal Safety Monitoring • Lateral Safety Monitoring • Intersection Safety Monitoring • Pre-crash Restraint Monitoring • Driver Visibility Improvement • Advanced Vehicle Longitudinal Control • Advanced Vehicle Lateral Control • Intersection Collision Avoidance • Automated Highway System

Iowa Statewide ITS Plan Highly Applicable Market Packages	
Market Package Category	**Market Packages**
Commercial Vehicle Operations (CVO)	• Freight Administration • On-board CVO Safety • HAZMAT Management
Emergency Management (EM)	• Emergency Response • Emergency Routing • Mayday Support
Other	• ITS Planning
Iowa Statewide ITS Plan Priority Market Packages	
Market Package Category	**Market Packages**
Advanced Traffic Management Systems (ATMS)	• Standard Railroad Grade Crossing • Advanced Railroad Grade Crossing • Railroads Operations Coordination
Commercial Vehicle Operations (CVO)	• Electronic Clearance • CV Administrative Processes • International Border Electronic Clearance • Weigh-In-Motion • Roadside CVO Safety

Market Packages Not Mapped for the Iowa Statewide ITS Plan

The following is a list, in no particular order, of the market packages not mapped to any Iowa Statewide ITS Plan user services.

- Emissions Monitoring and Management
- Fleet Administration
- CVO Fleet Maintenance

5.4 Customization of Market Packages

As seen in the earlier section, it is obvious that some of the market packages that are rated as highest, and priority for the Iowa Statewide ITS Plan do not address the local needs and user services and are not applicable to the implementation of the immediate and long-term projects. It is for this reason that a customization of the market packages was done to eliminate the packages which are inappropriate for the Iowa DOT Integrated ITS and Services Deployment Plan. This exercise allowed us to develop a customized master list of market packages which are comprehensive and specifically address the issues and needs in Iowa. To generate this customized list, a mapping exercise similar to the ones earlier was done.

The highly applicable market packages that were defined in Table 5-2 were mapped against the immediate short-term projects and the recommended long-term projects in the Iowa Statewide ITS Plan. Details of this mapping table are available in the System Architecture Report.

Customized List of Market Packages

Table 5-3, located below and on the following page, provides a list of the primary and secondary market packages that makes up the customized list of market packages. The market packages are grouped according to the type of ITS category they fall under, i.e. ATMS, ATIS, etc.

Table 5-3: Customized List of Iowa Statewide ITS Plan Market Packages

MARKET PACKAGE CATEGORY	MARKET PACKAGE
PRIMARY MARKET PACKAGES	
Advanced Traffic Management Systems (ATMS)	1. Network Surveillance 2. Surface Street Control 3. Freeway Control 4. Traffic Information Dissemination 5. Regional Traffic Control 6. Incident Management System 7. Road Weather Information System
Advanced Public Transportation Systems (APTS)	1. Transit Vehicle Tracking 2. Transit Fixed-route Operations 3. Demand Response Transit Operations 4. Multi-modal Coordination
Advanced Traveler Information Systems (ATIS)	1. Broadcast Traveler Information 2. Interactive Traveler Information 3. Autonomous Route Guidance 4. Dynamic Route Guidance 5. In-Vehicle Signing
Advanced Vehicle Safety Systems (AVSS)	1. Driver Visibility Improvement
Commercial Vehicle Operations (CVO)	1. Freight Administration 2. Electronic Clearance 3. CV Administrative Processes 4. HAZMAT Management
Emergency Management	1. Emergency Response 2. Emergency Routing 3. Mayday Support
Other	1. ITS Planning

MARKET PACKAGE CATEGORY	**MARKET PACKAGE**
SECONDARY MARKET PACKAGES	
Advanced Traffic Management Systems	1. Probe Surveillance 2. HOV Lane Management 3. Traffic Prediction/Demand Management 4. Electronic Toll Collection 5. Virtual TMC/Smart Probe Data 6. Standard Railroad Grade Crossing 7. Advanced Railroad Grade Crossing 8. Railroads Operations Coordination 9. Parking Facility Management 10. Reversible Lane Management
Advanced Public Transportation Systems (APTS)	1. Transit Passenger and Fare Management 2. Transit Security 3. Transit Maintenance 4. Transit Traveler Information
Advanced Traveler Information Systems (ATIS)	1. ISP-based Route Guidance 2. Integrated Transportation Management/Route Guidance 3. Yellow Pages and Reservation 4. Dynamic Ridesharing
Advanced Vehicle Safety Systems (AVSS)	1. Vehicle Safety Monitoring 2. Driver Safety Monitoring 3. Intersection Safety Warning 4. Intersection Collision Avoidance
Commercial Vehicle Operations (CVO)	1. Weigh-in-Motion 2. Roadside CVO Safety

5.5 Subsystems and Equipment Packages

A market package is implemented with a combination of interrelated equipment; this equipment often resides in several different subsystems within the architecture framework and may be operated by different stakeholders. For instance, the Transit Vehicle Tracking market package includes vehicle location equipment in the Transit Vehicle Subsystem and a base station element in the Transit Management Subsystem. In this example, all market package elements are owned and operated by the same transit stakeholder.

In other cases, the market package elements are owned and operated by different stakeholders. Many of the ATIS market packages require equipment in the information service provider subsystem that is owned and operated by a public or private information provider, as well as equipment that is acquired and operated by the consumer as part of the vehicle subsystem or personal information access subsystem. Since different end user equipment may be purchased and operated in different subsystems, these may be varied deployment subsystem-specific components.

To understand and analyze these potential deployment variations, the defined market packages must be decomposed to their constituent elements. The portion of the market package capabilities that are allocated to each subsystem are segregated and defined as "equipment packages" to support this additional resolution. An equipment package represents equipment (or software) which are likely to be purchased by an end-user to achieve a desired capability. This section will use the Iowa Statewide ITS Plan area customized market packages to identify the subsystems that are critical in developing a system architecture and identify the equipment packages that make up the market packages.

A mapping process to map the customized list of market packages (identified in Table 5-3) to subsystems and equipment packages identified in the National ITS Architecture was performed. As explained earlier, details on the mapping exercise are available in the System Architecture Report. The results of the mapping exercise to identify the Iowa DOT Statewide Plan list of subsystems and equipment packages is summarized below. Descriptions of the subsystems and the appropriate equipment packages are taken directly out of the National ITS Architecture and are available in the System Architecture Report.

Iowa DOT Statewide Plan Subsystems (SS) and Equipment Packages (EP)

1. **Archived Data Management (SS)**
   - Government Reporting System Support (EP)
   - ITS Data Repository (EP)
   - On-line Analysis and Mining
   - Traffic and Roadside Data Archival
   - Virtual Data Warehouse Services

2. **Commercial Vehicle Administration (SS)**
   - CV Information Exchange (EP)
   - CV Safety Administrator (EP)
   - Credentialing and Taxes Reporting (EP)

3. **Commercial Vehicle Check (SS)**
   - Roadside Electronic Screening (EP)
   - Citation and Accident Reporting (EP)

4. **Commercial Vehicle (SS)**
   - On-board Cargo Monitoring (EP)
   - On-board CV Electronic Data (EP)
   - On-board CV Safety (EP)

4. **Emergency Management (SS)**
   - Emergency Response Management (EP)
   - Emergency Vehicle Routing and Communications (EP)
   - Emergency Mayday and E-911 (EP)

5. **Emergency Vehicle (SS)**
   - On-board EV Incident Management Communicator (EP)

6. **Fleet and Freight Management (SS)**
   - Freight Administrator and Management (EP)
   - Fleet Credentials and Taxes Management Reporting (EP)
   - Fleet HAZMAT Management (EP)

7. **Information Service Provider (SS)**
   - Interactive Infrastructure Info (EP)
   - Basic Information Broadcast (EP)
   - Infrastructure Provided Route Guidance (EP)
   - EM Route Plan Information Dissemination (EP)

8. **Personal Information Access (SS)**
   - Personal Basic Information Broadcast (EP)
   - Personal Interactive Information Reception (EP)
   - Personal Route Guidance (EP)
   - Personal Mayday I/F (EP)

9. **Planning Subsystem (SS)**
   - Data Collection and ITS (EP)

10. **Remote Traveler Support (SS)**
    - Remote Basic Information Broadcast (EP)
    - Remote Interactive Information Reception (EP)
    - Remote Transit Fare Management (EP)
    - Remote Mayday I/F (EP)

11. **Roadway Subsystem (SS)**
    - Roadway Basic Surveillance (EP)
    - Roadway Signal Control (EP)
    - Roadway Freeway Control (EP)
    - Roadway Incident Detection (EP)
    - Roadway Traffic Information Dissemination (EP)
    - Roadside Signal Priority (EP)
    - Roadway In-Vehicle Signing (EP)

12. **Traffic Management (SS)**
    - Collect Traffic Surveillance (EP)
    - TMC Basic Signal Control (EP)
    - Traffic Maintenance (EP)
    - TMC Based Freeway Control (EP)
    - TMC Incident Detection (EP)
    - TMC Traffic Information Dissemination (EP)
    - TMC Regional Traffic Control (EP)
    - TMC Incident Dispatch Coordination/Communication(EP)
    - TMC Road Weather Monitoring (EP)

- TMC Input to In-vehicle Signing (EP)
- TMC Multi-modal Coordination (EP)

13. Transit Management (SS)
- Transit Center Tracking and Dispatch (EP)
- Transit Center Fixed-route Operations (EP)
- Transit Center Paratransit Operations (EP)
- Transit Center Multi-modal Coordination (EP)

14. Transit Vehicle Subsystem (SS)
- On-board Fixed-route Schedule (EP)
- On-board Maintenance (EP)
- On-board Paratransit Operations (EP)
- On-board Transit Signal Priority (EP)

15. Vehicle Subsystem (SS)
- Interactive Vehicle Reception (EP)
- Basic Vehicle Reception (EP)
- In-vehicle Signing System (EP)
- Vehicle Route Guidance (EP)
- Driver Visibility Improvement System (EP)
- Vehicle Mayday I/F (EP)

5.6 System Architecture

A system architecture "...defines the functions (e.g., gather traffic information or request a route) that must be performed to implement a given user service, the physical entities or subsystems where these functions reside (e.g., the roadside or the vehicle), the interfaces/information flows between the physical subsystems, and the communication requirements for the information flows (e.g., wireline or wireless). In addition, it identifies and specifies the requirements for the standards needed to support national and regional interoperability, as well as product standards needed to support economy of scale considerations in deployment." The system architecture provides a framework for delivering the selected market packages by identifying the major components of the system, referred to as subsystems, and how these subsystems relate to each other, including what data will be communicated between subsystems.

The Iowa DOT Statewide System Architecture will be developed from a physical and logical perspective. The physical layer will describe a technical and institutional layer. The technical architecture coordinates overall system operation by defining interfaces between equipment and systems that may be deployed by different organizational or operating agencies throughout Iowa. The institutional architecture represents the organizations, services, working arrangements, and jurisdictional structure that support the technical layer of the Iowa DOT statewide architecture.

Physical Architecture

The physical architecture provides agencies with a physical representation (though not a detailed design) of the important ITS interfaces and major system components. It provides a high-level structure around the processes and data flows defined in the logical architecture. The principal elements in the physical architecture are the 19 subsystems and architecture flows that connect these subsystems and terminators into an overall structure. A physical architecture takes the processes identified in the logical architecture and assigns them to subsystems. In addition, the data flows (also from the logical architecture) are grouped together into architecture flows. These architecture flows and their communication requirements define the interfaces required between subsystems, which form the basis for much of the ongoing standards work in the ITS program. Figure 5-1, on the following page, presents the systems and subsystems distributed along with the primary communications media (wireline, wireless, DSRC) identified. This diagram is frequently referred to as the "sausage diagram" within the National ITS Architecture due to the shape of the communication components. This diagram has been modified to reflect the subsystems that are part of the Iowa DOT Integrated ITS and Services Deployment Plan.

Technical Architecture

Figure 5-3 presents the Iowa DOT Statewide ITS Plan 20-Year Technical Architecture. As presented, this technical architecture represents a regional view of the ultimate ITS implementation over the next 20 years without taking into account who/what organization would be responsible for implementing all of the ITS systems. The white portions of the technical architecture represent those components and agencies that are currently performing some functions in Iowa, while the shaded portion represents potential future implementations within the region, based on the Iowa statewide prioritized needs, user services, and market packages described in earlier sections. This representation highlights the need for coordination and sharing of data and resources among the various transportation providers in the statewide area. The architecture presents a centralized approach to traffic management in the area. This does not dictate the need for a large physical building for a traffic management center; rather, it highlights the need for sharing the resources, data and some physical hardware. For example, the urban area TMCs will need to coordinate with other organizations such as Iowa DOT, and other cities and counties in Iowa, for implementing some parts of this architecture. Those organizations that perform traffic management functions will participate in this regional concept by sharing data (and potentially physical location and some control) between urban area TMCs and other transportation infrastructure elements.

This 20-year architecture presents the "big picture" for Iowa with regards to implementation of ITS. In order to remain consistent with other local, regional and national ITS implementations, this architecture was developed to be compatible with the National ITS Architecture, developed by the U.S. Department of Transportation. Using the architecture as a tool for the development of the Iowa DOT statewide 20-year architecture increases the likelihood that projects developed and implemented separately by the other cities in Iowa can be compatible and take full advantage of the synergies that might develop between their respective systems.

Figure 5-2: Iowa DOT Statewide ITS Plan Systems and Subsystems (Physical Architecture)

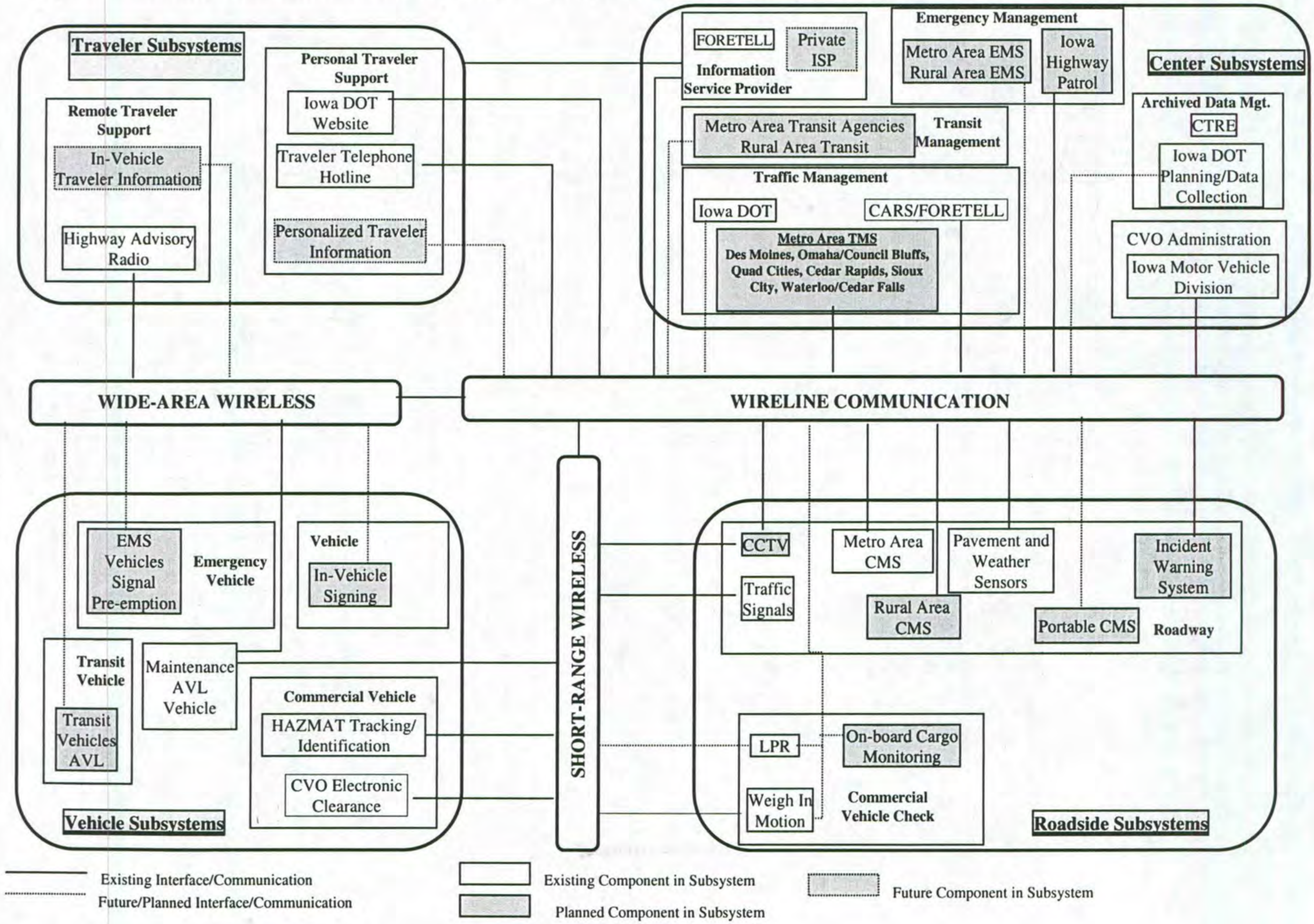
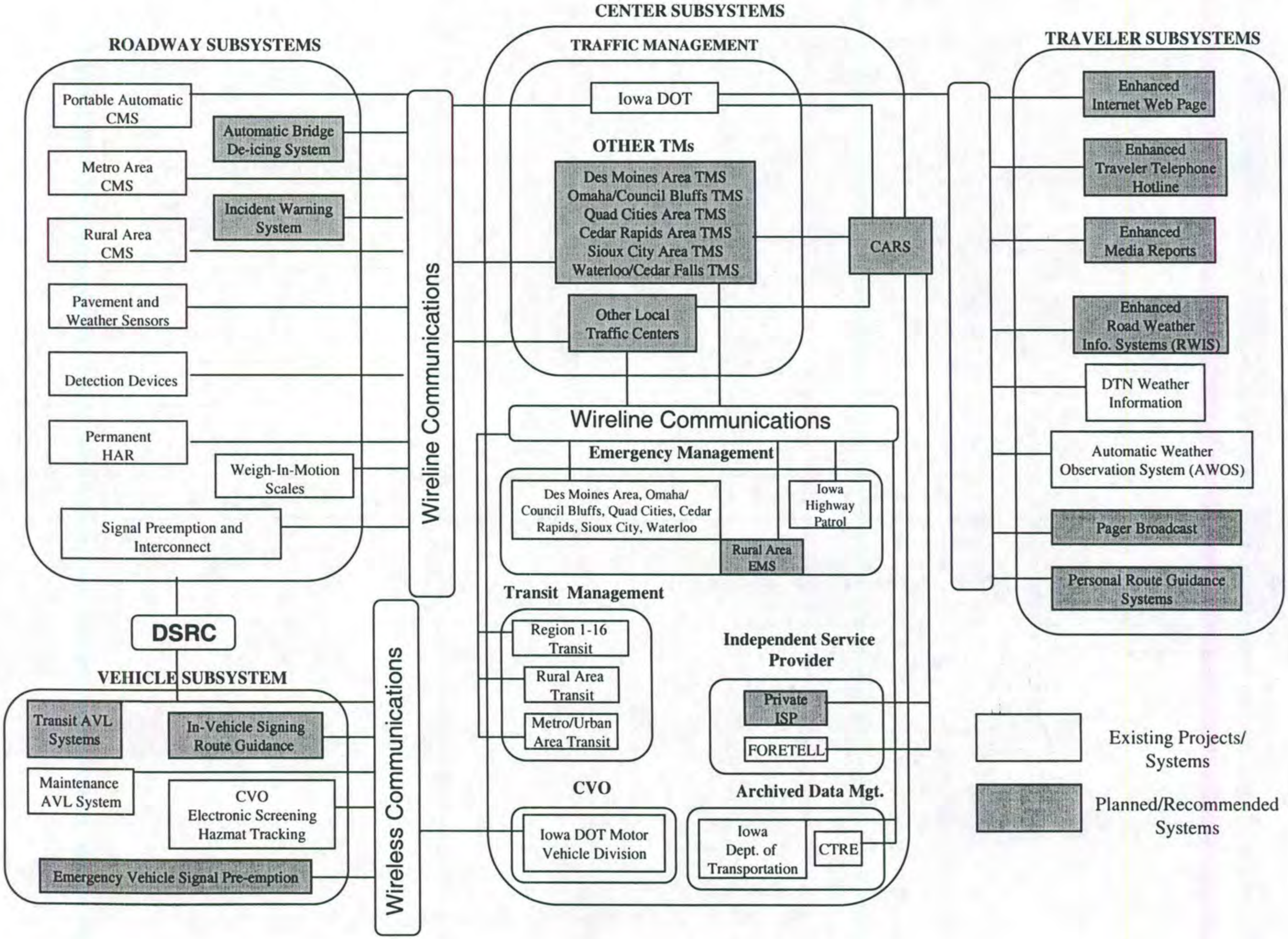


Figure 5-3: Iowa Statewide ITS Plan Recommended Architecture (Technical Architecture)



Subsystem Descriptions

The following sections describe the individual subsystems included in the 20-year technical architecture.

1. Center Subsystems

Traffic Management Control (TMC) Centers

The traffic management component of the 20-year technical architecture is separated into three main components:

Iowa DOT - Manages functions that deal with the statewide traffic control, interagency coordination, and planning functions. This function also provides standards compliance oversight and enforcement for public and private ITS activities. Though not likely to be a separate physical facility, Iowa DOT traffic management activities will be coordinated with the regional and local TMCs throughout Iowa.

Other Urban Area TMs - These are urban areas that perform traffic management activities and are recommended as areas that can host a traffic management center. The 20-year architecture presents an integrated approach where information (and even some control) of roadway infrastructure and operations is shared among various city, county and state organizations.

Other Local Traffic Centers - There are other cities and counties that perform traffic management functions in Iowa. For the 20-year architecture, it was assumed these local traffic centers will coordinate their information and efforts through the urban area TMCs and Iowa DOT to attain integrated and complete management of traffic in the state.

CARS - Consists of functions that deal with collection of raw and/or processed data and fusing this data to enhance the information made available to the user. Currently, this system collects construction information and road weather information. It processes it and sends it to the Foretell system that disseminates the processed data. In the future, this system could act as a central server that stores and provides users requesting the information through various mechanisms (public or private sector users). Information can include pre-trip travel, enroute driver, transit information, and additional functionality like route guidance and yellow pages traveler information. If the public sector wishes to retain "ownership" and control of the traveler information data, then this server would likely be included under the traffic management system. However, if the public sector wishes to leave the development and implementation of this server up to the private sector, then the server would remain in the traveler information system.

The systems described in the technical architecture can be combined into different types of traveler information based on the communication mechanism that they use. The following describe the types of traveler information systems that are part of the Iowa DOT Integrated ITS and Services Deployment Plan.

Emergency Management

This system consists of functions that deal with emergency response to traffic, transit and commercial incidents, mayday functions, and emergency routing functions.

Urban Area Emergency Management System - Includes coordination with the traffic management area for incident detection/notification/verification and potential signal preemption/ prioritization, use of AVL technologies for location of emergency vehicles for dispatching and tracking purposes, and emergency routing. Also includes operation of emergency 911 systems and the incorporation of that information into the normal management of the transportation infrastructure.

Rural Area EMS - Mostly deals with mayday applications, this area includes functions designed to assist motorists when stranded or involved in an accident/incident. Mayday systems can be user initiated (requires an action on the part of the traveler) or can be automatic systems based on sensor technology within the vehicle (i.e., airbag deployment sensors). This also includes operation of emergency 911 systems and the incorporation of that information into the normal management of the transportation infrastructure.

Iowa Highway Patrol - Interacts with Emergency Management Subsystem and the Commercial Vehicle Operations to assist in emergencies, commercial vehicle roadside inspections, etc.

Transit Management

Region 1-16 Transit Agencies, Rural Area Transit and Metro/Urban Area Transit - There are multiple local transit agencies in Iowa that perform some transit management functions. It is assumed in the 20-year architecture that all agencies will coordinate their system to establish a transit system that provides extensive coverage in the state. Functions include transit fare management, transit passenger management, transit security, interagency coordination, intermodal coordination, transit information dissemination, etc. Transit information dissemination is accomplished both through the transit system itself (on-board signing, traveler information terminals/kiosks at bus/rail stops, etc.), and through the larger traveler information system. Independent service providers can receive real-time schedule and fare information through the centralized data collection/fusion server and provide that information to their customers.

Commercial Vehicle Operations

Iowa DOT Motor Vehicle Division - This division manages the commercial vehicle operations in the state. It includes functions that deal with fleet and freight administration, electronic clearance, weigh-in-motion, and commercial vehicle safety. It also includes functions that deal with HAZMAT incident detection, verification, and notification. There are a number of commercial vehicle ITS programs that have been identified by the Motor Vehicle Division and are detailed are in the Iowa ITS/CVO Business Plan, August 1999.

Archived Data Management

This system consists of planning, data archiving, and data management activities.

Iowa DOT - Manages the ITS planning and data management activities for the state. This includes data collection, archiving, and possibly data sharing to other agencies regionally and locally.

The Center for Transportation Research and Education (CTRE) - CTRE is the focal point for transportation at Iowa State University. CTRE performs transportation research for public and private agencies; manages its own education program for students; and conducts local, regional and national transportation services and continuing education programs.

Independent Service Provider

This system deals with the functions necessary to disseminate information to travelers by processing information and adding value-added data for the traveling public.

Foretell - This project is being led by the Iowa DOT. It is designed to implement a commercially viable, self-sustaining integrated Intelligent Weather and Transportation System. Foretell is designed to increase safety, security and mobility, and will lead to improved Iowa DOT maintenance and operational efficiencies.

Private ISP - In the future, a private ISP may be interested in providing information to the traveling public in the Iowa area. Information can include incidents, route guidance, weather information, etc.

2. Roadway Subsystem

Within the 20-year architecture, the roadway system represents the infrastructure physically deployed on the roads in Iowa.

Detection Devices - Part of surveillance and includes communications and hardware installed to provide operational coverage of the freeways and arterials through speed sensors and detectors. This also includes communications and hardware installed to provide detailed operational surveillance coverage of the freeways and arterial streets through CCTVs.

Changeable Message Signs (CMS) - Part of roadside traffic information dissemination and includes the physical infrastructure in place on the freeway and arterials for disseminating traffic information through changeable message signs controlled remotely by various agencies. In the Iowa Statewide ITS Architecture, there are three types of changeable message signs: portable, metro area CMS, and rural area CMS.

Permanent Highway Advisory Radio (HAR) - Part of roadside traffic information dissemination and includes the physical infrastructure in place on the freeway and arterials for disseminating traffic information through specific radio channels.

Signal Preemption and Interconnect - Management and control of traffic signals and lane controls on the arterials.

Pavement and Weather Sensors - Part of surveillance and includes communications and hardware installed to provide weather conditions of the freeways and arterials through pavement and weather sensors, environmental sensor detectors.

Weigh-in-Motion Scales - Part of roadside detection equipment and includes weigh-in-motion scales to detect commercial vehicle traffic cargo on the freeways.

Automatic Bridge De-icing System - Part of surveillance and includes the pavement sensors installed on bridge decks to detect temperature changes and release de-icing chemicals.

Incident Warning System - Part of surveillance and includes detection devices, message signs, etc., positioned at strategic locations along the bridge (Interstate 74 Bridge in the Quad Cities) to notify travelers of non-recurring incidents.

The infrastructure components of the architecture are controlled and operated via the regional/statewide/local traffic management activities mentioned earlier. Together, they provide the combined capability to monitor, manage and control expressway, freeway and arterial street traffic throughout the area.

3. Traveler Subsystems

The development and deployment of traveler information systems is a prime area for private sector involvement. While the public sector is well equipped for the development and management of the infrastructure (roadways, traffic management, etc.), the private sector is well suited for the development of products to use the information collected by the public sector and provide that to the traveling public. The 20-year architecture focuses on four major areas within the traveler information systems as follows:

Interactive Traveler Information (Web Page, Personal Route Guidance) - These involve the user requesting information through a device/system with which they interact. Iowa DOT currently has a web page and this system can be enhanced to include route guidance, pre-trip and enroute travel information. These systems can be remote units like in-vehicle systems or hand-held personal computers. These systems can also perform route guidance functions.

Broadcast Traveler Information (Automated Telephone, RWIS, Pagers) - These systems provide traveler information through a broadcast mechanism where there is no interaction between the user and the broadcast system. This could include providing information to road weather information systems, pagers, automated telephone systems, etc. The information broadcast is real-time and supports enroute driver information.

Media Reports - Included separately, the interfaces with the media include electronic interfaces such as those described above as well as interfaces with the print media in Iowa. Though not real-time, the print media can provide a valuable source of information dissemination to the general public about known traffic and travel conditions. This can be of particular benefit in the dissemination of traffic information about planned events (road construction or special events).

Policy decisions by the Iowa DOT statewide partners will determine their role in providing traveler information services. Philosophically, the Iowa DOT partners, in cooperation with the other state and local agencies, must decide whether the provision of traveler information is to be left up to the private sector or if the public sector will provide this information as a public service. The architecture will support either approach.

Data Transmission Network (DTN) Weather Information - This is a system that delivers information via satellite to rest areas and is available through subscriptions.

Automatic Weather Observation System (AWOS) - This system is managed by the Iowa DOT Office of Transportation Data and collects weather information from 32 airports around Iowa. Data is available from an interactive Web site, found at www.dot.state.ia.us.

4. Vehicle Subsystems

This system consists of four main components: Personal Vehicle, Commercial Vehicle, Emergency Vehicle, Transit Vehicle.

Personal Vehicle - Consists of functions deployed in the individual traveler's vehicle that support probe surveillance, in-vehicle signing, routing/navigation, receiving in-vehicle traveler information, electronic toll, and interacting with the infrastructure for advanced automatic vehicle operation.

Commercial Vehicle - Includes functions that deal with roadside vehicle checks, on-board safety monitoring, on-board trip monitoring, vehicle mayday functions, electronic clearance, HAZMAT tracking, and interacting with the infrastructure for advanced automatic vehicle operation.

Emergency Vehicles - Includes functions that deal with regular and HAZMAT incident response and clearance, emergency routing, Mayday support, signal pre-emption/prioritization and interacting with the infrastructure for advanced automatic vehicle operation.

Transit Vehicles - Includes functions that deal with automatic vehicle location (AVL), on-board load and fare management, transit vehicle tracking sensors, intermodal coordination, on-board transit security, on-board transit information, and interacting with the infrastructure for advanced automatic vehicle operation.

Maintenance AVL System - Includes functions that deal with a "concept maintenance vehicle" which collects weather data for traveler information applications, maintenance fleets, and for the application of road treatment material.

Subsystem Interactions

The detailed discussion on the descriptions of interactions between the high-level centers identified on the 20-year technical architecture is available in the System Architecture Report. While the previous section focused on the functionality contained within each center, the subsystem interactions will focus on the data flows between the various subsystem components and the shared communication and control functions.

Details on the subsystem interactions are focused around six major subsystems: Roadway, Traffic Management, Traveler Information Systems, Emergency Management, Transit Management, and Commercial Vehicle Operations. The data flow diagrams for each of these subsystems are included in the System Architecture Report. In order to maintain consistency with the National ITS Architecture, the individual data flows identified in the diagrams were derived from the data flow diagrams contained within the National ITS Architecture.

Appendix B of the System Architecture presents a listing of these architecture data flows and the flow descriptions.

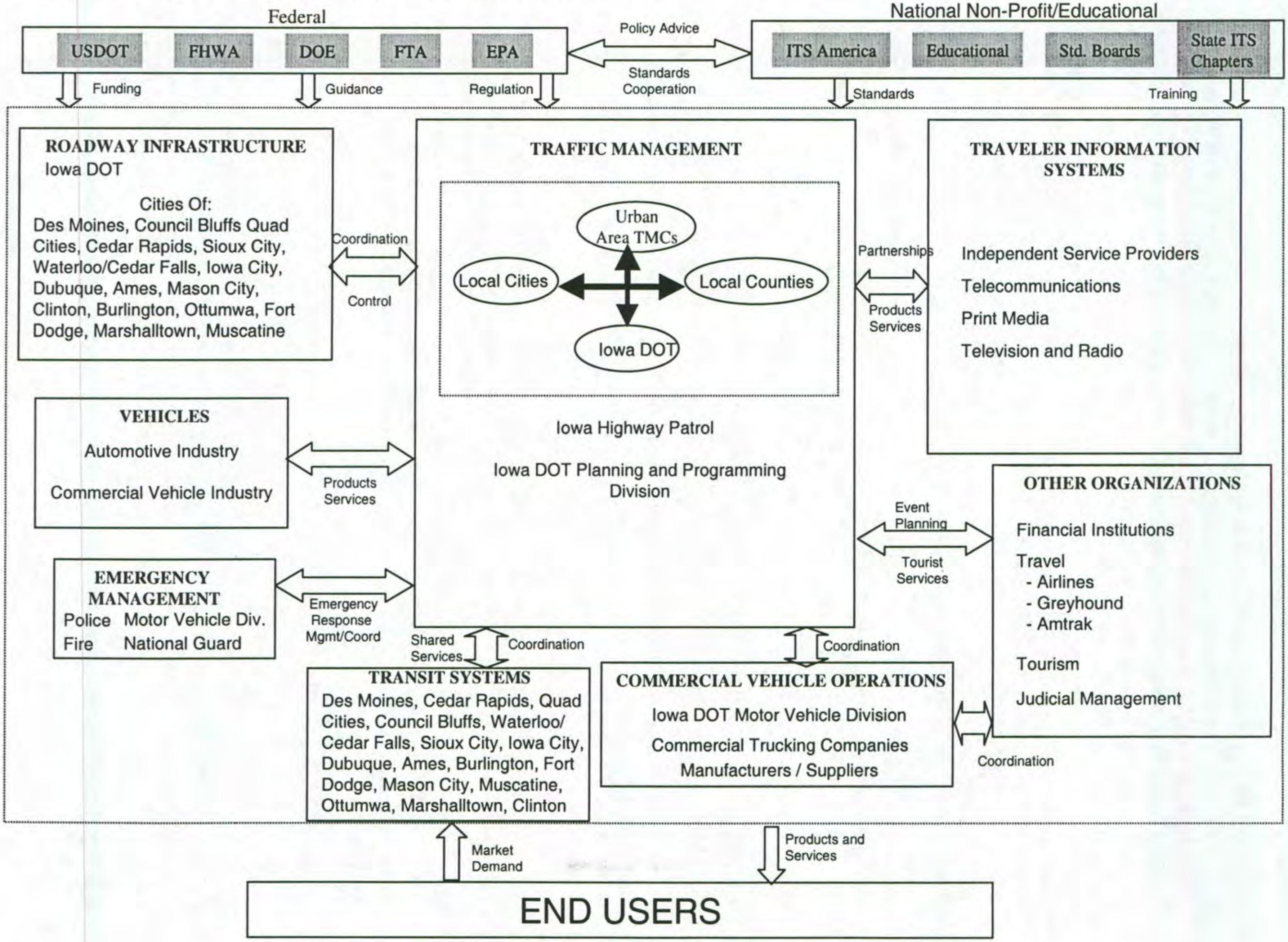
Institutional Architecture

The institutional layer presents a different view of the "ITS landscape" in a particular area than the technical layer. Where the technical layer focuses on the actual "systems" that are to be deployed (either legacy or new) and the hardware, software and communication components of those systems, the institutional layer focuses on the organizational activities and interactions that must take place. Figure 5-4 presents the institutional layer for the Iowa DOT Statewide ITS Plan. Similar to the technical view, the institutional layer was developed as a 20-year look into the future to develop the ideal institutional operating arrangements for a seamless, coordinated regional ITS operation. This depiction of the institutional layer is not intended to indicate only the areas where Iowa DOT will assume responsibility for operation and/or control of ITS activities. Some of the institutional arrangements depicted on this architecture diagram are beyond the responsibility and/or control of Iowa DOT. This is simply a "look into the future." It is intended to serve as a guide for the Iowa DOT Statewide ITS Plan agencies interaction with other agencies.

Statewide ITS Institutions

The institutional layer of the ITS architecture represents those organizations and agencies that will need to interact in some fashion in the 20-year regional ITS operating scenario depicted in the technical architecture. Obviously, Iowa DOT is not the only "player" in this scenario and will need to coordinate ITS activities with the agencies represented on the institutional layer. The following sections describe the various agencies and/or organizations that must interact with each other in a seamless deployment of ITS technologies in Iowa.

Figure 5-4 : Iowa DOT Statewide ITS Plan Institutional Architecture



Statewide Traffic Management Institutions

The central focus of the institutional architecture is a centralized, statewide traffic management function. This is depicted on the architecture drawing by the four inter-connected circles representing the Urban Area TMCs, other cities in Iowa, other counties, and the Iowa DOT. These key agencies are the ones tasked with managing the transportation infrastructure, providing transportation services to the traveling public, and coordinating deployment of ITS in the region. This architecture does not dictate a "lead" agency; rather, a coordinated group approach where each organization manages and operates its own infrastructure components. These components are not operated "in a vacuum." It is not required that these operations be physically co-located. It is more important that these organizations be coordinated in their approach to managing traffic in the region. This architecture emphasizes the point that what happens (or is implemented) on one part of the system will have impacts (some positive, some negative) on many other components.

Other institutions included within this component are the Iowa Highway Patrol, and the Iowa DOT Planning and Programming Division. While these institutions will not likely be deploying ITS technologies themselves, they will need to have input as part of a statewide deployment.

Roadway Infrastructure Institutions

Interactions between the roadway subsystem and the TMC subsystem involve mainly those organizations already discussed as part of the statewide traffic management approach. As the ITS picture expands and evolves over the next 20 years, it will be important for <u>ALL</u> institutions that operate any kind of roadway infrastructure to be working together to manage the traffic from a regional perspective.

Vehicle Institutions

The interactions depicted between the TMC and the vehicles component represent the regional organizations working with the automotive and commercial vehicle industries. These efforts will continue the evolution of ITS-related technologies into the vehicle and how these technologies might interact with both regional TMCs as well as ITS infrastructure imbedded into the roadway system. An example of this might be the evolution to a common "tag" or card to be used for electronic tolling and other transactions nationwide that would be installed by the vehicle manufacturers into every vehicle.

Emergency Management Institutions

The interaction between the TMC component and the emergency management services is key to the smooth operation of incident management and response. These organizations must talk together to share information on incidents (location, severity, duration, etc.), as well as to provide coordinated response plans. This interaction could evolve into a co-located operations center where traffic management and emergency management activities are conducted, or it could be a virtual center, physically located in several separate locations. The location is not the important issue; the communication and sharing of information on a real-time basis is the key ingredient.

Transit Institutions

Interaction between the multiple transit agencies (listed in the figure) and the TMC will be another case of two-way, shared information. The TMC component can provide the transit agencies with real-time, system-wide status of the transportation system. This information can be used to manage fleet operations and scheduling activities. As the transit agencies know more about what is happening on the roadways around the region, they can use this information to provide better service and more information to their customers, thus increasing the "quality" of their service. The transit agencies can also serve as a critical data input source to the statewide TMC efforts. Typically, transit systems operate one of the larger fleets of vehicles in a metropolitan area. Using existing communications capabilities with the transit vehicles (and especially as some of the agencies progress further with their implementation of AVL-equipped vehicles), these vehicles can serve as probes to the TMC system.

Commercial Vehicle Institutions

One of the key players in the commercial vehicle operations is the Iowa DOT Motor Vehicle Division. There are several programs the division operates currently, and has several future CVO projects including electronic screening, weigh-on motion, etc. Interactions between the commercial vehicle operations and the various agencies involved in traffic management (Iowa DOT, Urban TMCs, cities and counties) will be enhanced as more deployment occurs throughout Iowa.

Traveler Information Institutions

Interactions with the traveler information services (TIS) component represent an opportunity to provide information on the roadway conditions (speed, travel times, incidents, etc.) to the public for their use in travel planning. Several organizations (Iowa DOT, CARS/Foretell) see the delivery of traveler information as a part of their overall mission. In addition to the public agencies involved in delivering this information, many private sector organizations are also involved in providing these services. The public sector agencies that conduct the traffic management activities and control the roadway infrastructure provide the key ingredient in any approach to deliver traveler information. Without the collection of the data on the roadway infrastructure, delivery of traveler information is limited to static information and is of limited value. This puts the public agencies in a key position to establish potential public-private partnerships for the delivery of traveler information. The interaction between the private sector information service providers (ISPs) and the public agencies can range from the public agencies providing the data for free as a "public service," to cooperative partnerships with private organizations (potential sharing of resources, revenues, in-kind contributions), all the way to a free market approach of selling the information to the highest bidder. The exact nature of this relationship will be determined collectively by the public and private organizations.

Other Institutions

Finally, there are many other institutions that will be involved in the overall transportation picture that are not traditionally considered to be transportation providers. These interactions include continued evolution of the relationships with financial institutions as smart-card type technologies increase and pay-for-service becomes more common in one key area for ITS technology evolution. It is important that everyone know when special events are planned, and the expected impacts these events can have on the transportation system, so the appropriate planning measures can be implemented and travelers can be made aware of the situation. Other providers of transportation services, such as Greyhound, Amtrak and the tourism industry, need to be included in the overall planning and coordination of the ITS systems in the region. These institutions can play a key role in solving/servicing some of the niche transportation needs in the area, promoting multi-modal transportation, and decreasing the number of single-occupant-vehicle (SOV) trips.

Outside Influences

There are several "outside" influences to the institutional arrangements established for ITS operations in the Integrated ITS and Services Deployment Plan. These include the federal government, national and regional non-profit/educational organizations (e.g., ITS America, its state chapters, the Institute for Transportation Engineers, etc.), and the end users of these products.

The U.S. DOT, primarily through the Federal Highway Administration and the Federal Transit Administration, provide much of the funding, guidance, and regulatory control of ITS activities conducted in the area. Through activities such as the National ITS Architecture, field operational tests, and model deployment initiatives, the federal government sets standards and requirements for the design, implementation, and operation of ITS systems that use any source of Federal funding.

The primary role for the national and regional non-profit/educational organizations will be through assisting in the development of standards and provision of training programs for ITS professionals throughout the state and region. These organizations also interact with the federal agencies to coordinate their standards development activities as well as to provide policy guidance/advice.

The final outside influence identified as part of the institutional architecture is the end user. The end users are the traveling public who will receive the benefits of a statewide ITS.

Logical Architecture

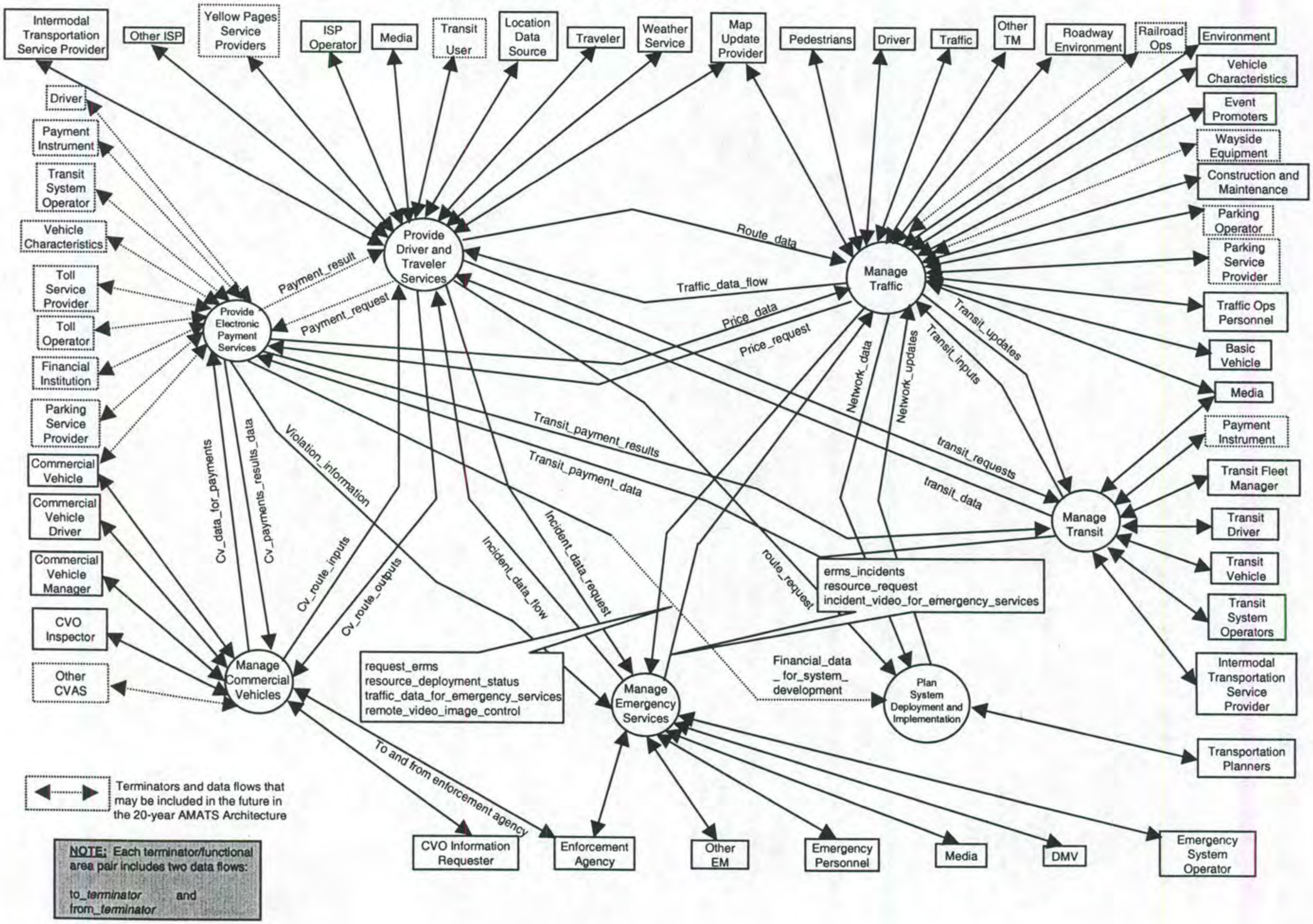
This section describes the logical architecture developed from the Iowa DOT Statewide ITS Plan User Services. This depiction of the architecture represents Iowa DOT's approach to managing ITS and, specifically, the management and operation of the local roadways. The logical architecture presented in Figure 5-4 was adapted from the National ITS Architecture, level 0 data flow diagram (DFD), and is designed to represent the system, as it will exist based on the proposed project list. Particular attention was given to management of traffic on the freeways and arterial streets in the area.

High-Level Data Flow Diagram

In the level-zero diagram in Figure 5-5, which is the highest level of a logical architecture, the Iowa Statewide ITS Program is presented as eight functional areas: manage traffic, manage commercial vehicles, provide vehicle monitoring and control, manage transit, manage emergency services, provide driver and traveler services, provide electronic payment services, and plan system deployment and implementation. This depiction shows the major high-level functions performed by, or integrated with, the Iowa DOT partners. The "boxes" around the outside of the figure represent terminators as described in the National ITS Architecture.

A terminator represents either an initial input "source" or an output "user" of the ITS information. Detailed descriptions of the data flow dictionary is provided as Appendix C in the system architecture report. The terminators represented on Figure 5-5 represent those sources and/or users of ITS information for which Iowa DOT statewide partners are anticipated to interact with (as depicted in the 20-year system architecture).

Figure 5-5: Iowa DOT Statewide ITS Plan High-Level Logical Architecture



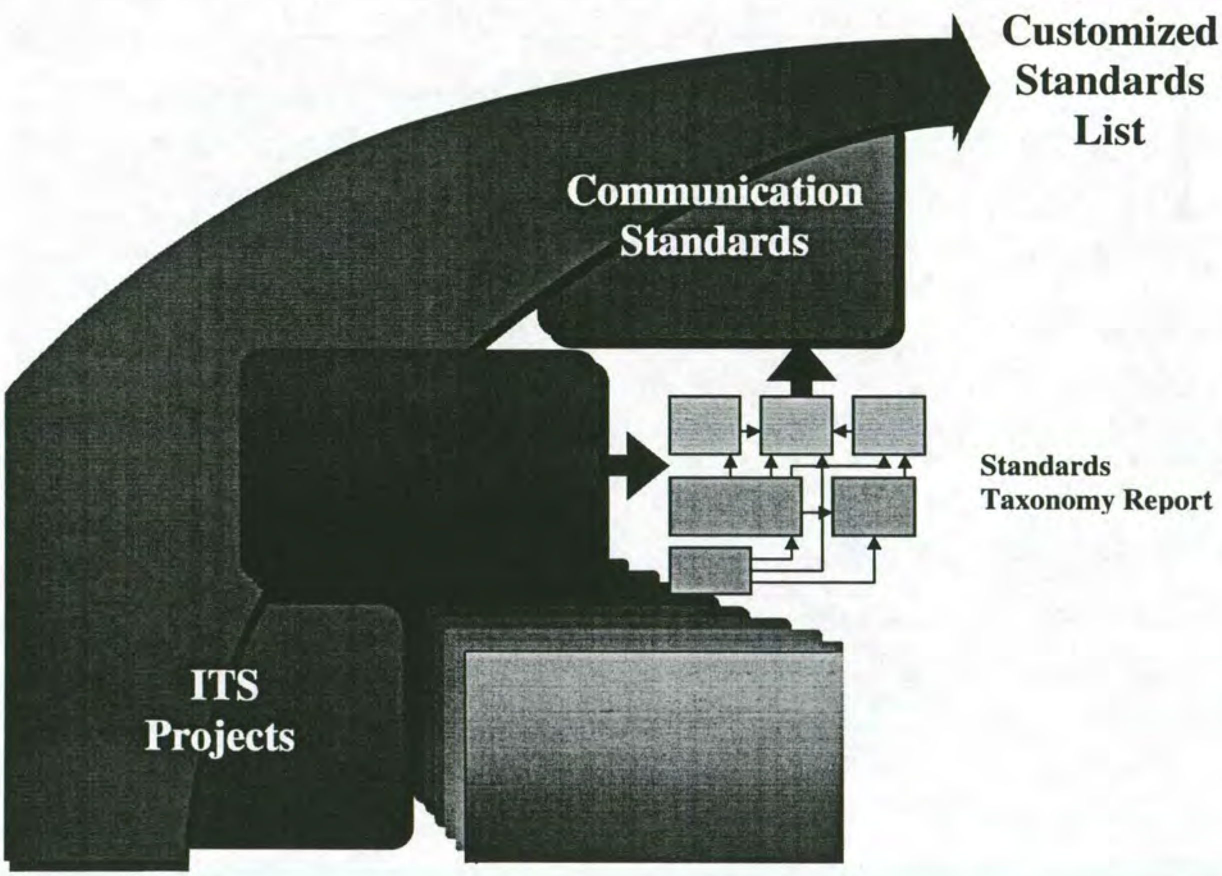
5.7 Standards

Standards can be thought of as the glue that pulls the various pieces of the architecture together. The logical architecture presents a functional view of the ITS user services. It defines the functions or processes that are required to perform the selected ITS user services, and the information or data flows that need to be exchanged between these functions. The physical architecture partitions the functions defined by the logical architecture into systems and subsystems. In order to accomplish the functions outlined in the logical architecture, some communication must take place between the elements of the physical architecture. Standards define how these communications take place.

Selecting Standards for the Iowa DOT Statewide ITS Plan

While the Iowa Statewide ITS Plan is a comprehensive plan, covering the whole state and all the appropriate ITS applications, it does not cover every conceivable ITS technology. As such, not every ITS standard discussed above will be applicable to the proposed projects for Iowa. In order to focus on those standards most relevant to the technologies and projects recommended, the selection process shown in Figure 5-6 was used.

Figure 5-6: ITS Standards Selection Process



Similar to the process used to develop the physical architecture, a mapping process was used to "map" the selected ITS projects to the appropriate ITS communication standards. The first step in this process was to map the projects to the ITS market packages presented in the National ITS Architecture. This mapping table is available in the system architecture report. Using the market packages that were defined through the mapping process, the next step in identifying the relevant standards for use with the proposed Iowa ITS Projects was to map the selected market packages to the applicable standards.

As part of the national ITS standards testing program, Battelle prepared for the U.S. Department of Transportation the ITS Standards Taxonomy Report (Draft)[2]. Appendix 2 of the taxonomy report provides a summary of the 1st-Order ITS standards relationships to the national ITS architecture market packages. The symbols used are consistent with those used in the national ITS architecture physical view. Using this approach for the primary market packages identified above, the market packages were then mapped to the ITS communication standards. Details on this approach and the mapping table for market packages to standards is available in the system architecture report.

Key Standards Supporting Recommended Projects for the Iowa DOT Statewide ITS Plan

Table 5-4 lists the key standards that support the implementation of the immediate-term projects and the long-term recommended projects.

Table 5-4: Key Standards Supporting Projects for the Iowa Statewide ITS Plan

#	Standard Name	Standard Title
2	TS 3.RMC	NTCIP - Object Definitions for Ramp Meter Control
4	TS 3.CLA.C	NTCIP - Class A and Class C Profile
7	TS 3.7	NTCIP - Object Definitions for Environmental Sensor Stations
9	TS 3.CORBA, TS 3.DATEX	NTCIP - Application Profile - CORBA & Data Exchange (DATEX)
13	TS 3.3	NTCIP - Class B Profile
15	TS 3.5	NTCIP - Object Definitions for Actuated Traffic Signal Controller Units
16	TS 3.6	NTCIP - Object Definitions for Dynamic Message Signs
18	TS 3.TSS	NTCIP - Object Definitions for Transportation Sensor Systems (formerly SEN)
19	TS 3.DCM	NTCIP - Data Collection & Monitoring Devices
22	ITE-9601-1	ATMS Data Dictionary (TMDD) - Section 1&2 (Links/Nodes/Events) (TM 1.01)
23	ITE-9601-3	ATMS Data Dictionary (TMDD) - Section 3&4 (Traffic Control/DMS/Video) (TM 1.02)
27	ITE-9604-1	Message Set for External TMC Communication (MS/ETMCC) (TM 2.01)
29	TCIP-CC	TCIP - Control Center Objects

[2] ITS Standards Taxonomy Report for the Intelligent Transportation Systems Standards Testing Program, prepared for the U.S. Department of Transportation, Battelle, July 12, 1999

#	Standard Name	Standard Title
34	TCIP-OB	TCIP – On-board Objects
35	TCIP-PI	TCIP – Passenger Information Objects
36	TCIP-SCH	TCIP – Scheduling/Runcutting Objects
38	TCIP-TM	TCIP – Traffic Management Objects
39	TS284	Commercial Vehicle Safety Reports
40	TS285	Commercial Vehicle Safety and Credentials Information Exchange
41	TS286	Commercial Vehicle Credential
45	P1512	Standard for Common Incident Management Message Set (IMMS) for use by EMCs
48	P1404	Guide for Microwave Communications System Development
50	P1455	Message Sets for DSRC ETTM & CVO
60	J2313	On-Board Land Vehicle Mayday Reporting Interface
63	J2354	Advanced Traveler Information System (ATIS) Message Set
64	J2355	ITS Data Bus Reference Architecture Information Report
65	J2364	Standard for Navigation and Route Guidance Function Accessibility While Driving
66	J2365	Standard for Navigation and Route Guidance Man-Machine Interface Transactions
73	J2369	Standards for ATIS Message Sets Delivered Over Bandwidth Restricted Media
77	J2395	ITS In-Vehicle Message Priority
78	J2396	Measurement of Driver Visual Behavior Using Video Based Methods (Def. & Meas.)
79	J2399	Adaptive Cruise Control: Operating Characteristics and User Interface
80	J2400	Forward Collision Warning: Operating Characteristics and User Interface

6.0

Projects

This section details the specific projects that will be pursued through Iowa's ITS program over the next decade. This section includes the identification and evaluation process that resulted from the needs assessment and prioritization process detailed in Section 3.0, an overview of each of the seven program areas and the projects included in each, and descriptions of the nearly 80 specific projects to be pursued.

6.1 Project Identification and Evaluation

This sub-section details the specific criteria and methodology for identifying and evaluating the most appropriate and beneficial future ITS projects to undertake as part of the Iowa DOT ITS and Services Deployment Plan. ITS activities undertaken in Iowa over the next decade will include the continuation of existing Iowa DOT initiatives, previously identified immediate-term projects, as well as future projects identified through this selection process.

Project Classifications

Existing Initiatives

As mentioned in Section 2.0, the Iowa DOT is currently supporting nearly 40 separate ITS initiatives throughout the state. Several of these current initiatives will be continued through deployment of immediate-term and future projects, and it is important that the current initiatives be fully integrated with these upcoming ITS project deployments.

Immediate-Term Projects

As a result of the Spring 1999 steering committee meetings, a few "early winner" immediate-term projects were identified to be pursued in Year 1. All nine immediate-term projects identified by the Iowa ITS Steering Committee were approved for funding and have been added to the Iowa DOT's Statewide Transportation Improvement Program. Of these projects, two are funded for Year 1 only, while the other seven projects will be continued into Years 2-5. Detailed descriptions of these projects are discussed in Subsection 6.3.

The immediate-term projects are:

- ❑ Iowa DOT Statewide Communications Plan (Statewide) = *Year 1 Only*
- ❑ National Model Expansion (Statewide) = *Year 1 Only*
- ❑ Statewide ITS Marketing and Education (Statewide) = *Years 1-5*
- ❑ Integrated Database Development and Packaging (Statewide) = *Years 1-5*
- ❑ Speed Processing of Crash Data (Statewide) = *Years 1-5*
- ❑ ITS Weather Information on the Iowa DOT Web Site (Statewide) = *Years 1-5*
- ❑ Red Light Running Demonstration Program (Statewide) = *Years 1-5*
- ❑ Incident Warning System Pilot Project (Quad Cities area) = *Years 1-5*
- ❑ Automated Bridge De-icing System Pilot Project (Cedar Rapids area) = *Years 1-5*

<u>Other Potential Years 2-10 Strategies/Projects</u>

In addition to the previously identified immediate-term projects to be pursued in Year 1, there are numerous other ITS advanced technologies and project support activities that could potentially be applied in Iowa. In order to identify the most appropriate and beneficial future ITS projects to undertake, it is first necessary to consider all possible ITS "strategies." Strategies, for purposes of this document, are defined as generic potential applications of ITS that are not specific to one particular location. Further explanation of this distinction is discussed on the following pages.

The potential ITS strategies available encompass a large "universe" of ITS advanced technologies and approaches that are in differing stages of maturity. Several ITS advanced technologies have already been widely deployed in several locations throughout the United States and internationally, while other technologies are less proven or are still under development. Therefore, not all ITS strategies will be applicable or feasible in Iowa within the next decade. The initial evaluation of these potential ITS strategies will support the identification of specific deployable projects for the 10-year ITS program. In addition, several of the current Iowa DOT ITS initiatives and the immediate-term projects are examples of these strategies already being applied in the state.

The potential ITS strategies, grouped by general deployment area, are listed on the following page. Strategies that are partially or fully addressed by immediate-term ITS activities are denoted by a ♦.

Table 6-1: Potential ITS Strategies[#]

ITS Planning, Marketing, and Administration
- ITS Plans and Studies ♦
- ITS Marketing and Education Programs ♦
- ITS Program Administration and Development ♦

Travel and Traffic Management
- Metropolitan Area Traffic Management Systems
- Regional/Inter-jurisdictional Traffic Signal Coordination Programs
- Metropolitan Area Incident/Event Management Programs
- Event Management and Routing Programs
- Highway-Railroad Operations Coordination and Interface Safety Systems
- Roadway Construction Coordination System
- Smart Work Zones / Portable Traffic Management Systems / Alternate Routes
- Crash Investigation Systems
- Emissions Testing and Mitigation Programs
- Automated Enforcement ♦
- Roadway Weather Safety / Incident Prevention Systems ♦
- Virtual TMC and Smart Probe Surveillance
- Dynamic Toll Management / Electronic Toll Payment

Traveler Information
- Rural Highway/Freeway Changeable Message Signs
- Rural Highway/Freeway HAR / Tourist Traveler Information
- Metropolitan Area Changeable Message Signs ♦
- Metropolitan Area HAR / Traveler Information
- Traveler Information at Rest Areas ♦
- Television and Radio Broadcast Traveler Information
- Automated Telephone Traveler Information System / Hotline
- Interactive Internet Traveler Information ♦
- In-Vehicle Signing / Route Guidance

Commercial Vehicle Operations
- CVO Automated Roadside Safety Inspection Systems
- Commercial Vehicle Administrative and Credential Programs
- On-Board CVO Safety Monitoring
- Commercial Vehicle Fleet and Freight Administrative/Management Programs
- Commercial Vehicle Hazardous Materials Tracking / Management
- CVO Electronic Clearance / Weigh-In-Motion / License Plate Reader Programs
- CVO Traveler Information System

Public Transportation Management
- Public Transportation Management / Administrative Systems ♦
- Metropolitan Area Transit AVL / Tracking Systems ♦
- Metropolitan Area Transit Traffic Signal Priority Systems ♦
- Regional Rural Transit AVL / Demand Response Transit Systems ♦
- Transit Electronic Fare Payment and Passenger Management ♦
- Transit Security Programs ♦
- Enroute Transit Information Systems ♦

Emergency Management
- Metropolitan Area EMS Traffic Signal Priority/Routing/Response Systems ♦
- Rural EMS / Mayday Response Systems ♦
- Consolidated Metropolitan Area EMS Communications Systems ♦

Advanced Vehicle Safety Systems
- Driver Safety Monitoring
- Vehicle Safety Monitoring
- Safety Control, Warning, and Collision Avoidance
- Driver Visibility Improvement Technologies
- Safety Readiness / Pre-crash Restraint Deployment
- Automated Highways and Vehicle Operations

[#] The potential ITS strategies are presented in market package bundles as defined in the National ITS Architecture.

Evaluation Criteria

This proposed strategy and project prioritization process, which includes specific criteria and prioritization methodology, can be used as the Iowa DOT is asked to consider new projects for inclusion in the plan as its implementation proceeds. The evaluation criteria accommodate two very different types of projects – those that focus on specific advanced technologies at specific locations throughout the state, such as the Automated Bridge Anti-Icing System Pilot Project in Cedar Rapids, and those that have a broader statewide focus, such as the Iowa DOT Statewide Communications Plan and Integrated Database Development and Packaging.

The evaluation of candidate strategies and projects must provide defensible answers to three basic questions:

1. **What** types of ITS strategies, if any, should the Iowa DOT pursue?

2. **Where** should these strategies be pursued as specific projects?

3. **When** should these specific projects be deployed?

What type of strategies to pursue has been partially addressed through the steering committee's previous prioritization of transportation problems and ITS solutions/strategies. In general, ITS strategies that address the priority problems and/or that advance the priority objectives should be implemented first. In addition, from among those types of ITS strategies that have been identified as responsive to the priority problems and objectives, those that have demonstrated the greatest benefits through actual deployments should be the highest priority.

Where and **when** to pursue the highest priority strategies as specific projects should be decided based on the past and potential severity of the problem and the readiness of the Iowa DOT and/or local partners to deploy and operate/maintain the improvement. In general, potential projects that address locations that demonstrate the greatest need should be implemented first.

ITS solutions basically address the same problems that are addressed by traditional improvements, including traffic congestion and safety. Therefore, the existing transportation planning/programming process that identifies and ranks problem areas throughout the state should also be considered when determining the priority of ITS deployments. Under this approach, ITS projects that address a problem that has already been identified in an existing plan as a high priority should be implemented first.

"What" Criteria

In order to prioritize the potential strategies into specific projects, a two-phased evaluation process should be followed. The first three criteria identified below will help determine what types of ITS strategies to pursue.

1) Number of **"Top 20" Problems** addressed.
2) Number of **Goals and Objectives** addressed.
3) Analysis of **General Benefits** of similar previous deployments of this strategy throughout the country (clear, achievable benefits and magnitude of benefits) and whether it is an extension of a proven Iowa winner.

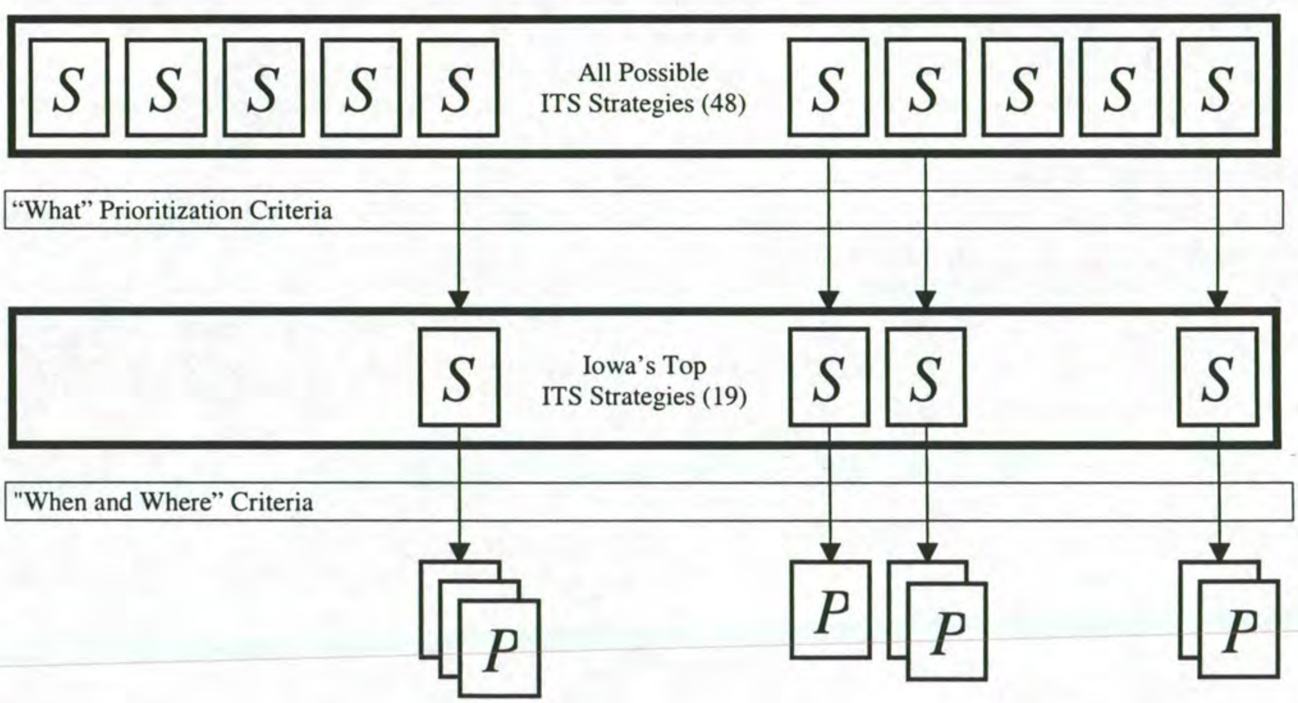
"Where and When" Criteria

The final three criteria will determine locations and timetables for deploying chosen ITS strategies at specific locations as projects. As mentioned earlier, the project "location" may be statewide for a strategy or project with applicability throughout the state or with a broader or more internal Iowa DOT operational focus.

1) **Quantitative Analysis** of local problem severity assessed through measures of congestion and safety.
2) Level of **Project Partner Support** for operations and maintenance activities.
3) Local **Partner Capability and Commitment** to implementing the appropriate technologies through the chosen project.

The diagram below illustrates this prioritization process.

Figure 6-1 – Evaluation Process



Strategy Evaluation Methodology

All commonly accepted general ITS strategies were considered in the initial evaluation of strategies. Once these appropriate strategies were prioritized, potential project locations and deployment scopes could then be identified and prioritized. The methodology used to apply the previous criteria to potential strategies and subsequent projects follows.

<u>Strategy Evaluation Method 1 – Strategies vs. Top Problems</u>

The first method used in the process of evaluating strategies was to compare the 48 potential strategies to the top 20 transportation problems in Iowa, which were identified at the May 1999 prioritization workshop. Each strategy was considered and rated based on its ability to address each of the top problems. A scaling system of 0 through 2 points, which was used throughout the strategies evaluation, was applied to each strategy. Two points were given to the strategy if it directly helped with the corresponding problem, while 1 point was given for a lesser indirect benefit. Zero points were awarded for no beneficial relationship between the problem and strategy.

Example: Metro area traffic management projects have a direct benefit in the area of safety and crashes on highways, therefore receiving 2 points. Meanwhile transit security programs have no relationship to CVO time spent at weigh stations, therefore receiving 0 points.

As a result of the scoring, each strategy received a total score. This score was simply a total of points "scored" against the top problems and is reflected in Table 6-2. The highest possible score was 48.

In Table 6-3, once all possible strategies were compared to the top problems, each problem was weighted based on its relative importance when ranked at the May 1999 prioritization workshop. Each individual score received by the strategies was multiplied by the weighting factor of the corresponding problem. This weighting factor was determined by the number of votes each problem received at the May workshop by the number of votes received by the top problem. This number, which ranged from 0.09 to 1.00, was then added to 1. The resulting weighting factors range from 2.00 for the highest-rated problem to 1.09 for the 20^{th}-rated problems.

Example: Personal security on highways received a weighting factor of 1.60. Therefore, the score of each strategy that addressed this problem was multiplied by 1.60.

As a result of the scoring and weighting, each strategy received a second total score. This score was simply a total of weighted points "scored" against the top problems. With weighting factored in, the highest possible score for Table 6-3 was 54.68.

Table 6-2: Potential ITS Strategies vs. Top Identified Problems (Not Weighted / Ranked Within Program Area)

Overall Rank	Potential Strategies	Top Problems 1: Safety / Crashes - Highways	2: Construction and Maint. - Highways	3: Personal Security - Highways	4: Lack of Road Conditions Information	5: Construction and Maint. - Streets	6: Safety / Crashes - Streets	7: Road Surface Conditions - Highways	8: Personal Security - Streets	9: Road Surface Conditions - Streets	10: Railroad Crossings - Streets	11: EMS Response Time - Streets	12: Lack of Weather Conditions Info.	13: Recurring Congestion - Streets	14: Travel Time - Highways	15: Travel Time - Streets	16: Lack of Rural Transit Coordination	17: Lack of Adequate Alternate Routes	18: Integration of Data	19: CVO Regulatory Time Spent	20: Lack of Multi-Modal Traveler Info.	21: CVO Time Spent at Weigh Stations	Total Score
	ITS Planning, Marketing, Administration																						
1	ITS Program and Data Administration	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	22
5	ITS Plans and Studies	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	21
5	ITS Marketing and Education Programs	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	21
	Travel and Traffic Management																						
5	Metro Area Traffic Management Systems	2	1	1	1	1	2	0	1	0	0	1	1	2	2	2	0	0	2	0	2	0	21
11	Smart Work Zones / Portable Traffic Management Systems	2	2	1	2	1	1	1	0	0	0	0	0	1	2	2	0	2	0	0	2	0	19
11	Metropolitan Area Incident/Event Management	2	2	1	0	2	2	0	0	0	1	2	0	2	2	2	0	0	1	0	0	0	19
13	Roadway Weather Safety / Incident Prevention Systems	2	0	1	2	0	2	0	1	0	0	0	2	2	1	2	0	0	0	0	2	0	17
14	Event Management and Routing Programs	1	0	0	1	1	1	0	0	0	0	1	0	2	2	2	1	2	0	0	1	0	15
16	Roadway Construction Coordination System	0	2	0	0	2	0	2	0	2	0	0	0	2	1	2	0	0	0	0	1	0	14
20	Crash Investigation Systems	2	0	0	0	0	2	0	0	0	0	2	0	2	2	2	0	0	0	0	0	0	12
24	Highway-Railroad Operations and Safety Systems	2	0	0	0	0	2	0	0	0	2	0	0	2	1	2	0	0	0	0	0	0	11
25	Regional Traffic Signal Coordination Programs	1	0	0	0	0	1	0	0	0	1	1	0	2	2	2	0	0	0	0	0	0	10
28	Virtual TMC and Smart Probe Surveillance	1	0	0	0	0	0	0	0	0	0	0	0	2	2	2	0	0	0	0	2	0	9
29	Automated Enforcement	2	0	0	0	0	2	0	0	0	2	0	0	1	0	1	0	0	0	0	0	0	8
36	Dynamic Toll Management / Electronic Toll Payment	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	0	0	0	0	0	0	6
47	Emissions Testing and Mitigation Programs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Traveler Information																						
1	Metropolitan Area Changeable Message Signs	1	2	1	2	2	1	0	1	0	1	0	2	2	2	2	0	1	0	0	2	0	22
1	Metropolitan Area HAR / Traveler Information	1	2	1	2	2	1	0	1	0	1	0	2	2	2	2	0	1	0	0	2	0	22
1	In-vehicle Signing / Route Guidance	0	2	2	2	2	0	0	2	0	1	0	2	2	2	2	0	1	0	0	2	0	22
5	Automated Telephone Traveler Information System / Hotline	1	2	1	2	2	0	0	1	0	1	0	2	2	2	2	0	1	0	0	2	0	21
9	Television and Radio Broadcast Traveler Information	1	2	1	2	2	0	0	1	0	0	0	2	2	2	2	0	1	0	0	2	0	20
9	Interactive Internet Information	1	2	1	2	2	0	0	1	0	0	0	2	2	2	2	0	1	0	0	2	0	20
17	Rural Highway/Freeway Changeable Message Signs	1	2	1	2	0	0	0	0	0	0	0	2	0	2	0	0	1	0	0	2	0	13
17	Rural Highway/Freeway HAR / Tourist Traveler Information	1	2	1	2	0	0	0	0	0	0	0	2	0	2	0	0	1	0	0	2	0	13
17	Traveler Information at Rest Areas	1	2	1	2	0	0	0	0	0	0	0	2	0	2	0	0	1	0	0	2	0	13
	Commercial Vehicle Operations																						
14	CVO Traveler Information System	1	1	0	2	1	1	1	0	1	0	0	2	1	1	1	0	0	0	1	1	0	15
20	CVO Electronic Clearance / Weigh-In-Motion / LPR	1	0	0	0	0	1	2	0	1	0	0	0	1	1	1	0	0	0	2	0	2	12
29	Hazardous Materials Tracking / Management	2	0	0	0	0	1	0	0	0	0	0	0	1	1	1	0	0	0	1	0	1	8
34	Automated Roadside Safety Inspection Systems	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	7
38	Commercial Vehicle Administrative / Credential	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	5
38	On-Board CVO Safety Monitoring	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	5
47	Commercial Vehicle Fleet and Freight Administration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Public Transportation Management																						
34	Enroute Transit Information Systems	0	0	0	0	0	0	0	0	0	0	0	0	2	1	2	0	0	0	0	2	0	7
38	Metropolitan Area Transit AVL / Tracking Systems	0	0	0	0	0	0	0	0	0	0	0	0	2	1	2	0	0	0	0	0	0	5
38	Metropolitan Area Transit Traffic Signal Priority Systems	0	0	0	0	0	0	0	0	0	0	0	0	2	1	2	0	0	0	0	0	0	5
38	Transit Security Programs	0	0	0	0	0	0	0	1	0	0	1	0	1	1	1	0	0	0	0	0	0	5
44	Public Transit Management / Administrative Systems	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	4
44	Transit Electronic Fare Payment / Passenger Management	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	4
46	Regional Rural / Demand Response Transit Systems	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2
	Emergency Management																						
20	Metropolitan Area EMS Signal Priority/Routing/Response	2	0	2	0	0	2	0	2	0	0	2	0	1	0	1	0	0	0	0	0	0	12
20	Consolidated Urban Area EMS Communications Systems	2	0	2	0	0	2	0	2	0	0	2	0	1	0	1	0	0	0	0	0	0	12
38	Rural EMS / Mayday Response Systems	2	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	5
	Advanced Vehicle Safety Systems																						
25	Driver Visibility Improvement Technologies	2	0	1	1	0	2	0	1	0	0	0	1	1	0	1	0	0	0	0	0	0	10
25	Automated Highways and Vehicle Operations	2	0	1	0	0	0	0	1	0	0	0	0	2	2	2	0	0	0	0	0	0	10
29	Driver Safety Monitoring	2	0	2	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	8
29	Vehicle Safety Monitoring	2	0	2	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	8
29	Safety Control, Warning, and Collision Avoidance	2	0	1	0	0	2	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	8
36	Safety Readiness / Pre-Crash Restraint Deployment	2	0	1	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	6

Table 6-3: Potential ITS Strategies vs. Top Problems (Weighted / Ranked Within Program Area)

		Top Problems																					
Overall Rank	Potential Strategies	1 Safety / Crashes - Highways	2 Construction and Maint. - Highways	3 Personal Security - Highways	4 Lack of Road Conditions Information	5 Construction and Maint. - Streets	6 Safety / Crashes - Streets	7 Road Surface Conditions - Highways	8 Personal Security - Streets	9 Road Surface Conditions - Streets	10 Railroad Crossings - Streets	11 EMS Response Time - Streets	12 Lack of Weather Conditions Info.	13 Recurring Congestion - Streets	14 Travel Time - Highways	15 Travel Time - Streets	16 Lack of Rural Transit Coordination	17 Lack of Adequate Alternate Routes	18 Integration of Data	19 CVO Regulatory Time Spent	20 Lack of Multi-Modal Traveler Info.	21 CVO Time Spent at Weigh Stations	Total Score
	ITS Planning, Marketing, Administration																						
4	ITS Program and Data Administration	2.00	1.66	1.60	1.46	1.43	1.40	1.37	1.34	1.23	1.20	1.20	1.20	1.20	1.20	1.17	1.17	1.11	2.22	1.11	1.09	1.09	28.45
7	ITS Plans and Studies	2.00	1.66	1.60	1.46	1.43	1.40	1.37	1.34	1.23	1.20	1.20	1.20	1.20	1.20	1.17	1.17	1.11	1.11	1.11	1.09	1.09	27.34
7	ITS Marketing and Education Programs	2.00	1.66	1.60	1.46	1.43	1.40	1.37	1.34	1.23	1.20	1.20	1.20	1.20	1.20	1.17	1.17	1.11	1.11	1.11	1.09	1.09	27.34
	Travel and Traffic Management																						
5	Metro Area Traffic Management Systems	4.00	1.66	1.60	1.46	1.43	2.80	0.00	1.34	0.00	0.00	1.20	1.20	2.40	2.40	2.34	0.00	0.00	2.22	0.00	2.18	0.00	28.23
11	Metropolitan Area Incident/Event Management	4.00	3.32	1.60	0.00	2.86	2.80	0.00	0.00	0.00	1.20	2.40	0.00	2.40	2.40	2.34	0.00	0.00	1.11	0.00	0.00	0.00	26.43
12	Smart Work Zones / Portable Traffic Management Systems	4.00	3.32	1.60	2.92	1.43	1.40	1.37	0.00	0.00	0.00	0.00	0.00	1.20	2.40	2.34	0.00	2.22	0.00	0.00	2.18	0.00	26.38
13	Roadway Weather Safety / Incident Prevention Systems	4.00	0.00	1.60	2.92	0.00	2.80	0.00	1.34	0.00	0.00	0.00	2.40	2.40	1.20	2.34	0.00	0.00	0.00	0.00	2.18	0.00	23.18
15	Event Management and Routing Programs	2.00	0.00	0.00	1.46	1.43	1.40	0.00	0.00	0.00	0.00	1.20	0.00	2.40	2.40	2.34	1.17	2.22	0.00	0.00	1.09	0.00	19.11
16	Roadway Construction Coordination System	0.00	3.32	0.00	0.00	2.86	0.00	2.74	0.00	2.46	0.00	0.00	0.00	2.40	1.20	2.34	0.00	0.00	0.00	0.00	1.09	0.00	18.41
22	Crash Investigation Systems	4.00	0.00	0.00	0.00	0.00	2.80	0.00	0.00	0.00	0.00	2.40	0.00	2.40	2.40	2.34	0.00	0.00	0.00	0.00	0.00	0.00	16.34
24	Highway-Railroad Operations and Safety Systems	4.00	0.00	0.00	0.00	0.00	2.80	0.00	0.00	0.00	2.40	0.00	0.00	2.40	1.20	2.34	0.00	0.00	0.00	0.00	0.00	0.00	15.14
27	Regional Traffic Signal Coordination Programs	2.00	0.00	0.00	0.00	0.00	1.40	0.00	0.00	0.00	1.20	1.20	0.00	2.40	2.40	2.34	0.00	0.00	0.00	0.00	0.00	0.00	12.94
31	Automated Enforcement	4.00	0.00	0.00	0.00	0.00	2.80	0.00	0.00	0.00	2.40	0.00	0.00	1.20	0.00	1.17	0.00	0.00	0.00	0.00	0.00	0.00	11.57
32	Virtual TMC and Smart Probe Surveillance	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	2.40	2.34	0.00	0.00	0.00	0.00	2.18	0.00	11.32
39	Dynamic Toll Management / Electronic Toll Payment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	2.40	2.34	0.00	0.00	0.00	0.00	0.00	0.00	7.14
47	Emissions Testing and Mitigation Programs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Traveler Information																						
1	Metropolitan Area Changeable Message Signs	2.00	3.32	1.60	2.92	2.86	1.40	0.00	1.34	0.00	1.20	0.00	2.40	2.40	2.40	2.34	0.00	1.11	0.00	0.00	2.18	0.00	29.47
1	Metropolitan Area HAR / Traveler Information	2.00	3.32	1.60	2.92	2.86	1.40	0.00	1.34	0.00	1.20	0.00	2.40	2.40	2.40	2.34	0.00	1.11	0.00	0.00	2.18	0.00	29.47
3	In-vehicle Signing / Route Guidance	0.00	3.32	3.20	2.92	2.86	0.00	0.00	2.68	0.00	1.20	0.00	2.40	2.40	2.40	2.34	0.00	1.11	0.00	0.00	2.18	0.00	29.01
6	Automated Telephone Traveler Information System / Hotline	2.00	3.32	1.60	2.92	2.86	0.00	0.00	1.34	0.00	1.20	0.00	2.40	2.40	2.40	2.34	0.00	1.11	0.00	0.00	2.18	0.00	28.07
9	Television and Radio Broadcast Traveler Information	2.00	3.32	1.60	2.92	2.86	0.00	0.00	1.34	0.00	0.00	0.00	2.40	2.40	2.40	2.34	0.00	1.11	0.00	0.00	2.18	0.00	26.87
9	Interactive Internet Information	2.00	3.32	1.60	2.92	2.86	0.00	0.00	1.34	0.00	0.00	0.00	2.40	2.40	2.40	2.34	0.00	1.11	0.00	0.00	2.18	0.00	26.87
17	Rural Highway/Freeway Changeable Message Signs	2.00	3.32	1.60	2.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	2.40	0.00	0.00	1.11	0.00	0.00	2.18	0.00	17.93
17	Rural Highway/Freeway HAR / Tourist Traveler Information	2.00	3.32	1.60	2.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	2.40	0.00	0.00	1.11	0.00	0.00	2.18	0.00	17.93
17	Traveler Information at Rest Areas	2.00	3.32	1.60	2.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	2.40	0.00	0.00	1.11	0.00	0.00	2.18	0.00	17.93
	Commercial Vehicle Operations																						
14	CVO Traveler Information System	2.00	1.66	0.00	2.92	1.43	1.40	1.37	0.00	1.23	0.00	0.00	2.40	1.20	1.20	1.17	0.00	0.00	0.00	1.11	1.09	0.00	20.18
23	CVO Electronic Clearance / Weigh-In-Motion / LPR	2.00	0.00	0.00	0.00	0.00	1.40	2.74	0.00	1.23	0.00	0.00	0.00	1.20	1.20	1.17	0.00	0.00	0.00	2.22	0.00	2.18	15.34
33	Hazardous Materials Tracking / Management	4.00	0.00	0.00	0.00	0.00	1.40	0.00	0.00	0.00	0.00	0.00	0.00	1.20	1.20	1.17	0.00	0.00	0.00	1.11	0.00	1.09	11.17
34	Automated Roadside Safety Inspection Systems	4.00	0.00	0.00	0.00	0.00	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.22	0.00	2.18	9.80
38	On-Board CVO Safety Monitoring	4.00	0.00	0.00	0.00	0.00	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.11	0.00	1.09	7.60
40	Commercial Vehicle Administrative / Credential	2.00	0.00	0.00	0.00	0.00	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.22	0.00	1.09	6.71
47	Commercial Vehicle Fleet and Freight Administration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Public Transportation Management																						
37	Enroute Transit Information Systems	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	1.20	2.34	0.00	0.00	0.00	0.00	2.18	0.00	8.12
41	Transit Security Programs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.34	0.00	0.00	1.20	0.00	1.20	1.20	1.17	0.00	0.00	0.00	0.00	0.00	0.00	6.11
42	Metropolitan Area Transit AVL / Tracking Systems	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	1.20	2.34	0.00	0.00	0.00	0.00	0.00	0.00	5.94
42	Metropolitan Area Transit Traffic Signal Priority Systems	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	1.20	2.34	0.00	0.00	0.00	0.00	0.00	0.00	5.94
44	Public Transit Management / Administrative Systems	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.20	1.20	1.17	1.17	0.00	0.00	0.00	0.00	0.00	4.74
44	Transit Electronic Fare Payment / Passenger Management	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.20	1.20	1.17	1.17	0.00	0.00	0.00	0.00	0.00	4.74
46	Regional Rural / Demand Response Transit Systems	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.34	0.00	0.00	0.00	0.00	0.00	2.34
	Emergency Management																						
20	Metropolitan Area EMS Signal Priority/Routing/Response	4.00	0.00	3.20	0.00	0.00	2.80	0.00	2.68	0.00	0.00	2.40	0.00	1.20	0.00	1.17	0.00	0.00	0.00	0.00	0.00	0.00	17.45
20	Consolidated Urban Area EMS Communications Systems	4.00	0.00	3.20	0.00	0.00	2.80	0.00	2.68	0.00	0.00	2.40	0.00	1.20	0.00	1.17	0.00	0.00	0.00	0.00	0.00	0.00	17.45
36	Rural EMS / Mayday Response Systems	4.00	0.00	3.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.40
	Advanced Vehicle Safety Systems																						
25	Driver Visibility Improvement Technologies	4.00	0.00	1.60	1.46	0.00	2.80	0.00	1.34	0.00	0.00	0.00	1.20	1.20	0.00	1.17	0.00	0.00	0.00	0.00	0.00	0.00	14.77
26	Automated Highways and Vehicle Operations	4.00	0.00	1.60	0.00	0.00	0.00	0.00	1.34	0.00	0.00	0.00	0.00	2.40	2.40	2.34	0.00	0.00	0.00	0.00	0.00	0.00	14.08
28	Driver Safety Monitoring	4.00	0.00	3.20	0.00	0.00	2.80	0.00	2.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.68
28	Vehicle Safety Monitoring	4.00	0.00	3.20	0.00	0.00	2.80	0.00	2.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.68
30	Safety Control, Warning, and Collision Avoidance	4.00	0.00	1.60	0.00	0.00	2.80	0.00	1.34	0.00	0.00	0.00	0.00	1.20	0.00	1.17	0.00	0.00	0.00	0.00	0.00	0.00	12.11
35	Safety Readiness / Pre-Crash Restraint Deployment	4.00	0.00	1.60	0.00	0.00	2.80	0.00	1.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.74

Strategy Evaluation Method 2 – Strategies vs. Goals and Objectives

The second method used in evaluating strategies was to compare potential strategies to the goals and objectives identified by the steering committee. Once again, the same scoring system of 0, 1 or 2 points was applied to each strategy, based on how well the potential strategy addressed an objective. Each of the 48 potential strategies was considered against each of the 23 objectives under the first four of the five general program goals. The fifth goal, balance, will be addressed through the overall ITS program direction and allocation of resources between general deployment areas and between urban and rural areas of the state.

Example: ITS plans and studies have a generally significant but indirect relationship with all objectives, therefore receiving 1 point for each of the objectives.

The total score was simply a total of points "scored" against the objectives and is reflected in Table B. The highest possible score under this second method was 46.00.

Strategy Evaluation Method 3 – Strategies vs. General Benefits

The third and last method used in evaluating the strategies involved comparing them to the general benefits to be expected through deployment of the strategy. Each potential strategy was rated based on each of four sub-criteria. These are listed below.

- Maturity – To what extent has the strategy been deployed?
- Magnitude of Potential Benefit – If successful, how great is the payoff in relation to other potential strategies?
- Documented Positive Benefit/Cost Ratios – Have the benefits been documented?
- Proven Iowa Winner – Has the strategy been successfully applied in Iowa?

Example: Traffic signal coordination is mature, but automated highway and vehicle operations are still in the developmental stage, with deployment not expected within the next five years. In terms of magnitude of potential benefit, successful incident management projects have a great potential payoff, while broadcasting tourist information on highway advisory radio does not have as high a payoff. Thirdly, the benefits of automated commercial vehicle credential systems have been documented in *Assessment of Intelligent Transportation Systems/Commercial Vehicle Operations User Services: ITS/CVO Qualitative Benefit/Cost Analysis*, while there have been no known published benefit/cost analysis of highway-railroad operations and safety systems. Finally, Iowa has successfully deployed an interactive Internet-based traveler information service. Iowa has not deployed an electronic toll collection system.

As other criteria, each project was given a rating of either 2, 1 or 0 for each of the sub-criteria. A score of 2 points was given if the question could be responded to directly or affirmatively, 1 for indirectly or somewhat, and 0 if the response was no. A strategy's benefit rating is the sum of its four scores. The highest possible score for this method was 8.

Strategy Evaluation Results

The overall results of the strategy evaluation process is shown in Table 6-4. These selected strategies encompass several advanced technologies and potential ITS projects at both the statewide and metropolitan area levels. A detailed breakdown of these potential projects by general deployment area and the analysis/prioritization of each is detailed in the following subsection.

Table 6-4: Results of Strategy Ranking

Top Priority	Potential Strategies	May	Score								
		Original Steering Committee Rank	Rank vs. Problems - Not Weighted		Rank vs. Problems - Weighted		Rank vs Goals		Rank vs. Benefits		Weighted Score
	ITS Planning, Marketing, Administration										
*	ITS Program and Data Administration	10,13	22	52.4%	28.45	52.0%	23	50.0%	6	75.0%	**58.6%**
*	ITS Plans and Studies	14	21	50.0%	27.34	50.0%	23	50.0%	6	75.0%	**57.5%**
*	ITS Marketing and Education Programs		21	50.0%	27.34	50.0%	23	50.0%	5	62.5%	**53.8%**
	Travel and Traffic Management										
*	Metro Area Traffic Management Systems	1,8,26	21	50.0%	28.23	51.6%	20	43.5%	7	87.5%	**60.4%**
*	Metropolitan Area Incident/Event Management	1,4,8,14	19	45.2%	26.43	48.3%	16	34.8%	6	75.0%	**53.0%**
*	Smart Work Zones / Portable Traffic Management Systems	4,26	19	45.2%	26.38	48.2%	19	41.3%	5	62.5%	**50.5%**
*	Roadway Weather Safety / Incident Prevention Systems	10,13	17	40.5%	23.18	42.4%	16	34.8%	6	75.0%	**50.3%**
*	Regional Traffic Signal Coordination Programs		10	23.8%	12.94	23.7%	11	23.9%	7	87.5%	**42.9%**
	Event Management and Routing Programs	26	15	35.7%	19.11	34.9%	11	23.9%	4	50.0%	**37.4%**
	Automated Enforcement	9	8	19.0%	11.57	21.2%	8	17.4%	6	75.0%	**36.1%**
	Dynamic Toll Management / Electronic Toll Payment		6	14.3%	7.14	13.1%	11	23.9%	6	75.0%	**34.1%**
	Roadway Construction Coordination System	20	14	33.3%	18.41	33.7%	12	26.1%	3	37.5%	**33.2%**
	Virtual TMC and Smart Probe Surveillance		9	21.4%	11.32	20.7%	14	30.4%	4	50.0%	**31.6%**
	Highway-Railroad Operations and Safety Systems	20	11	26.2%	15.14	27.7%	14	30.4%	3	37.5%	**30.9%**
	Crash Investigation Systems	26	12	28.6%	16.34	29.9%	11	23.9%	2	25.0%	**27.0%**
	Emissions Testing and Mitigation Programs		0	0.0%	0.00	0.0%	2	4.3%	3	37.5%	**12.1%**
	Traveler Information										
*	Metropolitan Area Changeable Message Signs	3	22	52.4%	29.47	53.9%	20	43.5%	8	100.0%	**65.3%**
*	Interactive Internet Information	2	20	47.6%	26.87	49.1%	23	50.0%	8	100.0%	**64.3%**
*	Automated Telephone Traveler Information System	14	21	50.0%	28.07	51.3%	17	37.0%	7	87.5%	**59.0%**
*	Television and Radio Broadcast Traveler Information	7	20	47.6%	26.87	49.1%	14	30.4%	7	87.5%	**56.6%**
*	Metropolitan Area HAR / Traveler Information	3	22	52.4%	29.47	53.9%	15	32.6%	4	50.0%	**48.2%**
*	Rural Highway/Freeway Changeable Message Signs	3	13	31.0%	17.93	32.8%	17	37.0%	6	75.0%	**45.9%**
*	In-vehicle Signing / Route Guidance	12,17,20	22	52.4%	29.01	53.1%	19	41.3%	2	25.0%	**42.2%**
*	Rural Highway/Freeway HAR / Tourist Information	3	13	31.0%	17.93	32.8%	17	37.0%	5	62.5%	**42.2%**
	Traveler Information at Rest Areas	3	13	31.0%	17.93	32.8%	11	23.9%	5	62.5%	**39.6%**
	Commercial Vehicle Operations										
	CVO Electronic Clearance / Weigh-In-Motion / LPR	18,20,29	12	28.6%	15.34	28.1%	15	32.6%	5	62.5%	**39.4%**
	Commercial Vehicle Fleet and Freight Administration	18	0	0.0%	0.00	0.0%	20	43.5%	8	100.0%	**38.7%**
	CVO Traveler Information System	29	15	35.7%	20.18	36.9%	20	43.5%	3	37.5%	**38.2%**
	Commercial Vehicle Administrative / Credential		5	11.9%	6.71	12.3%	11	23.9%	7	87.5%	**37.1%**
	Hazardous Materials Tracking / Management	20	8	19.0%	11.17	20.4%	12	26.1%	4	50.0%	**30.2%**
	On-Board CVO Safety Monitoring		5	11.9%	7.60	13.9%	14	30.4%	3	37.5%	**23.9%**
	Automated Roadside Safety Inspection Systems	20	7	16.7%	9.80	17.9%	8	17.4%	3	37.5%	**23.4%**
	Public Transportation Management										
*	Metropolitan Area Transit AVL / Tracking Systems	20	5	11.9%	5.94	10.9%	19	41.3%	7	87.5%	**40.2%**
	Metropolitan Area Transit Traffic Signal Priority Systems		5	11.9%	5.94	10.9%	14	30.4%	6	75.0%	**34.2%**
	Public Transit Management / Administrative Systems		4	9.5%	4.74	8.7%	21	45.7%	5	62.5%	**32.4%**
	Transit Electronic Fare Payment / Passenger Management		4	9.5%	4.74	8.7%	11	23.9%	6	75.0%	**31.8%**
	Enroute Transit Information Systems		7	16.7%	8.12	14.9%	13	28.3%	4	50.0%	**28.4%**
	Regional Rural / Demand Response Transit Systems		2	4.8%	2.34	4.3%	15	32.6%	3	37.5%	**20.0%**
	Transit Security Programs		5	11.9%	6.11	11.2%	11	23.9%	2	25.0%	**18.0%**
	Emergency Management										
*	Consolidated Urban Area EMS Communications Systems	4	12	28.6%	17.45	31.9%	13	28.3%	6	75.0%	**43.4%**
*	Metropolitan Area EMS Signal Priority/Routing/Response		12	28.6%	17.45	31.9%	9	19.6%	6	75.0%	**41.7%**
	Rural EMS / Mayday Response Systems	10	5	11.9%	8.40	15.4%	6	13.0%	5	62.5%	**28.3%**
	Advanced Vehicle Safety Systems										
	Driver Visibility Improvement Technologies	29	10	23.8%	14.77	27.0%	10	21.7%	3	37.5%	**28.5%**
	Automated Highways and Vehicle Operations		10	23.8%	14.08	25.7%	14	30.4%	2	25.0%	**26.1%**
	Safety Control, Warning, and Collision Avoidance		8	19.0%	12.11	22.1%	9	19.6%	2	25.0%	**21.9%**
	Driver Safety Monitoring		8	19.0%	12.68	23.2%	8	17.4%	2	25.0%	**21.7%**
	Vehicle Safety Monitoring		8	19.0%	12.68	23.2%	3	6.5%	2	25.0%	**19.6%**
	Safety Readiness / Pre-Crash Restraint Deployment		6	14.3%	9.74	17.8%	3	6.5%	2	25.0%	**17.0%**

Project Evaluation Methodology

Once the potential ITS strategies were compared to the "what" criteria, their resulting scores from each method were weighted and combined to produce an overall score. Based on this score, potential ITS projects representing the top scoring strategies could then be compared to the "where and when" criteria mentioned earlier.

<u>Project Evaluation Method 1 – Quantitative Analysis of Projects</u>

These selected top strategies logically encompass several advanced technologies and potential ITS projects at both the statewide and metropolitan area levels. In other words, some strategies represented a specific type of project or program that could be implemented at specific metropolitan regions or locations in the state, while other strategies represented higher level projects that would be administered at a statewide level. Therefore, potential projects can be categorized as metropolitan area-specific or statewide.

The potential metropolitan area-specific projects included those ITS programs and systems that are applicable to the main large metropolitan areas and other medium or small cities of the state. In order to determine where ITS would most likely be utilized, the urbanized areas of Iowa were classified into three categories. Depending on the type and scope of the potential ITS application, the possible locations considered for deployment were included in one or more of these categories. The categories and the cities that they include are listed below.

- Large Cities/Metropolitan Areas (95,000 and above population) – Cedar Rapids, Council Bluffs/Omaha, Des Moines, Quad Cities, Sioux City, and Waterloo/Cedar Falls areas.
- Medium Cities (45,000 to 75,000 population) – Ames, Dubuque, and Iowa City areas.
- Small Cities (25,000 to 35,000 population) – Burlington, Clinton, Fort Dodge, Marshalltown, Mason City, Muscatine, and Ottumwa areas.

In order to evaluate the need for ITS applications in these locations, certain core criteria were established. These seven core criteria were a basis for comparing general safety and operations conditions between the potential locations. Depending on the type of project or program being evaluated, these core criteria were included or not included in an evaluation and were weighted differently for different projects. The seven core criteria are:

1) Total metro area population
2) Total lane-miles of all roadways and freeways/expressways at metro level
3) Daily VMT on all roadways and freeways/expressways at metro level
4) Travel density on all roadways and freeways/expressways at metro level
5) Total personal injury crashes at county level
6) Total fatalities over 10 years at county level
7) Past progress and success of existing ITS activities

The potential statewide projects can be further broken down into two sub-categories. The first statewide sub-category consists of those that are administered at a central Iowa DOT level and are not site-specific, such as integrated database development and packaging. The second statewide sub-category consist of projects that are applicable throughout the state, but will involve the use of specific advanced technologies and other ITS-related programs at specific "roadway-level" locations, such as portable traffic management systems.

While some statewide projects would need to go through an additional evaluation, a detailed prioritization/analysis of potential statewide projects was not done at this point in order to evaluate these programs and systems along side metropolitan area-specific projects. In other words, the first sub-category of statewide projects will not require site-specific evaluation, while the second site-specific sub-category of statewide projects will eventually require another level of detailed quantitative analysis to determine and prioritize specific "roadway level" locations for ITS applications.

The results of applying these core criteria to some of the strategies is reflected in the order of the potential projects in Table 6-5.

In addition to the quantitative analysis of the metropolitan area-specific projects, these potential projects were also evaluated based on additional "where and when" criteria.

Table 6-5: Results of Initial Project Evaluation

Potential Strategies / Projects	Deployment Timeframe			
	Immediate-term (Year 1)	Definite (Years 2-5)	Probable (Years 6-10)	Potential (Years 11-Later)
ITS Planning, Marketing, and Administration				
ITS Plans and Studies				
Quad Cities Area ITS Plan		X		
Cedar Rapids Area ITS Plan		X		
Sioux City Area ITS Plan		X		
Waterloo Area ITS Plan		X		
Statewide Rural Transit ITS Feasibility Study (Statewide)		X		
Travel and Traffic Management				
Metropolitan Area Traffic Management				
Des Moines Area Traffic Management System		X		
Council Bluffs Traffic Management System Enhancements		X		
Quad Cities Area Traffic Management System			X	
Cedar Rapids Area Traffic Management System			X	
Sioux City Area Traffic Management System			X	
Waterloo/Cedar Falls Traffic Management System			X	
Metropolitan Area Incident/Event Management				
Des Moines Area Incident/Event Management		X		
Omaha/Council Bluffs Incident/Event Management		X		
Quad Cities Area Incident/Event Management			X	
Cedar Rapids Area Incident/Event Management			X	
Sioux City Area Incident/Event Management			X	
Waterloo/Cedar Falls Incident/Event Management			X	
Smart Work Zones / Portable Traffic Management				
Smart Work Zones / Portable TMS (Statewide)		X		
Roadway Weather Safety / Incident Prevention				
Concept Vehicle Expansion (Statewide)		X		
Expanded Incident Warning Systems (Statewide)		X		
Expanded Automated Bridge De-icing Systems (Statewide)		X		
Active Low-visibility Road Warning System (Statewide)				X
Roadway-Stream Flood Warning Program (Statewide)				X
Expanded Active Speed Warning Signs (Statewide)				X
Regional Traffic Signal Coordination				
Expanded Des Moines Area Signal Pilot Project		X		
Council Bluffs Regional Signal Coordination		X		
Quad Cities Area Regional Signal Coordination		X		
Cedar Rapids Area Regional Signal Coordination		X		
Waterloo/Cedar Falls Area Regional Signal Coordination		X		
Sioux City Area Regional Signal Coordination		X		
Iowa City Area Regional Signal Coordination				X
Dubuque Area Regional Signal Coordination				X
Ames Area Regional Signal Coordination				X
Mason City Area Regional Signal Coordination				X
Clinton Area Regional Signal Coordination				X
Burlington Area Regional Signal Coordination				X
Ottumwa Area Regional Signal Coordination				X
Fort Dodge Area Regional Signal Coordination				X
Marshalltown Area Regional Signal Coordination				X
Muscatine Area Regional Signal Coordination				X
Event Management and Routing				
Ames Area Event Management / Alternate Routes				X
Iowa City Area Event Management / Alternate Routes				X
Dubuque Area Event Management / Alternate Routes				X
Automated Enforcement				
Expanded Red Light Running Program (Statewide)		X		
Highway-Rail Operations and Safety				
Highway-Railroad Safety and Delay Study (Statewide)				X
Highway-Rail Interface Coordination System (Statewide)				X

Potential Strategies / Projects	Deployment Timeframe: Immediate-term (Year 1)	Definite (Years 2-5)	Probable (Years 6-10)	Potential (Years 11-Later)
Traveler Information				
Metropolitan Area Changeable Message Signs				
Council Bluffs Metropolitan Area CMS/Portable CMS		X		
Des Moines Metropolitan Area CMS Expansion		X		
Quad Cities Metropolitan Area CMS Expansion		X		
Cedar Rapids Metropolitan Area CMS Expansion		X		
Waterloo/Cedar Falls Metropolitan Area CMS/Portable CMS		X		
Sioux City Metropolitan Area CMS/Portable CMS		X		
Interactive Internet Information				
Expanded Internet Traveler Information (Statewide)		X		
Automated Telephone Traveler Information				
Updated Telephone Traveler Information System (Statewide)		X		
Television and Radio Traveler Information				
Broadcast Traveler Information Expansion (Statewide)		X		
Metropolitan Area Highway Advisory Radio				
Des Moines HAR for I-235 Reconstruction			X	
Council Bluffs HAR / Traveler Information			X	
Quad Cities HAR / Traveler Information			X	
Cedar Rapids HAR / Traveler Information			X	
Waterloo/Cedar Falls HAR / Traveler Information			X	
Sioux City HAR / Traveler Information			X	
Rural Highway/Freeway Changeable Message Signs				
Expanded Rural Highway/Freeway CMS (Statewide)			X	
In-vehicle Signing / Route Guidance				
Statewide In-vehicle Signage/Guidance Study (Statewide)			X	
Rural Highway/Freeway HAR / Tourist Information				
Statewide Rural Highway/Freeway HAR System (Statewide)			X	
Traveler Information at Rest Areas				
Expanded Traveler Information at Rest Areas (Statewide)				X
Commercial Vehicle Operations				
Electronic Clearance / Weigh-In-Motion / LPR				
Expanded CVO Electronic Clearance/WIM (Statewide)			X	
CVO Traveler Information				
Updated Commercial Vehicle Information System (Statewide)			X	
Hazardous Materials Tracking / Management				
HAZMAT Tracking / Identification Mechanism (Statewide)				X
On-Board CVO Safety Monitoring				
CVO Collision Avoidance Systems (Statewide)				X
Public Transportation Management				
Urban Area Transit AVL / Tracking				
Expanded Des Moines Transit AVL			X	
Expanded Cedar Rapids Transit AVL			X	
Quad Cities Transit AVL System			X	
Council Bluffs Transit AVL System			X	
Waterloo/ Cedar Falls Transit AVL System			X	
Sioux City Transit AVL System			X	
Iowa City Transit AVL System				X
Dubuque Transit AVL System				X
Ames Transit AVL System				X
Burlington Transit AVL System				X
Clinton Transit AVL System				X
Fort Dodge Transit AVL System				X
Mason City Transit AVL System				X
Muscatine Transit AVL System				X
Expanded Ottumwa Transit AVL System				X
Marshalltown Transit AVL System				X
Urban Area Transit Traffic Signal Priority				
Des Moines Transit Signal Priority System			X	
Cedar Rapids Transit Signal Priority System			X	
Quad Cities Transit Signal Priority System			X	
Council Bluffs Transit Signal Priority System			X	
Waterloo/ Cedar Falls Transit Signal Priority System			X	
Sioux City Transit Signal Priority System			X	
Iowa City Transit Signal Priority System				X
Dubuque Transit Signal Priority System				X
Ames Transit Signal Priority System				X

Potential Strategies / Projects	Deployment Timeframe			
	Immediate-term (Year 1)	Definite (Years 2-5)	Probable (Years 6-10)	Potential (Years 11-Later)
Public Transit Management / Administrative				
Des Moines Transit Management System				X
Cedar Rapids Transit Management System				X
Quad Cities Transit Management System				X
Council Bluffs Transit Management System				X
Waterloo/ Cedar Falls Transit Management System				X
Sioux City Transit Management System				X
Iowa City Transit Management System				X
Dubuque Transit Management System				X
Ames Transit Management System				X
Burlington Transit Management System				X
Clinton Transit Management System				X
Fort Dodge Transit Management System				X
Mason City Transit Management System				X
Muscatine Transit Management System				X
Ottumwa Transit Management System				X
Marshalltown Transit Management System				X
Regional Rural / Demand Response				
Statewide Regional Rural Transit Model			X	
Regional Transit Implementation - Phase 1				X
Regional Transit Implementation - Phase 2				X
Emergency Management				
Consolidated Urban Area EMS Communications				
Des Moines EMS Communications System			X	
Omaha/Council Bluffs EMS Communications			X	
Quad Cities Area EMS Communications System			X	
Cedar Rapids Area EMS Communications System			X	
Sioux City Area EMS Communications System			X	
Waterloo/Cedar Falls EMS Communications System			X	
Metropolitan EMS Pre-emption/Routing/Response				
Des Moines EMS Traffic Signal Pre-emption			X	
Council Bluffs Area EMS Traffic Signal Pre-emption			X	
Quad Cities EMS Signal Pre-emption Enhancements			X	
Cedar Rapids EMS Traffic Signal Pre-emption			X	
Sioux City Area EMS Traffic Signal Pre-emption			X	
Waterloo/Cedar Falls EMS Signal Pre-emption Enhancements			X	
Iowa City EMS Traffic Signal Pre-emption				X
Dubuque EMS Traffic Signal Pre-emption				X
Ames EMS Signal Pre-emption Enhancements				X
Rural EMS / Mayday Response				
Rural EMS/Mayday Communications Plan (Statewide)			X	
Statewide Rural EMS Redistricting Study (Statewide)				X

Project Evaluation Method 2 – Projects vs. Project Partner Support

The second method in prioritizing potential project location under each top strategy is to assess the level of project partner support for ***operations and maintenance*** activities. Essentially, where this support exists, high-ranking projects should be pursued. This evaluation method will be applied through the stakeholder review process.

Project Evaluation Method 3 – Projects vs. Partner Capability and Commitment

The last method in comparing potential projects is to assess local partner capability and commitment to implementing the appropriate technologies through the chosen project. For the most part, high-ranking projects should be pursued where this capability and commitment to supply ***capital costs*** is strongest. This evaluation method will be also applied through the stakeholder review process.

Both the second and third methods of evaluating the potential ITS projects were addressed through a series of stakeholder review sessions, held in four different locations across the state on December 14-17. Final results of those stakeholder review sessions are reflected in Table 6-6 on the following pages. Only projects to be included in this plan are listed in this table. Year 1 (immediate-term) projects are also shown.

Table 6-6: Final Project Prioritization and Phasing

Potential Strategies / Projects	Deployment Timeframe: Immediate-term (Year 1)	Years 2-5	Years 6-10
ITS Planning, Marketing, and Administration			
ITS Program and Data Administration			
Iowa DOT Statewide Communications Plan (Statewide)	X		
National Model Expansion (Statewide)	X		
Statewide Integrated Database (Statewide)	X		
Speed Processing of Crash Data (Statewide)	X		
ITS Plans and Studies			
Quad Cities Area ITS Plan		X	
Cedar Rapids Area ITS Plan		X	
Sioux City Area ITS Plan		X	
Waterloo Area ITS Plan		X	
ITS Marketing and Education			
Statewide ITS Marketing and Education Program (Statewide)	X		
Travel and Traffic Management			
Metropolitan Area Traffic Management			
Des Moines Area Traffic Management System		X	
Council Bluffs Traffic Management System Enhancements		X	
Quad Cities Area Traffic Management System			X
Cedar Rapids Area Traffic Management System			X
Sioux City Area Traffic Management System			X
Waterloo/Cedar Falls Traffic Management System			X
Metropolitan Area Incident/Event Management			
Des Moines Area Incident/Event Management		X	
Omaha/Council Bluffs Incident/Event Management		X	
Quad Cities Area Incident/Event Management			X
Cedar Rapids Area Incident/Event Management			X
Sioux City Area Incident/Event Management			X
Waterloo/Cedar Falls Incident/Event Management			X
Smart Work Zones / Portable Traffic Management			
Smart Work Zones / Portable TMS Pool (Statewide)		X	
Roadway Weather Safety / Incident Prevention			
Incident Warning System Quad Cities Pilot Project	X		
Automated Bridge De-icing System Cedar Rapids Pilot	X		
Concept Vehicle Expansion (Statewide)		X	
Expanded Incident Warning Systems (Statewide)		X	
Expanded Automated Bridge De-icing Systems (Statewide)		X	
Regional Traffic Signal Coordination			
Expanded Des Moines Area Signal Coordination		X	
Council Bluffs Regional Signal Coordination		X	
Quad Cities Area Regional Signal Coordination		X	
Cedar Rapids Area Regional Signal Coordination		X	
Waterloo/Cedar Falls Area Regional Signal Coordination		X	
Sioux City Area Regional Signal Coordination		X	
Automated Enforcement			
Red Light Running Program Dubuque Pilot Project	X		
Expanded Red Light Running Program (Statewide)		X	
Highway-Rail Operations and Safety			
Highway-Railroad Safety and Delay Study (Statewide)			X
Crash Investigation Systems			
Total Stations Project Expansion (Statewide)			X

Potential Strategies / Projects	Deployment Timeframe Immediate-term (Year 1)	Years 2-5	Years 6-10
Traveler Information			
Metropolitan Area Changeable Message Signs			
Statewide/Regional Portable CMS Pool (Statewide)		X	
Interactive Internet Information			
ITS Weather Information on Iowa DOT Web Site (Statewide)	X		
Expanded Internet Traveler Information (Statewide)		X	
Automated Telephone Traveler Information			
Updated Telephone Traveler Information System (Statewide)		X	
Television and Radio Traveler Information			
Broadcast Traveler Information Expansion (Statewide)		X	
Metropolitan Area Highway Advisory Radio			
Statewide Metropolitan HAR			X
Rural Highway/Freeway Changeable Message Signs			
Expanded Rural Highway/Freeway CMS Pool (Statewide)			X
In-Vehicle Signing / Route Guidance			
Statewide In-vehicle Signage/Guidance Study (Statewide)			X
Rural Highway/Freeway HAR / Tourist Information			
Statewide Rural Highway/Freeway HAR System (Statewide)			X
Traveler Information at Rest Areas			
Expanded Traveler Information at Rest Areas (Statewide)		X	
Commercial Vehicle Operations			
Electronic Clearance / Weigh-In-Motion / LPR			
Expanded CVO Electronic Clearance/WIM (Statewide)			X
CVO Traveler Information			
Updated Commercial Vehicle Information System (Statewide)			X
Public Transportation Management			
Urban Area Transit AVL / Tracking			
Waterloo/ Cedar Falls Transit AVL System		X	
Expanded Cedar Rapids Transit AVL			X
Council Bluffs Transit AVL System			X
Quad Cities Transit AVL System			X
Sioux City Transit AVL System Expansion			X
Urban Area Transit Traffic Signal Priority			
Des Moines Transit Signal Priority System		X	
Cedar Rapids Transit Signal Priority System			X
Council Bluffs Transit Signal Priority System			X
Sioux City Transit Signal Priority System			X
Regional Rural / Demand Response			
Statewide Regional Rural Transit Feasibility Study / Model		X	
Rural Transit ITS Deployment - Phase I		X	
Rural Transit ITS Deployment - Phase II			X
Emergency Management			
Consolidated Urban Area EMS Communications			
Quad Cities Area EMS Communications System		X	
Des Moines EMS Communications System			X
Omaha/Council Bluffs EMS Communications			X
Cedar Rapids Area EMS Communications System			X
Sioux City Area EMS Communications System			X
Waterloo/Cedar Falls EMS Communications System Expansion			X
Metropolitan EMS Pre-emption/Routing/Response			
Des Moines EMS Traffic Signal Pre-emption			X
Council Bluffs Area EMS Traffic Signal Pre-emption			X
Quad Cities EMS Signal Pre-emption Enhancements			X
Cedar Rapids EMS Traffic Signal Pre-emption			X
Sioux City Area EMS Traffic Signal Pre-emption			X
Waterloo/Cedar Falls EMS Signal Pre-emption			X
Rural EMS / Mayday Response			
Rural EMS/Mayday Communications Plan (Statewide)			X

6.2 Overview of Program Areas and Projects

The projects that make up the Iowa DOT ITS program for the next decade are grouped/organized into six general program areas. This section will include the general objective of each program area and the projects that will be pursued within each area.

ITS Planning, Marketing, and Administration

The ITS planning, marketing and administration program area consists of critical ITS program support activities. These activities include planning for future ITS deployment, building and maintaining public support and the Iowa DOT knowledge base concerning ITS, administering the overall Iowa ITS program, and administering crucial data that is essential to maintaining an ITS and other key Iowa DOT activities. This area encompasses several of the most important existing ITS initiatives in Iowa, as well as very important activities that will guide the future of ITS in Iowa. Activities under this area ranked very high in the evaluation of projects over the next decade, especially in Years 1-5.

Over the next decade, ITS planning, marketing and administration activities will be relied upon to provide a solid foundation for the statewide ITS program. For this reason, these projects will receive strong consideration and emphasis in the deployment schedule over Years 1-10. It is expected that the role these activities play in the ITS program will remain an important part of the overall program, but funding allocated for the activities will decrease after Year 5. By this time, many of these activities will be completed and more resources will be spent on deployment of ITS technologies.

This program area includes three general ITS "strategies" that will be pursued in Years 1-10:

- ITS Program and Data Administration
- ITS Plans and Studies
- ITS Marketing and Education

ITS Program and Data Administration

Several existing Iowa DOT initiatives and immediate-term projects that were identified through this strategic plan are considered ITS program and data administration activities. Existing programs such as the officer information manager, automated turning movement data collection, Foretell, and GIS/ALAS are just a few of the activities underway with the Iowa DOT. These existing initiatives are discussed in greater detail in Section 2.0. Immediate-term projects, such as the statewide integrated database development and packaging, speed processing of crash data, and National Model expansion are all activities that will provide a solid foundation for Iowa's ITS program over the next decade. Details of these and other immediate-term program and data administration projects are detailed in Section 6.3.

ITS Plans and Studies

ITS Plans are a very important element in the implementation of a successful Intelligent Transportation System. Over the past few years, ITS early deployment plans were completed for the Des Moines and Omaha/Council Bluffs metropolitan areas. These plans have provided in-depth local input and the context and vision for specific ITS deployment in these metropolitan areas. Since the existence of these plans is seen as a necessary precursor to deployment of ITS in metropolitan areas, the completion of ITS plans for the other four large metropolitan areas are slated for Years 2-5. These areas are the Quad Cities, Cedar Rapids, Sioux City and Waterloo/Cedar Falls. These plans will provide the basis for future ITS deployments in these four areas.

ITS Marketing and Education

Since early in the process of developing the statewide ITS program, the Iowa DOT has recognized that, with the rapid advancements being made in the application of advanced technologies today, there is a definite need to integrate knowledge and utilization of ITS through public education and marketing. The overall objective of this strategy is the dissemination of information about ITS advanced technologies, potential applications of these technologies, and benefits to be gained through their use. These activities will target Iowa DOT staff; other state, regional, and local decision-makers and staff; and the traveling public in Iowa. These audiences will be reached through the use of specific marketing tools and media such as television advertising, radio announcements, informational presentations, and newspaper articles. Like the other administration and planning activities, ITS marketing and education will be more heavily utilized in Years 1-5 in order to disseminate knowledge to a wide audience early in the Iowa ITS program.

Travel and Traffic Management

The travel and traffic management program area consists of ITS activities that support the overall improved operations and safety of traffic on Iowa's roadways. This program area also encompasses some of the existing ITS initiatives in Iowa, as well as very important future activities. Activities under this program area ranked very high and received heavy consideration in prioritization of projects over the next decade, especially in Years 1-5.

Over the next decade, travel and traffic management activities will be relied upon to provide a solid foundation for the statewide ITS program. These projects are emphasized in the deployment schedule over Years 1-10. It is expected that the role these travel and traffic management activities play in the ITS program will remain an important part of the overall program through the 10 years of this ITS program. By Year 10, many of these activities will be well established throughout the state.

This program area includes eight general ITS "strategies" that will be pursued in Years 1-10:

- Metropolitan Area Traffic Management Systems
- Metropolitan Area Incident/Event Management Programs
- Smart Work Zones / Portable Traffic Management Systems
- Roadway Weather Safety / Incident Prevention Systems
- Regional Traffic Signal Coordination
- Automated Enforcement
- Highway-Rail Operations and Safety
- Crash Investigation Systems

<u>Metropolitan Area Traffic Management Systems</u>

Metropolitan traffic management systems are a key ITS strategy. Traffic management includes a wide variety of specific ITS applications, including service patrols, network surveillance and detection, freeway traffic control and ramp metering, and local street network signal coordination. Traffic management is also very closely associated with roadside and pre-trip traveler information, which are used as tools to disseminate information supplied through traffic management system components. Different components of this strategy will be implemented in the six largest metropolitan areas in the state in the next 10 years.

Among specific milestones to be expected are:

- A functioning traffic management center, including the components identified in the Des Moines Metropolitan Area ITS Strategic Plan, in the Des Moines metropolitan area by Year 5.
- Council Bluffs traffic operations, as identified in the Omaha Metropolitan Area Intelligent Transportation Systems Early Deployment Planning Study, incorporated into an Omaha traffic management center by Year 5.
- Key traffic management components functioning in Quad Cities, Cedar Rapids, Sioux City and Waterloo/Cedar Falls areas. The extent of these activities will vary in each area, and will be based upon the results of the ITS plans completed for these areas in Years 2-5.

<u>Metropolitan Area Incident/Event Management Programs</u>

Because incidents are a major cause of congestion, incident/event management programs have been identified as having a significant importance to maintaining safety and improving operations on major roadways in Iowa's metropolitan areas. For this reason, updated incident management programs will be initiated along side traffic management activities in each of the six largest metropolitan areas in Iowa during Years 2-10. The incident detection and reporting technologies associated with incident management programs are part of an overall traffic management system. Though these traffic management tools are essential to incident management, this program area focuses on the formal coordination of response and clearance activities or procedures.

Incident management includes the involvement and cooperation of several agencies in each of the applicable metropolitan areas. Though many of these agencies may have the necessary resources to handle incidents, the key to incident management is the coordination of these resources through interagency cooperation.

Smart Work Zones / Portable Traffic Management Systems

Portable traffic management systems are intended to improve traffic operations and safety around and within work zones. A typical portable TMS consists of a trailer-mounted changeable message sign, a CCTV camera for vehicle detection, and sensors to detect vehicle speed and presence. Currently, the Iowa Department of Transportation is co-sponsoring a research project along with three other states to assess the application of ITS and other technologies to improve safety and minimize delay at work zones. This strategy will be pursued through a project beginning in Year 2. This project will consist of a statewide program to deploy PTMS units at various work zone locations across the state each construction season.

Roadway Weather Safety / Incident Prevention Systems

This broadly focused ITS strategy involves a variety of uses of specific spot applications of advanced technologies 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. Currently, the Iowa DOT is participating in a pooled fund research study of which the objective is to develop a concept maintenance vehicle that has the ability to collect roadway weather data while it clears roadways. This effort is being furthered through the integration of weather information on the Iowa DOT web site in Years 1-5, and through the expansion of the concept vehicle program in Years 2-5. The multiple benefits of this initiative also include the more efficient use of maintenance fleets.

In the first five years of the Iowa ITS program, two pilot projects, an incident warning system on the Interstate 74 bridge in the Quad Cities area and an automated bridge anti-icing system on Interstate 380 in Cedar Rapids, will be deployed. Additional locations for both of these types of systems will also be funded in Years 2-5. Detailed descriptions of both of these spot ITS applications, as well as the concept vehicle project, can be found in Subsection 6.3.

Regional Traffic Signal Coordination

Regional traffic signal coordination is a key ITS strategy that has been applied fairly 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.

Currently, there is an extensive amount of traffic signal interconnection work programmed for the Des Moines area, as well as in other urban areas throughout the state. Under the Iowa ITS Program further regional signal coordination work will be pursued in the Des Moines area, as well as in the other five major metropolitan areas of Omaha/Council Bluffs, Quad Cities, Cedar Rapids, Waterloo/Cedar Falls and Sioux City.

Automated Enforcement

This ITS strategy involves the use of advanced technologies to enforce traffic regulations and consequently reduce the risk of crashes at a specific location. One example of automated enforcement that will be pursued in Iowa is red light running enforcement. Details of this technology are discussed later in Subsection 6.3. Today, disregard for red lights at signalized intersections is becoming increasingly common in many cities. This problem has resulted in increased intersection crashes across the United States, and has been singled out by the U.S. DOT as a priority to be addressed.

In tune with many areas across the country, the Iowa Department of Transportation has a desire to analyze the significance of this practice in Iowa. The Iowa DOT is currently sponsoring a research project to evaluate red light running crashes in Iowa. One of the objectives of this research is to assess crash data to determine the scope of the problem in the state. In addition, through the development of an immediate-term demonstration program and implementation of permanent systems around the state in Years 2-5, the Iowa ITS program is addressing this growing national concern.

Highway-Rail Operations and Safety

Efforts under this strategy focus on the growing problem of safety and operations where surface streets and highways meet rail corridors. Though this strategy did not rank as high as other travel and traffic management strategies in the project prioritization process, concern was expressed concerning this topic from a significant number of stakeholders. Many of these concerns came from areas located along the Union Pacific rail corridor. The major issues surrounding rail-highway intersections possible specific advanced technologies to be utilized will be looked at through the completion of a Highway-Rail Safety and Delay Study in Years 6-10.

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. 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.

Crash investigation technologies will be utilized in the Des Moines area as part of the traffic and incident management activities pursued during the Interstate 235 reconstruction activities in Years 2-10. Specifics of this effort can be found in Section 6.3. Depending on results of other ITS plans, further applications of crash investigation systems will be utilized in other metro areas of Iowa in Years 6-10.

Traveler Information

The traveler information program area consists of ITS activities that support the overall improved safety and operations of traffic on Iowa's roadways by supplying travelers with important information before their trips begin, as well as during their trips. This program area encompasses several of the existing ITS initiatives in Iowa, as well as key future activities. Activities under this area have received heavy consideration in prioritization of projects over the next decade, especially in Years 1-5.

Over the next decade, traveler information activities will be relied upon to work closely with traffic management and other efforts to provide a solid foundation for efforts of the statewide ITS program. These projects are heavily emphasized in the deployment schedule over Years 1-10. It is expected that the role traveler information will play in the ITS program will remain an important part of the overall program through the 10 years of this ITS program. By Year 10, many traveler information activities discussed in this subsection will be fully deployed and well established throughout the state.

This program area includes nine general ITS "strategies" that will be pursued on varying levels in Years 1-10:

- Metropolitan Area Changeable Message Signs
- Interactive Internet Information
- Automated Telephone Traveler Information
- Television and Radio Traveler Information
- Metropolitan Area Highway Advisory Radio
- Rural Highway/Freeway Changeable Message Signs
- In-vehicle Signing / Route Guidance
- Rural Highway/Freeway Highway Advisory Radio
- Traveler Information at Rest Areas

<u>Metropolitan Area Changeable Message Signs</u>

The use of changeable message signs (CMS) to relay traveler information is another key ITS strategy. CMS are used closely with traffic management activities in metropolitan areas to relay important information on traffic conditions, weather problems, or construction that is supplied through traffic management system components. Permanent CMS have already been deployed in a few locations in the Des Moines, Quad Cities and Cedar Rapids areas. In the future, under the Iowa ITS program, additional permanent CMS will be deployed in conjunction with full traffic management system deployments, while portable CMS units will be utilized in other areas.

Specifically, over Years 2-5, additional permanent CMS will be installed in the Des Moines and Council Bluffs areas as part of those traffic management systems being deployed. Permanent CMS will be deployed in other major cities during Years 6-10 as these areas develop and implement traffic management system components. Until then, portable CMS will be utilized where needed through a statewide/regional portable CMS pool. This effort is being funded in Years 1-5 to supply portable CMS units to different areas of the state as needed for special events and other traffic management activities.

Interactive Internet Information

With the phenomenal growth in the use, accessibility and power of the Internet over the past few years, this versatile communication tool is an excellent medium for relaying traveler information to millions of potential users. Understanding this trend, the Iowa DOT has undertaken several initiatives over the past few years that utilize the Internet to provide traveler information. In addition to supplying traveler information on the Iowa DOT Web site; Des Moines bus schedules, bus routes, and construction schedules have been provided. These existing initiatives are discussed in greater detail in Section 2.0. In the immediate term, more timely and detailed weather information will be soon integrated into the Iowa DOT Web site; and over the next decade, Internet traveler information will be expanded to include a wider variety and more detailed traveler information. Much of this expansion will be determined by the very dynamic and rapid growth of the Internet market.

Automated Telephone Traveler Information System

Another method of distributing traveler information is through the telephone. Like the Internet, the telephone systems of today are changing and advancing much quicker than most people could have imagined just a few years ago. This dynamic market will also play a large part in determining the future of traveler information. Currently, there is a traveler telephone hotline available to travelers. The hotline is sponsored by the Iowa State Patrol. This hotline provides travelers with general detour and weather information. Over the next few years, this system will be complimented with a more advanced telephone traveler information system that will utilize more detailed and real-time data developed through several sources, including Iowa DOT initiatives, such as Foretell and CARS.

Television and Radio Broadcast Traveler Information

Television and radio are two of the most effective methods of relaying any type of information, including traveler information. In several areas around the United States, these media are utilized extensively to provide congestion and weather information, and are well received by the public. Currently, traffic information is broadcast over radio and television in various locations throughout Iowa. Often, this information is somewhat limited and could be greatly enhanced by utilizing higher quality road and weather information being provided through Iowa's other ITS initiatives. In Years 2-5, funding has been designated to expand and improve the broadcast traveler information across the state.

Metropolitan Area HAR / Traveler Information

Highway advisory radio (HAR) is another method of relaying traveler information to the public over a dedicated AM radio broadcast. Under this strategy, these radio broadcasts are dedicated to local or regional information about traffic congestion or construction detours. These systems broadcast over a limited area and will be used for specific spot applications in major metropolitan areas. These systems will be integrated into deployments of traffic management activities in the Des Moines and Omaha/Council Bluffs areas in Years 2-5. Later, in Years 6-10, HAR will be utilized in other metropolitan areas for specific situational applications.

Rural Highway/Freeway Changeable Message Signs

This application of changeable message signs is focused on deployment of permanent or portable signs along rural stretches of highway. Possible locations for these signs would be at key decision points, such as at state borders or major roadway crossroads, where weather conditions or construction might warrant a route change or closure. The Iowa DOT currently utilizes some portable CMS at a few locations in Iowa. Possible locations of future permanent CMS along rural highways and freeways will be looked at in Years 6-10, as well as the addition of portable CMS units to supplement the units used in other areas.

In-Vehicle Signing and Route Guidance

This general ITS strategy involves providing detailed traveler information and, in some cases, personalized route directions directly to travelers in their vehicles. This information, most likely, would be provided through a third-party information service provider. Though this type of technology did not rank as high as other forms of traveler information, it was seen as an important strategy to investigate. This investigation would look at what type of role, if any, the Iowa DOT or the traveler information that will be developed will play in this type of application over the next decade. Therefore, the Iowa DOT will look at this possibility in Years 6-10 through an in-vehicle signage and route guidance study.

Rural Highway/Freeway HAR / Tourist Traveler Information

This strategy is similar to HAR applications mentioned above, but would be applied in rural areas. Currently, permanent HAR systems are being utilized in the Mason City and West Branch areas to provide tourist information to motorists. Another portable HAR system has been utilized in the Okoboji area during recent construction activities. In Years 6-10, a statewide pool of HAR units will be acquired to provide traveler information during specific events or construction outside of the major metropolitan areas.

Traveler Information at Rest Areas

This strategy focuses on providing traveler information at Iowa's rest areas. Currently, there are computer terminals installed at interstate highway rest areas that are linked to the Iowa DOT weather information. Future efforts will focus on upgrading these current systems with the same improved weather and roadway information being utilized by other traveler information outlets.

Commercial Vehicle Operations

The commercial vehicle operations program area consists of activities that support the overall safety, operations and efficiency of commercial trucking activity. ITS/CVO functions work by streamlining the regulatory functions associated with commercial trucking and improving the safety of the commercial vehicles themselves. This program area encompasses some existing ITS initiatives underway in Iowa, mainly overseen by the Iowa DOT Motor Vehicle Division. Several of these initiatives have been successfully implemented or are in the testing stages. ITS activities in the CVO arena are very much dependent on the private sector for further development. In addition, these strategies did not rank well during the project evaluation process. For these reasons, activities under this area have received lesser consideration in prioritization of projects over the next decade, but do represent a few initiatives in Years 6-10.

The overall recommendation for this program area is to follow the priorities identified by the Iowa DOT in its ITS/CVO Business Plan. The goal of the ITS/CVO Business Plan is to provide an environment to create a network using technology that will enhance efficiency, safety, compliance, and enforcement for commercial vehicle operations.

Under the statewide ITS plan, the CVO program area includes two (2) general ITS "strategies" that will be pursued on varying levels in Years 6-10:

- Electronic Clearance / Weigh-In-Motion
- CVO Traveler Information

<u>Electronic Clearance / Weigh-In-Motion</u>

Under this strategy, advanced technologies are used to speed up the weighing and subsequent clearance of commercial vehicles. Specifically, this effort involves the implementation of main line weigh-in-motion scales on the most heavily traveled trucking corridors across the state. Interstate 35 and Interstate 80 are both principal trucking routes for the midwestern United States. Funding for electronic clearance/weigh-in-motion efforts has been designated for Years 6-10.

<u>CVO Traveler Information</u>

This strategy involves the implementation of a system to provide commercial vehicle operators with a dedicated information system that would provide them with necessary information on several aspects of CVO activity, including permitting, repairs, accommodations, fuel and other services. Such a system was discussed in the Des Moines Metropolitan Area ITS Plan, and will be explored in Years 6-10. This system would most likely be an Internet-based system.

Public Transportation Management

This ITS strategy focuses on the improved operations of public transit services. Public transit systems across the United States have used ITS technologies to manage their fleets more efficiently. Though this strategy did not score as high as other strategies during the initial project evaluation process, specific transit projects were supported through the stakeholder review process. Currently, there are a few transit-related ITS initiatives taking place across the state, and future efforts under this plan will build on these efforts.

Over the next decade key metropolitan areas have been targeted to deploy ITS technologies, and a major effort will be made to implement ITS within regional/rural transit agencies. By Year 10, the state of Iowa will have a well-established transit backbone that utilizes advanced technologies to provide passengers, especially the growing number of Iowa's aging population, with convenient and reliable mobility.

This program area includes three general ITS "strategies" that will be pursued on varying levels in Years 1-10:

- Metropolitan/Urban Area Transit AVL
- Metropolitan/Urban Area Transit Signal Priority
- Regional/Rural Demand Response Transit

<u>Metropolitan Area Transit AVL / Tracking Systems</u>

This strategy focuses on providing improved operations of urban fixed-route transit service through the use of automatic vehicle location technology. Under this strategy, transit vehicles are equipped with global positioning system receivers which are able to communicate their locations through satellites to a central dispatch location. As a result, transit agencies are able to track the position of their vehicles and use this knowledge to optimize their routing and scheduling. Transit AVL projects will be pursued in the six largest metropolitan areas of Iowa under this plan. Des Moines is just completing the deployment of transit AVL on its vehicles, and beginning in Years 2-5, the Waterloo/Cedar Falls area's Metro Transit Authority will use this technology. In Years 6-10 further Transit AVL deployments or expansions are slated for the Council Bluffs, Cedar Rapids, Quad Cities and Sioux City areas. Details of these projects can be found in Section 6.3.

<u>Metropolitan Area Transit Traffic Signal Priority</u>

This strategy involves the use of traffic signal priority for transit vehicles. Specifically, this involves equipping selected traffic signals with automated signal control systems. By giving priority to buses, the traffic signal system is potentially optimizing the throughput of people rather than the throughput of vehicles. This strategy will be pursued in the Des Moines area in Years 2-5, and in other metropolitan areas in Years 6-10.

Regional/Rural Demand Response Transit

This strategy involves the utilization of ITS advanced technologies, such as AVL and transit management systems, by the various rural demand response transit agencies. Over the past few years a few regional agencies in Iowa have been pursuing ITS approaches to managing their fleets. Under this plan, a statewide model will be developed that would assess the overall need for ITS technologies for the 16 regional transit agencies in Iowa and plan phased deployment of ITS using lessons learned from early implementations in Region 15. This model development would happen in Year 2, while deployment in the some regions would begin upon completion of the study/model. Details can be found in Section 6.3.

Emergency Management

This program area involves the deployment of advanced technologies that support the overall improved response of emergency services. These technologies, which include traffic signal preemption, improved communications, and mayday systems; have not been widely deployed in Iowa to date. Though these technologies did not rank high in the initial project evaluation process, emergency management is still considered a very important area to which ITS can be successfully applied.

Over the next decade, emergency management strategies will be utilized to provide a sound foundation for dependable responsive emergency response across the state. These efforts will be closely coordinated with traffic and incident management efforts in larger urban areas, and will also build upon private sector innovations that have been rapidly developing in recent years.

This program area includes three general ITS "strategies" that will be pursued on varying levels in Years 1-10:

- Consolidated Urban Area EMS Communications Systems
- EMS Signal Preemption and Routing
- Rural EMS/Mayday Response

Consolidated Urban Area EMS Communications Systems

Under this strategy, advanced technologies are used to improve communications between emergency services in order to better respond to and manage an emergency situation. Currently, several areas in Iowa have problems communicating between different agencies that respond to emergencies (i.e. fire, police, ambulance, HAZMAT). Over the next 10 years, the focus of this strategy will be to update and coordinate the communications systems in larger metropolitan areas. Deployment will start in the Quad Cities in Years 2-5 and spread to the other five large metropolitan areas in Years 6-10. Details of these deployments can be found in Section 6.3.

Metropolitan Area EMS Traffic Signal Priority/Routing/Response Systems

This strategy involves the use of traffic signal preemption systems for emergency vehicles, such as police, fire and ambulance. Specifically, this involves equipping emergency vehicles and selected intersections with automated signal control systems. Much like transit priority systems, these systems would allow emergency vehicles better progression through intersections during emergency situations. These technologies will be deployed in Years 6-10 in larger metropolitan areas. Details of these deployments can be found in Section 6.3.

Rural EMS / Mayday Response

This strategy involves the use of advanced technologies to detect and respond to emergency situations in rural areas. Most of the technologies behind such efforts are being led by the private automobile industry through programs using in-vehicle satellite communications to notify a centralized dispatch center of a vehicle incident or crash. Though most of the work being done in this area is through the private sector, the role of the Iowa DOT will be explored in a rural EMS / Mayday Communications Plan. This plan, which is slated for Years 6-10, is discussed in more detail in the following section.

6.3 Project Descriptions

This section details the specifics of the projects identified for implementation over the next ten years through the Iowa Statewide ITS Program. The project descriptions are organized/grouped by the program areas covered in the previous section. A complete overview of the immediate-term and future projects is shown in Table 6-7 on the following page.

Table 6-7: Projects in the Ten-Year Iowa ITS Program

Strategies / Projects	Deployment Timeframe					
	Year 1 (Immediate term)	Year 2	Year 3	Year 4	Year 5	Years 6-10
ITS Planning, Marketing, and Administration						
ITS Program and Data Administration						
1/1/1 Iowa DOT Statewide Communications Plan (Statewide)	■					
1/1/2 National Model Expansion (Statewide)	■					
1/1/3 Statewide Integrated Database (Statewide)	■	■	■	■	■	
1/1/4 Speed Processing of Crash Data (Statewide)	■	■	■	■	■	
ITS Plans and Studies						
1/2/1 Quad Cities Area ITS Plan		■				
1/2/2 Cedar Rapids Area ITS Plan			■			
1/2/3 Sioux City Area ITS Plan			■			
1/2/4 Waterloo Area ITS Plan			■			
ITS Marketing and Education						
1/3/1 Statewide ITS Marketing and Education Program (Statewide)	■	■	■	■	■	
Travel and Traffic Management						
Metropolitan Area Traffic Management						
2/1/1 Des Moines Area Traffic Management System		■	■	■	■	
2/1/2 Council Bluffs Traffic Management System Enhancements		■	■	■	■	
2/1/3 Quad Cities Area Traffic Management System						■
2/1/4 Cedar Rapids Area Traffic Management System						■
2/1/5 Sioux City Area Traffic Management System						■
2/1/6 Waterloo/Cedar Falls Traffic Management System						■
Metropolitan Area Incident/Event Management						
2/2/1 Des Moines Area Incident/Event Management		■				
2/2/2 Omaha/Council Bluffs Incident/Event Management		■				
2/2/3 Quad Cities Area Incident/Event Management						■
2/2/4 Cedar Rapids Area Incident/Event Management						■
2/2/5 Sioux City Area Incident/Event Management						■
2/2/6 Waterloo/Cedar Falls Incident/Event Management						■
Smart Work Zones / Portable Traffic Management						
2/3/1 Smart Work Zones / Portable TMS Pool (Statewide)		■	■	■	■	
Roadway Weather Safety / Incident Prevention						
2/4/1 Incident Warning System Quad Cities Pilot Project	■	■	■	■	■	
2/4/2 Expanded Incident Warning Systems (Statewide)		■	■	■	■	
2/4/3 Automated Bridge Anti-icing System Cedar Rapids Pilot	■	■	■	■	■	
2/4/4 Expanded Automated Bridge Anti-icing Systems (Statewide)		■	■	■	■	
2/4/5 Concept Vehicle Expansion (Statewide)			■	■	■	
Regional Traffic Signal Coordination						
2/5/1 Expanded Des Moines Area Signal Coordination		■	■	■	■	
2/5/2 Council Bluffs Regional Signal Coordination		■	■	■	■	
2/5/3 Quad Cities Area Regional Signal Coordination		■	■	■	■	
2/5/4 Cedar Rapids Area Regional Signal Coordination		■	■	■	■	
2/5/5 Waterloo/Cedar Falls Area Regional Signal Coordination		■	■	■	■	
2/5/6 Sioux City Area Regional Signal Coordination		■	■	■	■	
Automated Enforcement						
2/6/1 Red Light Running Program Dubuque Pilot Project	■	■	■	■	■	
2/6/2 Expanded Red Light Running Program (Statewide)		■	■	■	■	
Highway-Rail Operations and Safety						
2/7/1 Highway-railroad Safety and Delay Study (Statewide)						■
Crash Investigation Systems						
2/8/1 Total Stations Project Expansion (Statewide)						■

Strategies / Projects	Deployment Timeframe: Year 1 (Immediate term)	Year 2	Year 3	Year 4	Year 5	Years 6-10
Traveler Information						
Metropolitan Area Changeable Message Signs						
3/1/1 Statewide/Regional Portable CMS Pool (Statewide)		■	■	■	■	
Interactive Internet Information						
3/2/1 ITS Weather Information on Iowa DOT Web Site (Statewide)	■	■	■	■	■	
3/2/2 Expanded Internet Traveler Information (Statewide)			■	■	■	
Automated Telephone Traveler Information						
3/3/1 Updated Telephone Traveler Information System (Statewide)			■	■	■	
Television and Radio Traveler Information						
3/4/1 Broadcast Traveler Information Expansion (Statewide)			■	■	■	
Metropolitan Area Highway Advisory Radio						
3/5/1 Statewide Metropolitan HAR						■
Rural Highway/Freeway Changeable Message Signs						
3/6/1 Expanded Rural Highway/Freeway CMS Pool (Statewide)						■
In-Vehicle Signing / Route Guidance						
3/7/1 Statewide In-vehicle Signage/Guidance Study (Statewide)						■
Rural Highway/Freeway HAR Pool						
3/8/1 Statewide Rural Highway/Freeway HAR System (Statewide)						■
Traveler Information at Rest Areas						
3/9/1 Expanded Traveler Information at Rest Areas (Statewide)			■	■	■	
Commercial Vehicle Operations						
Electronic Clearance / Weigh-in-motion / LPR						
4/1/1 Expanded CVO Electronic Clearance/WIM (Statewide)						■
CVO Traveler Information						
4/2/1 Updated Commercial Vehicle Information System (Statewide)						■
Public Transportation Management						
Urban Area Transit AVL / Tracking						
5/1/1 Waterloo/ Cedar Falls Transit AVL System		■	■	■	■	
5/1/2 Cedar Rapids Transit AVL System Enhancements						■
5/1/3 Council Bluffs Transit AVL System						■
5/1/4 Quad Cities Transit AVL System						■
5/1/5 Sioux City Transit AVL System Expansion						■
Urban Area Transit Traffic Signal Priority						
5/2/1 Des Moines Transit Signal Priority System		■	■	■	■	
5/2/2 Cedar Rapids Transit Signal Priority System						■
5/2/3 Council Bluffs Transit Signal Priority System						■
5/2/4 Sioux City Transit Signal Priority System						■
Regional Rural / Demand Response						
5/3/1 Statewide Regional Rural Transit Study / Model		■				
5/3/2 Rural Transit ITS Deployment - Phase I			■	■	■	
5/3/3 Rural Transit ITS Deployment - Phase II						■
Emergency Management						
Consolidated Urban Area EMS Communications						
6/1/1 Quad Cities Area EMS Communications System		■	■	■	■	
6/1/2 Des Moines EMS Communications System						■
6/1/3 Omaha/Council Bluffs EMS Communications						■
6/1/4 Cedar Rapids Area EMS Communications System						■
6/1/5 Sioux City Area EMS Communications System						■
6/1/6 Waterloo/Cedar Falls EMS Communications System Expansion						■
Metropolitan EMS Pre-emption/Routing/Response						
6/2/1 Des Moines EMS Traffic Signal Pre-emption						■
6/2/2 Council Bluffs Area EMS Traffic Signal Pre-emption						■
6/2/3 Quad Cities EMS Signal Pre-emption Enhancements						■
6/2/4 Cedar Rapids EMS Traffic Signal Pre-emption						■
6/2/5 Sioux City Area EMS Traffic Signal Pre-emption						■
6/2/6 Waterloo/Cedar Falls EMS Signal Pre-emption						■
Rural EMS / Mayday Response						
6/3/1 Rural EMS/Mayday Communications Plan (Statewide)						■

Program Area 1: ITS Planning, Marketing, and Administration: ITS Program and Data Administration

Project 1/1/1 – Iowa DOT Statewide Communications Plan

Brief Project Summary:

This project involves the development of an overall communications plan for Iowa. This plan will support a state-level study evaluation of the current information infrastructure owned and used by the Iowa DOT, as well as those systems that the state interfaces with. This study will, among other things; involve identifying needs, resources, and sharing opportunities for the Iowa DOT towers by other entities, including regional rural transit and emergency medical services (EMS). The end result of this study will be the statewide plan for sharing communications resources.

The study will also look into the possible use of local towers for Iowa DOT use and 800 MHz radio systems. The Statewide Communications Plan project will involve coordination with the current DOT study being done to determine if the Iowa DOT wants to allow fiber optics companies to use our right of way and how we should be compensated.

Background:

Currently, there is no statewide plan to guide the coordinated communications efforts in Iowa. This plan is needed to assess the potential for sharing Iowa DOT transmitter tower capacity with other users, and possible use of local infrastructure by the Iowa DOT. This study will help identify the entities interested in using the infrastructure, why this use is needed, and how this can be accomplished. It will involve an evaluation of what this infrastructure can structurally handle.

Actions:

The Iowa Department of Transportation Information Technology Division will be the lead on this project. The main objective of this project is to produce a plan that will focus mainly on the communication needs of the Statewide ITS Program and the needs of the Iowa DOT in general. This plan will involve the coordination of EMS and regional rural transit communications throughout the state as well as throughout Iowa DOT divisions and offices

The first phase of this project will identify the resource requirements, such as bandwidth needs and overall capacity of the system. The second phase will identify possible resource-sharing opportunities with other groups; such as city/county law enforcement, city/county maintenance, EMS, fire, transit, Iowa DOT, private sector services, etc. Thirdly, the plan will provide recommendations and implementation strategies for outside entities, such as rural and regional transit, and for the Iowa DOT to foster a statewide emergency dispatch system. This project will also be coordinated with the current study to determine if the Iowa DOT wants to allow fiber optic companies to use its right-of-way and how they should be compensated.

Creating a statewide communications plan will involve input from a variety of stakeholders. Staff from the Iowa DOT, other key state agencies, rural transit providers, emergency medical services, MPO's and RPA's, county and local government officials, private communications providers, and others will all need to be involved in developing this plan. Together, these groups will identify the current strengths and weaknesses of Iowa's communications environment and make recommendations for inclusion in the plan.

Benefits:

By identifying the strengths and weaknesses of the communications system in Iowa, this plan will help guide specific improvements that will heighten the efficiency of the current and future communications infrastructure. As a result, travelers, the Iowa DOT, emergency vehicles, transit operators, and commercial vehicle operators will benefit from improved communication, safety, and the wealth of information being shared.

Costs:

The cost to develop a statewide communications plan is estimated at approximately $300,000. Additional upgrading and integration of the current communications system and the implementation of the plan will entail additional expenses and will be determined by the findings of the plan.

There are no additional operations and maintenance costs associated with this project.

Schedule:

This project is proposed for Year 1, immediately following completion of the ITS Plan, in order to identify any deficiencies in and opportunities for improvement of the Iowa DOT's statewide communications network.

Program Area 1: ITS Planning, Marketing, and Administration: ITS Program and Data Administration

Project 1/1/2 – National Model Expansion

Brief Project Summary:

This project involves the expansion of the current Iowa DOT efforts as part of the National Model for the State Application of Data Collection and Management Technology to Improve Highway Safety. This program is focused on developing software to share information, resources, and technologies to improve highway safety. Expansion of this project will also support the speed processing of crash data through the ADVANTAGE Safety program.

ITS projects under this effort include mobile digital radios, bar code readers, GPS applications, and an FHWA Inspection Selection System. This National Model Program is expected to improve data acquisition for roadway incidents, leverage proven technology for law enforcement, streamline communications of safety information to stakeholders, and extend the use of this information for short and long range safety and law enforcement programs.

Background:

The National Model Program is a consortium effort involving the Iowa DOT Motor Vehicle Division, Iowa Department of Public Safety, Iowa Highway Patrol, and the Federal Highway Administration. This project focuses on sharing information, resources, and technologies to improve highway safety.

Key components of the project are identification of technologies that support its goals, demonstration of those technologies already in place in Iowa, and development of those technologies that are not yet available in the Iowa technology environment.

Actions:

This project will be lead by the Iowa DOT Motor Vehicle Division and will provide funding to support further research and software development for the key projects of the National Model Program. These key ITS projects include:

- Bar-coded registrations
- Mobile digital radios
- Bar code readers
- Advantage Safety (includes MARS and Automated Citations)
- Driver License bar coding/magnetic strip
- FHWA Inspection Selection System
- PC Miler
- Incident reporting
- Automated inspections

Benefits:

The expected benefits of the program are improved data acquisition for roadway incidents, leveraging of proven technology for law enforcement, streamlining communications of safety information to stakeholders, and extending the use of this information for short and long range safety and law enforcement programs.

Costs:

Further software development for this project will cost approximately $600,000.

Additional operations and maintenance resulting from this project will be included in the operating costs of the agencies participating in the National Model Program. Therefore, there are no additional costs are associated with this effort.

Schedule:

This project is scheduled for deployment in the immediate term, Year 1.

Program Area 1: ITS Planning, Marketing, and Administration: ITS Program and Data Administration

Project 1/1/3 – Integrated Database Development and Packaging

Brief Project Summary:

This project involves the development of a process for integrating and packaging Iowa DOT database initiatives, such as the Condition Acquisition and Reporting System (CARS) and Location Referencing System (LRS), to be compatible with the Iowa DOT data warehouse, called the Coordinated Transportation Analysis and Management System (CTAMS). These database initiatives will provide the foundation for several other ITS projects.

Background:

In order to manage infrastructure, it is necessary to compile information that enables the organization to determine how the transportation system is functioning, helps them identify potential problem areas and needs, and supplies information that yields proactive solutions that enable the transportation system to function at optimum levels. Two fundamental tools aid in the integration of transportation data: linear referencing systems (LRS) and geographic information systems (GIS). Since many of the available data sets contain unrelated databases (e.g. wetlands and traffic volumes), the most logical method of integrating the data is through spatial relationships (e.g. the wetland is in proximity to the road carrying traffic).

Intelligent transportation systems often utilize location attributes. Information from ITS field data collectors, such as the location of congestion on the road network at specific times of the day, can aid in the development of needs assessments, deployment of traffic control devices, and changes in real-time signage and traffic flow regulators. Since it has been found that ITS applications are generally data users *and* data providers, it is especially important that the databases integrate with the ITS and the transportation / asset management systems and visa versa.

Actions:

The ultimate goal of this project is to have a fully inclusive database that incorporates information from all of the relevant Iowa DOT information systems.

Since these systems use Oracle databases, this project will act as a bridge to link all three systems. The project will ensure that future Oracle databases will be able to share or "pull" the same data. The major focus of this project will be on designing software and ensuring that future database-driven applications, such as CARS, LRS, and Foretell, are coordinating their designs with common field descriptions and consistently formatting the major aspects of the database structure during design.

The current Iowa DOT LRS Development Project is a one-year design and pilot effort to prove the effectiveness of deploying a LRS at the Iowa DOT. The project will develop a system that will be applied to all public roads in Iowa; this includes Interstates, US routes, and county, city and institutional roads.

Benefits:

Coordinated development of Iowa DOT databases will ensure that data sharing will occur seamlessly between each of the systems and the CTAMS data warehouse, resulting in a wealth of accurate and timely data available for use by the Iowa DOT to streamline its day-to-day operations.

Costs:

The cost to fully complete the software development, integration, and packaging of these systems will be approximately $450,000 over five years. This cost estimate includes additional operations and maintenance costs for these systems, which is estimated at $135,000 over the 5 years of the project.

Schedule:

This project is proposed for deployment in the immediate-term, Years 1-5.

Program Area 1: ITS Planning, Marketing, and Administration: ITS Program and Data Administration

Project 1/1/4 – Speed Processing of Crash Data

Brief Project Summary:

This project will involve the enhancement of the current statewide crash data reporting system with automated collection and data capture tools through the ADVANTAGE Safety System. These computer devices allow for crash data to be converted to a useable format on site or before the data is sent to the processing center. This additional computer equipment will improve the accuracy and timeliness of the crash data being entered. This will allow Iowa DOT personnel, such as traffic engineers to utilize this crash data to make quicker decisions.

This project is a part of the National Model for the State Application of Data Collection and Management Technology to Improve Highway Safety (National Model), which is a program for sharing information, resources, and technologies to improve safety on highways. These units are also used for ticketing and other enforcement activities by various agencies.

Background:

Currently, the crash data reporting system in Iowa is done manually through reporting paper crash information directly from the counties and municipalities. These paper reports are sent to the Iowa DOT Motor Vehicle Division collection facilities in Des Moines. The raw data is converted to a useable form for the Geographic Information System – Accident Locations and Analysis System (GIS-ALAS). Currently, the Iowa DOT has a backlog of one year.

Actions:

This project will be lead by the Iowa DOT Motor Vehicle Division and involves providing funding for computer hardware to expand the Officer Information Manager System / Advantage Safety System for more law enforcement vehicles throughout Iowa. This expansion would include Iowa State Patrol, county sheriff, and municipal police department vehicles in the areas of highest concentration of crashes.

The first phase of this project would include introduction and/or expansion of this technology in the 23 counties recognized as having the highest crash rates in the state. These areas include Des Moines, Cedar Rapids, Sioux City, Council Bluffs, Quad Cities, Waterloo, and other major cities. Future phases will expand the efforts of this project into the other areas of the state. Eventually, the state could utilize a fully automated system to facilitate speed processing of important crash data.

Benefits:

The implementation of this project will speed acquisition of data on roadway incidents and crashes. Data collected by this computer equipment can then be used by the Iowa DOT and other agencies to improve roadway safety and efficiency across the state. Staffing impacts on the Iowa DOT Motor Vehicle Division will be minimal.

Costs:

The estimated cost for computer equipment to expand the ADVANTAGE Safety project to include additional agencies in the 23 highest crash counties is estimated at approximately $400,000 per year for five years for a total project cost of $2,000,000.

This funding will allow 70 to 75 police cars to be equipped and supporting equipment in the station to be purchased each year.

Additional operations and maintenance resulting from this project will be included in the operating costs of the agencies participating in the National Model Program.

Schedule:

This project is proposed for deployment in Years 1-5. The project will be expanded in future years to include other areas of the state.

Program Area 1: ITS Planning, Marketing, and Administration: ITS Plans and Studies

Project 1/2/1 – Quad Cities Area Regional ITS Plan

Brief Project Summary:

This project involves the development of a regional ITS plan for the greater Quad Cities area during Year 2. This plan will involve input from area agencies and transportation professionals establish objectives, define and prioritize specific projects, and develop a timeline for deployment. The plan will ultimately provide a necessary regional focus for the deployment of specific ITS applications for the future, and will incorporate projects and standards identified in the Statewide ITS Plan.

Background:

The Quad Cities area is one of the largest metropolitan areas in Iowa and encompasses the Iowa cities of Davenport and Bettendorf, as well as the cities of Rock Island and Moline in Illinois. To date, this region does not have an ITS Plan. In the past, there has been an interest in utilizing ITS-related technologies to improve mobility in this growing region.

Issues to be considered include toll collection on the Centennial Bridge, the updating and formalization of incident management planning, coordination of traffic signals between jurisdictions, and integration of activities and lessons learned from the I-74 Bridge Incident Warning System.

Actions:

This project will most likely be lead by the Bi-State Metropolitan Planning Organization. The I-74 Incident Warning System will be incorporated into any applicable future ITS deployments in the region and is seen as a key to demonstrating the benefits of ITS to the region. Regional signal integration and incident management coordination will also be key issues to consider in the plan.

Benefits:

This project will facilitate strategic deployment of future ITS efforts in the region. Plans provide an opportunity to gather input and support from area agencies, transportation professionals, and stakeholders, set objectives, define and prioritize projects, develop a timeline for deployment, and develop a regional architecture. The individual plans will lay the groundwork for ITS deployment in each of the four cities and assist in prioritizing future rural ITS initiatives.

Costs:

The regional plan for the Quad Cities will cost approximately $275,000.

There are no additional operations and maintenance costs associated with this project.

Schedule:

This project is proposed for deployment in Year 2.

Program Area 1: ITS Planning, Marketing, and Administration: ITS Plans and Studies

Project 1/2/2 – Cedar Rapids Area Regional ITS Plan

Brief Project Summary:

This project involves the development of a regional ITS plan for the greater Cedar Rapids area during Year 3. This plan will involve input from area agencies and transportation professionals concerning specific regional needs. The plan will provide a regional focus for the deployment of specific ITS applications for the future, and will incorporate projects and standards identified in the Statewide ITS Plan.

Background:

The Cedar Rapids area is another large metropolitan area located in eastern Iowa. Currently, this area does not have an ITS plan. Issues to be considered for this region include incident management planning, coordination of traffic signals, and safety issues on the tri-level interchange and ramps of Interstate 380. In the past, there has been an interest in formalizing incident management planning in Cedar Rapids. Icing problems on the elevated section of Interstate 380 is being addressed through an immediate-term project, and this effort will be considered in the regional plan.

Actions:

A primary focus of this plan will be on incident management and signal coordination activities in the area, rather than freeway congestion. Another major issue in this region is the use and control of changeable message signs.

Benefits:

This project will facilitate strategic deployment of future ITS efforts in the region. Plans provide an opportunity to gather input and support from area agencies, transportation professionals, and stakeholders, set objectives, define and prioritize projects, develop a timeline for deployment, and develop a regional architecture. The individual plans will lay the groundwork for ITS deployment in each of the four cities and assist in prioritizing future rural ITS initiatives.

Costs:

The regional plan for Cedar Rapids will cost approximately $275,000.

There are no additional operations and maintenance costs associated with this project.

Schedule:

This project is proposed for deployment in Year 3.

Program Area 1: ITS Planning, Marketing, and Administration: ITS Plans and Studies

Project 1/2/3 – Sioux City Area Regional ITS Plan

Brief Project Summary:

This project involves the development of a regional ITS plan for the greater Sioux City area during Year 3. This plan will involve input from area agencies and transportation professionals concerning specific regional needs. The plan will provide a regional focus for the deployment of future ITS applications, and will incorporate projects and architecture standards identified in the Statewide ITS Plan.

Background:

The Sioux City area is a relatively large metropolitan area in northwestern Iowa. Interstate 29 is the main through commercial and commuting freeway for the region. From 1992-1996, there was an increase of 36 percent in truck traffic AADT along I-29 through the Sioux City metropolitan area and vehicular traffic has increased 74 percent over the same period. During the same time 668 crashes occurred (1 fatality and $2,219,960 in property damage) on I-29 from Hamilton Boulevard to the Floyd River. 58 of these crashes involved commercial vehicles. Capacity and operational efficiency of the Interstate system in this segment of the downtown area are expected to increase 100 percent over 1996 traffic counts by 2020, primarily due to accelerated urban development.

Actions:

This ITS plan will focus on operational issues along Interstate 29 (including incident warning and signage issues), incident management and alternate route planning, emergency management, and regional signal coordination issues. SIMPCO will be involved in the project implementation, and this plan will incorporate the work they've already done.

Benefits:

This project will facilitate strategic deployment of future ITS efforts in the region. Plans provide an opportunity to gather input and support from area agencies, transportation professionals, and stakeholders, set objectives, define and prioritize projects, develop a timeline for deployment, and develop a regional architecture. The individual plans will lay the groundwork for ITS deployment in each of the four cities and assist in prioritizing future rural ITS initiatives.

Costs:

The regional plan will cost approximately $275,000.

There are no additional operations and maintenance costs associated with this project.

Schedule:

This project is proposed for deployment in Year 3.

Program Area 1: ITS Planning, Marketing, and Administration: ITS Plans and Studies

Project 1/2/4 – Waterloo/Cedar Falls Area Regional ITS Plan

Brief Project Summary:

This project involves the development of a regional ITS plan for the greater Waterloo/Cedar Falls area during Year 3. This plan will involve input from area agencies and transportation professionals concerning specific regional needs. The plan will provide a regional focus for the deployment of future ITS applications, and will incorporate projects and standards identified in the statewide ITS plan.

Background:

The major issues to consider for the Waterloo/Cedar Falls area are regional signal coordination, EMS communications in the surrounding area, highway-rail corridor safety, and transit enhancements. Traffic and incident management concerns are not as important to this region, because of relatively few freeway miles and little congestion. However, the Avenue of the Saints corridor will cause some issues to arise over the next few years.

Actions:

The regional ITS plan for Waterloo/Cedar Falls will focus primarily on regional transit and signal operations issues. Transit AVL efforts pursued under the Statewide ITS Plan will be incorporated into this plan.

Benefits:

This project will facilitate strategic deployment of future ITS efforts in the region. Plans provide an opportunity to gather input and support from area agencies, transportation professionals, and stakeholders, set objectives, define and prioritize projects, develop a timeline for deployment, and develop a regional architecture. The individual plans will lay the groundwork for ITS deployment in each of the four cities and assist in prioritizing future rural ITS initiatives.

Costs:

The regional plan will cost approximately $275,000.

There are no additional operations and maintenance costs associated with this project.

Schedule:

This project is proposed for deployment in Year 3.

Program Area 1: ITS Planning, Marketing, and Administration: ITS Marketing and Education

Project 1/3/1 – Statewide ITS Marketing and Education

Brief Project Summary:

This project involves the promotion of intelligent transportation systems (ITS) in Iowa through an extensive public education and marketing campaign. The overall objective of this project is the dissemination of information about ITS advanced technologies, potential applications of these technologies, and benefits to be gained through their use. This project will target Iowa DOT staff; other state, regional, and local decision-makers and staff; and the traveling public in Iowa through the use of specific marketing tools and media.

Background:

With the rapid advancements being made in the application of ITS today, there is a definite need to integrate knowledge and utilization of these advanced technologies into the practices of the Iowa DOT. At the same time, in order to provide maximum transportation benefits to Iowa through implementing ITS, it is very important to implement an aggressive marketing and public education program to educate the general public.

Since there is no such ITS marketing and education program currently in place, it will be essential for the Iowa DOT to establish one during Year 1. Awareness of the applications and identification of the benefits of ITS are two of the most crucial elements in garnering support for and the ultimate acceptance of any new ideas, such as the use of advanced ITS technologies.

Actions:

The Iowa Department of Transportation Director's Staff Division will be the lead on this project. To address the conventional media (television, radio, and newspapers), the Iowa DOT will utilize its in-house Office of Media and Marketing Services to publicize the current activities and successes of the Iowa ITS program. These current activities include the concept maintenance vehicle, the Iowa DOT web site, smart work zones, and the Foretell weather forecasting project.

In addition, advertisements will alert the public to future applications of ITS advanced technologies that will improve the safety and convenience of travel throughout the state. A third aspect of this project will be an aggressive statewide effort to build a relationship with the media in order to produce newspaper articles and develop radio and television features supportive of and draw attention to the Iowa DOT efforts.

This Statewide ITS Marketing and Education project will also include transit technology demonstrations at the semi-annual IPTA conferences held in June and November.

Finally, to directly reach decision-makers and the general public with information about ITS, the Iowa DOT will also develop informational presentations intended for specific target audiences. These audiences will be informed of current ITS efforts and advances through presentations developed by the Iowa Transportation Center personnel. The Iowa Communications Network will also be utilized for these efforts. The target audiences include:

- Iowa Department of Transportation field personnel
- Other state agency personnel
- Local decision-makers and staff
- Metropolitan planning organization (MPO) technical and policy committee members and staff
- Regional planning affiliation (RPA) technical and policy committee members and staff
- Local fire, police, and emergency personnel
- Local chambers of commerce and economic development groups
- University and college classes

In addition to traditional presentations made directly to target audiences, interactive presentation materials will be made available over the Internet. These materials, as well as videos will also be available to local agencies or to other interested parties. The production of interactive and informational presentations could involve some assistance from consultant services.

Benefits:

This project will be the foundation for all future ITS efforts by creating a better understanding and public support of the application of advanced technologies. These project actions will ultimately benefit the efforts of the Iowa DOT to successfully reach the goals and objectives set forth in its current Integrated ITS and Services Deployment Plan.

Costs:

The cost for implementation of the marketing and education campaign would be approximately $125,000 annually. This cost includes the development of traditional and interactive presentation materials, production costs for media materials, and broadcast costs. Additional funds may be needed for consultant services in production of presentation materials. These costs are estimated at up to $50,000 annually. Project costs will vary depending on the frequency, time, and length of media broadcasts and printings. There will be minimal costs associated with training of transportation center planners and field service coordinators and with presenting informational materials. The total project cost for Years 1-5 is estimated at approximately $875,000. This amount assumes the need for consultant services.

There are no additional operations and maintenance costs associated with this project.

Schedule:

This project is proposed for deployment in Year 1, and will continue in Years 2-5, in order to obtain maximum public support and understanding of Iowa DOT efforts concerning ITS.

Program Area 2: Travel and Traffic Management: Metropolitan Area Traffic Management

Project 2/1/1 – Des Moines Metropolitan Area Traffic Management System

Brief Project Summary:

This project involves the development of a comprehensive freeway/arterial traffic management system for the Des Moines metropolitan area starting in Year 2. This system will focus on the reconstruction of Interstate 235 and incorporate numerous traffic management elements; such as service patrols, network surveillance and detection, freeway traffic control, and a traffic management center. The objective is to reduce congestion and improve safety. It will also include several other ITS elements in an integrated system.

Background:

The Des Moines area has prepared an ITS early deployment plan. There is currently an I-235 Steering Committee that includes a traffic management sub-committee. This sub-committee is starting to put together plans for the reconstruction of I-235. A high priority in the Des Moines area is to implement surveillance cameras, which can also be used to collect data, such as vehicle classification. Under-utilization of the existing variable message signs in Des Moines is a concern for this area. Part of the problem is that the Highway Patrol has to contact the Iowa DOT to get a message posted, and this communication does not always occur.

Actions:

The Iowa DOT will be the lead on this project. The Des Moines Traffic Management System will depend on the deployment of several individual projects and is closely associated with the Des Moines Incident Management System. Together the projects provide for a system that monitors traffic conditions on the freeway system to identify traffic flow impediments, implement appropriate control and management strategies, and finally, provide en-route information to freeway travelers.

The Des Moines Area Traffic Management System project calls for the development of a comprehensive freeway/arterial traffic management system. By quickly and accurately detecting and verifying incidents on the freeways, these incidents may be cleared to allow for the uninhibited traffic flow. If an incident or construction activity blocks traffic lanes, alternate route information will be broadcast via permanent and portable variable message signs, the Internet, highway advisory radio and television and radio.

The project scope includes numerous traffic management elements: such as service patrols, network surveillance and detection, freeway traffic control, and a traffic management center. In terms of hardware, the project also includes a fiber optic communications network, permanent changeable message signs and highway advisory radio. The Des Moines Early Deployment Plan calls for the development of an incident management plan and an incident management information system. These efforts are discussed in further detail under Project 2/2/1. The plan will define the roles of the agencies that will be involved in the management of the traffic management system. The system development will allow for communication and management of traffic data.

Benefits:

The potential benefits of a regional traffic management system include improvements to safety, reduction in travel time and delay, increased throughput, and flow improvements. Although Des Moines has relatively little congestion now, vehicle miles traveled within the Des Moines Metropolitan Area are expected to almost double over the next 20 years. In the shorter term, major reconstruction of Interstate 235 is scheduled to begin in 2001 and last five years. Traveler information and traffic and incident management efforts will minimize the expected disruption of traffic flow that the reconstruction is expected to cause.

Urban areas that have fully deployed integrated traffic management systems have experienced significant improvement in traffic flow. For example:

- Portland, Oregon realized a 43 percent reduction in crashes, a 39 percent reduction in travel time, and a 60 percent increase in speed.

- Minneapolis, Minnesota realized a 27 percent reduction in crashes and a 35 percent increase in speed.

- Seattle, Washington realized a 52 percent decrease in travel time, a 39 percent decrease in crash rates, and an 86 percent increase in speed.

The 20-year B/C Ratio for the Des Moines Traffic Management System is **3 to 1**. The cost of delay was drawn from the Des Moines Metropolitan Area ITS Strategic Plan. The Des Moines Plan Vehicle travel time was valued at $10.30 or twice the minimum wage at the time. Detail of this benefit/cost calculation can be found in Appendix E.

Costs:

The cost to fully implement this project will be approximately $22,000,000 over 10 years of operation. $16,000,000 of this cost is the fiber optic communications network identified in the Des Moines Area Early Deployment Plan. Years 2-5 costs are estimated at approximately $11,000,000.

Additional operations and maintenance of the Des Moines Traffic Management System is estimated at approximately ten percent[3] of the total implementation cost or $2,455,000 over Years 2-5. This includes regular maintenance of system components and 3 FTE's.

According to the Des Moines Area ITS Strategic Deployment Plan, the Traffic Management Center facility would most likely be housed in an existing facility, thus reducing maintenance costs.

Schedule:

This project is proposed for deployment in Year 2. Deployment of the traffic management system will continue for several years.

[3] Based on observed operations and maintenance estimates from earlier deployments across the United States

Program Area 2: Travel and Traffic Management: Metropolitan Area Traffic Management

Project 2/1/2 – Council Bluffs Metropolitan Area Traffic Management System

Brief Project Summary:

This project involves the implementation of freeway management strategies on the Iowa side of the greater Omaha metropolitan area. This system will incorporate numerous traffic management elements; such as service patrols, network surveillance, and detection. This project will also include the use of traveler information, such as changeable message signs and highway advisory radio.

Background:

The Nebraska Department of Roads together with the Iowa Department of Transportation completed an early deployment plan for the Omaha Metropolitan Area. The plan, which was completed in 1995, called for an integrated traffic management system to be deployed throughout Omaha and Council Bluffs. This proposed project is to deploy components of the traffic and incident management system in Council Bluffs and the surrounding area. The project will include the use of traveler information, such as changeable message signs and highway advisory radio.

Actions:

The Omaha area is pursuing some projects, such as freeway service patrols and some signal coordination. However, lack of funds is an impediment to further deployment. Their first attempt to fund the design of the regional traffic management center, a cornerstone of the regional ITS, was unsuccessful. The lack of a clear ITS "champion," the failure to effectively market and attract private sector partners, and the absence of severe congestion have also hampered efforts. In a survey of Omaha area travelers, safety and construction were identified as the highest priorities.

The Iowa DOT and Nebraska DOR will both be involved with this project. The Omaha Metropolitan Area ITS Early Deployment Planning Study gives further detail on estimates of specific technology deployments. One of the top priorities for the Iowa side of the river will be the installation of permanent CMS at key locations throughout the area.

Benefits:

The potential benefits of a regional traffic management system include improvements to safety, reduction in travel time and delay, increased throughput, and flow improvements. Vehicle miles traveled (VMT) in the Omaha Metropolitan area are expected to increase by 42 percent between 1998 and 2020. An advanced traffic management system will be an integral part of the region's strategy to maintain free flow of traffic.

The Omaha Metropolitan Area Strategic Deployment Plan estimates the B/C Ratio of the fully deployed system to be **4 to 1.** The Omaha Plan assumes the value of vehicle travel time to be \$10.00 per hour which includes vehicle wear at \$.04 per stop. Fuel was valued at \$1.25 per gallon.

Costs:

The cost to fully implement this project will be approximately \$4,100,000 for the first ten years of operation. This amount is based on 10 percent of the cost of the entire Omaha area ITS scope for the first 10 years. This cost includes communications, operations and maintenance, and staffing needs. This cost also includes approximately \$850,000 for permanent changeable message signs and highway advisory radio at key decision points around the Council Bluffs area. This estimate does not include the estimated cost of regional signal coordination, which is addressed in Project 2/5/2.

The cost for deployment in Years 2-5 is estimated at \$1,640,000.

Additional maintenance of this system is estimated at approximately ten percent of the implementation cost or \$410,000 over Years 2-5.

Schedule:

This project is proposed for deployment in Year 2.

Program Area 2: Travel and Traffic Management: Metropolitan Area Traffic Management

Project 2/1/3 – Quad Cities Area Traffic Management System

This project, scheduled for deployment in Years 6-10, involves the development of a regional traffic management system for the greater Quad Cities area, which encompasses cities in both Iowa and Illinois. Specific elements and costs of this system will be determined through the Quad Cities Area Regional ITS Plan to be completed in Year 2 and through lessons learned from the deployment of an incident warning system on the Interstate 74 bridge through Project 2/4/1.

Project 2/1/4 – Cedar Rapids Area Traffic Management System

This project, scheduled for deployment in Years 6-10, involves the development of a regional traffic management system for the Cedar Rapids area. Specific elements and costs of this system will be determined through the Cedar Rapids Area Regional ITS Plan to be completed in Year 3.

Project 2/1/5 – Sioux City Area Traffic Management System

This project, scheduled for deployment in Years 6-10, involves the development of a regional traffic management system for the Sioux City area. Specific elements and costs of this system will be determined through the Sioux City Area Regional ITS Plan to be completed in Years 3.

Project 2/1/6 – Waterloo/Cedar Falls Area Traffic Management System

This project, scheduled for deployment in Years 6-10, involves the development of a regional traffic management system for the Waterloo/Cedar Falls area. Specific elements and costs of this system will be determined through the Waterloo/Cedar Falls Area Regional ITS Plan to be completed in Years 3.

Program Area 2: Travel and Traffic Management: Metropolitan Area Incident/Event Management

Project 2/2/1 – Des Moines Area Incident/Event Management Program

Brief Project Summary:

This project is very closely tied to Project 2/1/1 – Des Moines Traffic Management System. It involves the development of an updated comprehensive incident management program for the Des Moines area. This program would involve the formalization and coordination of procedures of the several agencies within the region to provide incident management strategies during the Interstate 235 reconstruction. This program would involve the documentation of existing incident management practices and procedures, and recommendation of updated procedures and agreements. This project is discussed in more detail in the Des Moines Area ITS Early Deployment Plan and calls for the development of an incident management information system.

Background:

The Des Moines area prepared an incident management plan in the 1980's, in conjunction with construction in West Des Moines. There are detailed alternate route plans, but they may not be viable or up-to-date. There is currently a Metro Traffic Management Team in place, which deals with incident management and a special traffic management subcommittee of the I-235 Steering Committee, which will dissolve after I-235 construction is completed. Incident management efforts currently focus on the metro area interstates, where most transportation problems are. In addition, there are currently privately operated service patrols on I-80/I-35 and on I-235.

Actions:

This incident management program is dependent on the infrastructure being deployed as part of the Des Moines traffic management activities. The development of a traffic management center provides an opportunity for synchronizing the efforts of the TMC staff and agencies responsible for incident response. TMC personnel can identify and, to some degree, assess the severity of traffic incidents or events, passing the information on to the appropriate responding agency using incident management information system software. This project will also incorporate the use of motorcycle patrols and crash investigation technologies by local police departments to assist in traffic and incident management activities. This project is discussed in more detail in the Des Moines Area ITS Early Deployment Plan.

Benefits:

Incidents cause approximately 60 percent of the vehicle hours lost to congestion. The swift clearing of incidents will have a direct impact on the length of any delay the incident causes.

The Des Moines Incident/Event Management Program is an integral component of the Des Moines Advanced Traffic Management System. Together, these projects are expected to decrease delay and improve safety on Des Moines Area Interstates. Urban areas that have fully deployed integrated traffic management systems/incident management programs have experienced significant improvement in traffic flow. For example:

- Portland, Oregon realized a 43 percent reduction in crashes, a 39 percent reduction in travel time, and a 60 percent increase in speed.
- Minneapolis, Minnesota realized a 27 percent reduction in crashes and a 35 percent increase in speed.
- Seattle, Washington realized a 52 percent decrease in travel time, a 39 percent decrease in crash rates, and an 86 percent increase in speed.

Costs:

Based on the Des Moines EDP, an incident management program in Des Moines will cost approximately $90,000 to implement. This covers software development and an incident management plan.

Operations and maintenance costs for this project are included in the costs of the Des Moines Traffic Management System.

Schedule:

This project design is proposed for Year 2 in order to assist with traffic and incident management activities during the reconstruction of Interstate 235.

Program Area 2: Travel and Traffic Management: Metropolitan Area Incident/Event Management

Project 2/2/2 – Council Bluffs Area Incident/Event Management Program

Brief Project Summary:

This project involves the development of an incident management program for the Council Bluffs area in concert with incident management activities on the Omaha side of the region. This program would involve the formalization and coordination of procedures of the several agencies within the region, and would involve the documentation of existing incident management practices and procedures, and recommendation of updated procedures and agreements.

Background:

The Omaha Metropolitan Area EDP calls for an integrated traffic management system to be deployed throughout Omaha and Council Bluffs. This proposed project is to deploy components of the traffic and incident management system in Council Bluffs and the surrounding area. To date, Omaha has developed a set of alternate route plans. Red-tagging of vehicles for removal has been successful, but has been discontinued in Council Bluffs due to a lack of funding from the Iowa DOT. In general, regional incident management is seen as a major challenge. The local Council Bluffs street system lacks the capacity for efficient routing of detour traffic.

Actions:

The Iowa DOT and Nebraska DOR will both be involved with this project. Like the Des Moines Incident Management Program, this program is closely associated with the area's traffic management infrastructure. The development of a traffic management center in the Omaha area provides an opportunity for synchronizing the efforts of the TMC staff and agencies responsible for incident response. TMC personnel can identify and, to some degree, assess the severity of traffic incidents or special events, passing the information on to the appropriate responding agency using incident management information system software.

Benefits:

The potential benefits of a regional traffic management system include improvements to safety, reduction in travel time and delay, increased throughput, and flow improvements. Vehicle miles traveled (VMT) in the Omaha Metropolitan Area are expected to increase by 42 percent between 1998 and 2020. An advanced traffic management system will be an integral part of the region's strategy to maintain free flow of traffic.

Costs:

The Iowa share of this project is estimated at approximately $50,000. Operations and maintenance costs are included in the area's Traffic Management System costs.

Schedule:

This project design is proposed for Year 2.

Program Area 2: Travel and Traffic Management: Metropolitan Area Incident/Event Management

Project 2/2/3 – Quad Cities Area Incident/Event Management Program

This project, scheduled for deployment in Years 6-10, involves the development of a formalized incident management program for the greater Quad Cities area. Specifics of this program will be determined through the Quad Cities Area Regional ITS Plan to be completed in Year 2.

Project 2/2/4 – Cedar Rapids Area Incident/Event Management Program

This project, scheduled for deployment in Years 6-10, involves the development of a formalized incident management program for the Cedar Rapids area. Specifics of this program will be determined through the Cedar Rapids Area Regional ITS Plan to be completed in Year 3.

Project 2/2/5 – Sioux City Area Incident/Event Management Program

This project, scheduled for deployment in Years 6-10, involves the development of a formalized incident management program for the Sioux City area. Specifics of this program will be determined through the Sioux City Area Regional ITS Plan to be completed in Year 3.

Project 2/2/6 – Waterloo/Cedar Falls Area Incident/Event Management Program

This project, scheduled for deployment in Years 6-10, involves the development of a formalized incident management program for the Waterloo/Cedar Falls area. Specifics of this program will be determined through the Waterloo/Cedar Falls Area Regional ITS Plan to be completed in Year 3.

Program Area 2: Travel and Traffic Management: Smart Work Zones / Portable Traffic Management Systems

Project 2/3/1 – Statewide Smart Work Zones / Portable TMS Pool

Brief Project Summary:

This project involves the establishment of a pool of Smart Work Zones / Portable Traffic Management Systems within the Iowa DOT. A typical portable TMS consists of a trailer mounted changeable message sign, a CCTV camera for vehicle detection and sensors to detect vehicle speed and presence. Portable traffic management technology will improve traffic operations and safety around and within work zones. The smart work zone program will be administered at the state level and will be utilized in the most critical work zones throughout the state, based on traffic volumes and potential impact of the roadwork on operations and safety.

Background:

Currently, the Iowa Department of Transportation is co-sponsoring a research project entitled; "Midwest Smart Work Zone Deployment Initiative" along with the states of Nebraska, Kansas, and Missouri. The objective of this research project is to assess the application of ITS and other technologies to improve safety and minimize delay at work zones.

An analysis of the costs and benefits of various applications is part of this project. This research project is expected to greatly assist the Iowa DOT in developing a project scope and deployment strategy for smart work zones.

Actions:

This project involves the procurement and operation of Portable Traffic Management Systems across the state of Iowa. PTMS units provide freeway/incident management functionality including surveillance, vehicle detection, and traveler information. These units can be used for work zones as well as for special event traffic control. One identified key location where these units will be deployed over the coming years will be along Interstate 80 in the Iowa City area during reconstruction activities.

Benefits:

Existing PTMS systems are capable of providing real time traffic flow information (congestion, lane closures, travel speeds, travel times etc.) in remote settings. This information, which is collected by the constituents ITS hardware, is transmitted to traffic management personnel who then convey the information to motorists through changeable message signs and highway advisory radio. Real time traffic congestion information, if provided in advance of work zone lane closures along with possible alternate routes, significantly reduces congestion and delay while improving safety. A significant benefit of such a system is portability.

Other states have implemented ITS technologies to improve safety and alleviate congestion at work zones. The Minnesota Department of Transportation (Mn/DOT) operates the Advanced Traffic Management System. The program has been thought to be beneficial to motorists. An evaluation of the operational test of the PTMS at work zones indicated that throughput increased while traffic actually slowed down in the vicinity of the work-zone. With the introduction of the PTMS, Mn/DOT observed traffic volumes increase 3.6 percent in the morning peak period and 6.6 percent in the evening peak period.

Costs:

One portable traffic management system costs approximately $85,000. Under this project, the Iowa DOT will purchase ten units at a total cost of $850,000 in Years 2-5.

Maintenance of these systems is estimated at approximately five percent of the cost of deployment, or $4,250 per unit per year over Years 2-5. Over Years 2-5, maintenance costs of this project will be approximately $114,750.

Operations costs of these units, including transport and set-up, will most likely be included in the operating costs associated with the construction activities.

Schedule:

This project is proposed for deployment in Years 2-5.

Program Area 2: Travel and Traffic Management: Roadway Weather Safety / Incident Prevention

Project 2/4/1 – Incident Warning System Pilot Project (I-74 Bridge in the Quad Cities)

Brief Project Summary:

This project involves the installation of an incident warning system to notify travelers of incidents and subsequent delays on and around the Interstate 74 bridge over the Mississippi River in the Quad Cities. This project would benefit from a partnership with the Illinois Department of Transportation and the Bi-State Regional Planning Commission. This project will be part of a larger analysis of regional river crossing-related traffic issues.

Background:

Currently, the roadway system around the Interstate 74 bridge over the Mississippi has been experiencing traffic-related problems for several years. This bridge is one of the few access ways across the river between the Illinois and Iowa Quad Cities. Lack of adequate access between the Iowa and Illinois sides of the river and traffic volumes of over 60,000 vehicles per day have created daily congestion on the bridge. Furthermore, this congestion is often magnified by poor bridge geometry and traffic incidents.

These incidents have the potential to cause traffic queues of over a mile, and secondary incidents due to back ups are not uncommon. This situation has heightened the need for an effective traffic management solution, such as an incident warning system to allow motorists to route around the traffic problem or to anticipate significant delays.

Actions:

The Iowa DOT Highway Division will be the lead on this project, but this project will also involve significant input from local agencies and the Illinois DOT. This project will involve two separate phases: design and implementation. The initial design phase will include the determination of what advanced technologies will be needed to support incident identification, verification, response, and clearance.

Under implementation, this project will involve the use of incident detection, surveillance, and traveler information to help with the congestion problem on the Interstate 74 bridge. To create an effective warning system, information about incidents must be transferred from the location of the incident to the traveler quickly. This information will allow travelers to make decisions about their route or to allow extra time for the delay.

Under this effort, changeable message signs (CMS) will be located at key locations to provide this roadside traveler information to motorists. These signs could be located on both the Iowa and Illinois sides of the bridge. Information gathered from the surveillance system will be relayed to these message signs and other signs in the area once they are installed. This information will also be relayed over the Internet or other media to monitor traffic at home or work.

Benefits:

The implementation of an incident warning system will help alleviate problems associated with incidents on and around the bridge by allowing motorists to change their route or allow time for delays. This will ultimately reduce waiting time for commuters on both sides of the river.

An incident warning system can effectively change driver behavior. An automated hazardous conditions warning system was implemented in the Netherlands in October of 1991 to elicit safer driving behavior in hazardous conditions (fog). The system has had a positive effect on speed choice. Use of the system resulted in a decrease of speed of about 6 miles per hour and a slight reduction in standard deviation of speed. Using the relation between mean speed and number of accidents, such reductions would be expected to result in a 15 percent reduction in the crash rate along the particular segment.

Assuming a 15 percent reduction in crashes and crash-related costs, the five-year benefit-cost ratio for an incident warning system along I-29 through Sioux City is **3 to 1.**

Details of these benefit/cost calculations can be found in Appendix E.

Costs:

The first phase of this project, design, will cost approximately $100,000 during Year 1. Implementation of the incident warning system, which would take place starting in Year 2, is estimated at approximately $500,000. This cost includes possible additional communications costs for Years 2-5. The total project cost, Years 1-5, is estimated at approximately $600,000. This total project cost of $600,000 includes operations and maintenance of the system.

Currently, the Illinois DOT has acquired Federal funding to study river crossings and how to apply ITS technologies to subsequent problems. The Iowa DOT will most likely be looked at to participate in the study and contribute state funding to match the Federal funds.

Schedule:

This project design is proposed for Year 1, with implementation of the project in Years 2-5.

Program Area 2: Travel and Traffic Management: Roadway Weather Safety / Incident Prevention

<u>Project 2/4/2 – Expanded Incident Warning Systems</u>

Brief Project Summary:

This project involves the installation of additional incident warning systems, similar to the scope of the immediate-term project in the Quad Cities, to notify travelers of incidents and subsequent delays at specific locations throughout the state. Preliminary locations for incident warning systems include along Interstate 29 in Sioux City and along US Highway 20/61 in Dubuque.

Background:

In general, incident warning systems are deployed at high crash locations where timely traveler information can alleviate the hazard. An incident warning system typically includes vehicle detection systems to measure traffic speed and congestion. Current conditions and traffic flow information is broadcast to the drivers via highway advisory radio or variable message signs.

Both the Sioux City and Dubuque incident warning systems will be located near highway-rail intersections. In each case, train traffic has interrupted traffic flow on or near major highway corridors. The focus of both systems is to coordinate the operations of the rail crossing warning systems with a secondary warning system that would alert highway traffic of delays or backups. Further details of each system will need to be determined through a preliminary engineering phase.

Actions:

These projects will also involve significant input from local agencies and will most likely involve two separate phases: design and implementation. The initial design phase will include the determination of what advanced technologies will be needed to support incident identification, verification, response, and clearance. The implementation phase will likely involve the use of surveillance and detection devices positioned at strategic locations in the areas. This project will incorporate lessons learned from the I-74 pilot deployment in the Quad Cities.

Benefits:

An incident warning system can effectively change driver behavior. The implementation of an incident warning system will help alleviate problems associated with incidents on and around the subject areas by allowing motorists to change their route or allow time for delays.

An incident warning system can effectively change driver behavior. An automated hazardous conditions warning system was implemented in the Netherlands in October of 1991 to elicit safer driving behavior in hazardous conditions (fog). The system has had a positive effect on speed choice. Use of the system resulted in a decrease of speed of about 6 miles per hour and a slight reduction in standard deviation of speed. Using the relation between mean speed and number of crashes, such reductions would be expected to result in a 15 percent reduction in the crash rate along the particular segment.

Costs:

Though each warning system is very unique to its particular location, design costs are estimated at approximately $100,000, while implementation cost is estimated at between $400,000 and $500,000 per location. Implementation costs vary on the location and extent of the system. Implementation at each site is estimated at about $450,000. Operations and maintenance is approximately $135,000 over the two years of the project.

Two systems will be deployed, one in Sioux City and one in Dubuque, during Years 2-5, at a cost of $595,000 per location. Therefore, it is estimated that total cost for two additional systems is approximately $1,235,000.

Schedule:

This project is proposed for deployment in Years 2-5.

Program Area 2: Travel and Traffic Management: Roadway Weather Safety / Incident Prevention

Project 2/4/3 – Automated Bridge Anti-icing Pilot Project (I-380 Bridges in Cedar Rapids)

Brief Project Summary:

This project involves the design and implementation of an automated bridge anti-icing system on the super-elevated sections of Interstate 380 bridges in downtown Cedar Rapids. Under this project, when pavement temperature of the bridge deck reaches a certain point, Iowa DOT personnel will be notified and will release the liquid chemicals onto the bridge deck and the area leading up to the bridge.

It is also possible to integrate this system with a RWIS type system that will automatically trigger the release of deicing chemicals onto the roadway when preset roadway and atmospheric conditions are met. The system does send an alarm to users when it is spraying materials, but needs no human to trigger the process.

Background:

Currently, this section of Interstate 380 has seen an above average number of snow/ice related crashes at these super-elevated bridges. This problem has fueled local efforts to find a solution to these problem areas. Bridge anti-icing systems have shown to be effective in other areas of the country, and this section of roadway is a good candidate for a pilot test of this advanced technology in Iowa.

In addition, since there is a RWIS System along Interstate 380, this information could be used to provide the necessary insight into when to use the de-icing system or to automatically trigger its use. Because of the curvature of the interstate roadways, a curve warning system might also be utilized.

Actions:

This project will be lead by the Iowa DOT Highway Division, but will also involve input and cooperation from local agencies. This project will include two separate phases: design and implementation. The initial design phase will include an assessment of the problem areas and determination of the most suitable locations for a de-icing system along this section of I-380. During the design phase, it may be necessary to do a detailed crash analysis along with some type of thermal mapping in order to determine the most appropriate locations for the de-icing system.

Under the implementation phase of this project, pavement sensors will likely be installed in the bridge decks and de-icing chemicals will be stored at the site of the bridges. Once operational, when pavement temperature of the bridge deck reaches a certain point, Iowa DOT personnel will automatically be notified and the liquid chemicals will be released onto the deck. This release will be done either by Iowa DOT personnel or automatically. A closed-circuit television (CCTV) camera will likely be used to monitor conditions. Existing variable message signs, located prior to the de-icing locations, will notify drivers that de-icing chemicals are being applied.

This system, when fully implemented, will involve five major ITS components:

- Weather and pavement sensing
- De-icing chemicals storage and distribution system
- Computer software system for remote operation
- Roadside traveler information
- Video surveillance

Benefits:

Bridge anti-icing systems are expected to prevent the formation of ice on bridge decks. The states of Utah, Wisconsin, Minnesota and Pennsylvania have recently installed anti-icing systems on bridges that have historically iced up in winter months.

The Pennsylvania Department of Transportation (PennDOT) has deployed fully automated bridge anti-icing systems at three sites. PennDOT has been impressed with the positive response of the public. Although not yet quantified, it is clear that the number of minor crashes at these locations has fallen. The detection equipment also allows the county maintenance crews to track pavement conditions as well as the response of the anti-icing spraying system in real-time. By gauging pavement conditions at the bridge, the maintenance crews are able to respond more quickly to worsening conditions throughout the region. Based on their successful experience, the Pennsylvania DOT plans to expand deployment.

Costs:

The design phase of this project is estimated at approximately $100,000. The cost for implementation of a bridge anti-icing system, for one elevated span, is estimated at $100,000. For this project, it is estimated that the system would be deployed in five specific sections along I-380 for a total implementation cost of $500,000. The total project cost, Years 1-5, is estimated at approximately $600,000. This estimate includes design, implementation, and continued operations and maintenance of the system.

Schedule:

The design phase of this project is proposed for Year 1, with implementation of the project in Years 2-5.

Program Area 2: Travel and Traffic Management: Roadway Weather Safety / Incident Prevention

Project 2/4/4 – Expanded Automated Bridge Anti-Icing Systems

Brief Project Summary:

This project involves the design and implementation of additional automated bridge de-icing systems on specific highway/bridge sections in the Council Bluffs and Des Moines areas.

Background:

As with the Cedar Rapids Pilot Project, bridge sections in several locations across the state have seen an above average number of snow/ice related crashes. Bridge anti-icing systems have shown to be effective at lowering these crashes. Anti-icing is a snow and ice control concept and strategy in which a freezing point depressant chemical, either in a liquid or pre-wetted solid form, is spread directly onto the pavement either shortly before the storm begins or immediately thereafter. This action prevents snow or ice from bonding to the pavement and, thus, prevents a hard-to-remove ice or snow pack from forming during or after the storm. The automated bridge anti-icing system consists of environmental sensors and a sprayer system to apply anti-icing solution to the bridge deck. The system is programmed to identify environmental conditions (temperature and precipitation) that are likely to result in the formation of ice and to trigger the application of the anti-icing solution.

Actions:

This project will be lead by the Iowa DOT Highway Division, but will also involve input and cooperation from local agencies. Each specific location of this project will involve two separate phases: design and implementation. The initial design phase will include an assessment of the problem areas and determination of the most suitable locations for anti-icing systems, based on past crash data. Under the implementation phase of this project, pavement sensors will likely be installed in the bridge decks and anti-icing chemicals will be stored at the site of the bridges.

Under this project, an analysis of potential locations was completed, and the top two locations will be funded. A preliminary analysis showed that among major roadways in the metropolitan areas, two locations showed a significant number of snow/ice related crashes. These two locations are:

- Interstate 80 bridge over the Missouri River in Omaha/Council Bluffs
- Interstate 235 bridge over the Des Moines River in Des Moines

Benefits:

Bridge anti-icing systems are expected to prevent the formation of ice on bridge decks. The states of Utah, Wisconsin, Minnesota and Pennsylvania have recently installed anti-icing systems on bridges that have historically iced up in winter months. Although the systems that have been installed are at different levels of automation, all intend to move towards full automation.

The Pennsylvania Department of Transportation (PennDOT) has deployed fully automated bridge anti-icing systems at three sites. PennDOT has been impressed with the positive response of the public. Although not yet quantified, it is clear that the number of minor crashes at these locations has fallen. The detection equipment also allows the county maintenance crews to track pavement conditions as well as the response of the anti-icing spraying system in real-time. By gauging pavement conditions at the bridge, the maintenance crews are able to respond more quickly to worsening conditions throughout the region. Based on their successful experience, the Pennsylvania DOT plans to expand deployment.

Costs:

The design phase for each of these projects is estimated at approximately $100,000. The cost for implementation of a bridge de-icing system, for one elevated span, is estimated at $100,000. Each location is estimated to be approximately 2 elevated spans for an implementation cost of $200,000 per site. Therefore, the estimated total cost for two systems is approximately $600,000 over Years 2-5.

This cost estimate includes approximately ten percent included for continued operations and maintenance.

Schedule:

These efforts are proposed for Years 2-5.

Program Area 2: Travel and Traffic Management: Roadway Weather Safety / Incident Prevention

Project 2/4/5 – Concept Maintenance Vehicle Expansion

Brief Project Summary:

The future deployment of these vehicles will depend on the current progress made on the test vehicle. Funding designated under this project will be focused on enhancement of the current project. This project is described in more detail under project 3/2/1.

Background:

Iowa is currently participating along with Minnesota and Michigan in a pooled fund research study with the objective to develop a concept maintenance vehicle. This project funds the deployment of this concept vehicle in locations throughout Iowa.

Actions:

The future deployment of these vehicles will depend on the current progress made on the test vehicle. Funding designated under this project will be focused on enhancement of the current project. This project is described in more detail under project 3/2/1.

Benefits:

In general terms, the expected benefits of the concept maintenance vehicle include improved collection of weather data for traveler information applications, more efficient use of maintenance fleets and road treatment material, and better maintained roads.

Costs:

An estimate of future funding for this effort is approximately $450,000 over three years.

Schedule:

This project is proposed for deployment in Years 3-5.

Program Area 2: Travel and Traffic Management: Regional Traffic Signal Coordination

Project 2/5/1 – Expanded Des Moines Area Traffic Signal Coordination

Brief Project Summary:

Regional traffic signal coordination projects call for the calibration and coordination of traffic signals within a region. This specific project involves the further improvement of arterial and highway traffic flow in the Des Moines area through communications links and integrated control strategies that enable integrated intra-jurisdictional and inter-jurisdictional traffic control. These 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.

Background:

Currently, the Des Moines MPO has an extensive amount of traffic signal interconnection work programmed in their STIP over the next few years. Most of this work is designated for the City of Des Moines. Additional funding through this effort will focus on coordination between jurisdictions.

Actions:

This project will build on current activities in the Des Moines area. Under this funding, 40 additional intersections will be upgraded in the region.

Benefits:

Upon completion of the coordination of a traffic control system the following benefits may be realized. These benefits are based on nationwide national averages:

- Decrease in travel times by 8 to 15 percent
- Increase in travel speeds by 14 to 22 percent
- Decrease in vehicle stops up to 35 percent
- Decrease in delays and congestion by 17to 37 percent
- Decrease in fuel consumption by 6 to 12 percent

An Iowa study of traffic signal improvements conducted in the late 1980's found that the benefit to cost ratio of coordinating traffic signals along arterial streets in 16 Iowa cities averaged approximately **14 to 1.** [4]

[4] Maze, T.H. Hawkins, N.R. Graham, J., and Elahi, M. "Iowa's Statewide Traffic Signal Improvement Program, ' May, 1990, pp. 27-31.

Costs:

The cost of the signal upgrade portion of this project is estimated at approximately $2,000,000, which will cover approximately 40 intersections. In addition to the signal upgrades, the cost of communications can run as high as $50,000 per mile for installation of fiber optic cable. It is estimated that approximately 30 miles of communications will be needed at a cost of an additional $1,500,000.

In addition, operations and maintenance costs are estimated at $500,000 in Years 2-5
Therefore, the total cost of this project is approximately $4,000,000 over four years.

Schedule:

This project is proposed for Years 2-5.

Program Area 2: Travel and Traffic Management: Regional Signal Coordination

Project 2/5/2 – Council Bluffs Traffic Signal Coordination

Brief Project Summary:

This project involves the improvement of arterial and highway traffic flow in the Council Bluffs area through communications links and integrated control strategies that enable integrated inter-jurisdictional traffic control.

Background:

Under the Omaha Area ITS EDP, one of the key areas of focus was the signal systems in the greater Omaha area. Many of these intersections were in the Council Bluffs area.

Actions:

This project will involve the upgrading of approximately 20 signalized intersections in the Council Bluffs area. This is based on approximately 10 percent of the money devoted to signal systems in the Omaha Area ITS EDP. This work should be coordinated with other signal system work identified in the Omaha Area ITS EDP.

Project Benefits:

Traffic signal coordination ensures appropriate traffic signal progression, which enables motorists to experience less congestion and delay. Upon completion of the coordination of a traffic control system the following benefits may be realized. These benefits are based on nationwide national averages:

- Decrease in travel times by 8 to 15 percent
- Increase in travel speeds by 14 to 22 percent
- Decrease in vehicle stops up to 35 percent
- Decrease in delays and congestion by 17 to 37 percent
- Decrease in fuel consumption by 6 to 12 percent

An Iowa study of traffic signal improvements conducted in the late 1980's found that the benefit to cost ratio of coordinating traffic signals along arterial streets in 16 Iowa cities averaged about **14 to 1.**

Costs:

Each intersection is estimated to cost about $50,000.

The cost of this project is estimated at approximately $1,300,000 over 10 years. In Years 2-5, 12 intersections will be outfitted at a cost of approximately $600,000. In addition to the signal upgrades, the cost of communications can run as high as $50,000 per mile for installation of fiber optic cable. It is estimated that approximately 9 miles of communications will be needed at a cost of an additional $450,000.

In addition, operations and maintenance costs are estimated $150,000 in Years 2-5. The total cost of this project is approximately $1,200,000 over four years.

Schedule:

This project is proposed for Years 2-5, with four intersections done each year.

Program Area 2: Travel and Traffic Management: Regional Signal Coordination

Project 2/5/3 – Quad Cities Area Regional Signal Coordination

Brief Project Summary:

This project involves the improvement of arterial and highway traffic flow in the Quad Cities region through communications links and integrated control strategies that enable integrated inter-jurisdictional traffic control.

Background:

This issue will be addressed in the Quad Cities Area Regional ITS Plan. Current plans for upgrading signal system communications involve the use of twisted-pair cable. An identified need is to upgrade these plans to include fiber optic cable.

Actions:

These 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. Signals were highlighted as an important project for the Quad Cities area during stakeholder reviews.

Benefits:

Traffic signal coordination ensures appropriate traffic signal progression, which enables motorists to experience less congestion and delay. Upon completion of the coordination of a traffic control system the following benefits may be realized. These benefits are based on nationwide national averages:

- Decrease in travel times by 8 to 15 percent
- Increase in travel speeds by 14 to 22 percent
- Decrease in vehicle stops up to 35 percent
- Decrease in delays and congestion by 17 to 37 percent
- Decrease in fuel consumption by 6 to 12 percent

An Iowa study of traffic signal improvements conducted in the late 1980's found that the benefit to cost ratio of coordinating traffic signals along arterial streets in 16 Iowa cities averaged approximately 14 to 1.

Costs:

This project will cost approximately $250,000 per year in Years 2-5, for a total of $1,000,000. This cost estimate will cover approximately 20 intersections on the Iowa side of the river. In addition to the signal upgrades, the cost of communications can run as high as $50,000 per mile for installation of fiber optic cable. It is estimated that approximately 15 miles of communications will be needed on the Iowa side at a cost of an additional $750,000.

Operations and maintenance costs are estimated at approximately $250,000 for the entire project.

The total cost of Iowa's portion of this project, including operations and maintenance, is estimated at approximately $2,000,000 over four years.

Schedule:

This project is proposed for Years 2-5.

Program Area 2: Travel and Traffic Management: Regional Signal Coordination

Project 2/5/4 – Cedar Rapids Area Regional Signal Coordination

Brief Project Summary:

This project involves the improvement of arterial and highway traffic flow in the Cedar Rapids area through communications links and integrated control strategies that enable integrated inter-jurisdictional traffic control.

Background:

This project should also be addressed in the Cedar Rapids Area Regional ITS Plan. Cedar Rapids officials have recently met with a consultant to address signal upgrade issues. Key locations in the area include along Collins Road and between the Cedar Rapids and Marion jurisdictions.

Actions:

This project provides 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. Signals were highlighted as an important project for the Cedar Rapids area during stakeholder reviews.

Benefits:

Traffic signal coordination ensures appropriate traffic signal progression, which enables motorists to experience less congestion and delay. Upon completion of the coordination of a traffic control system the following benefits may be realized. These benefits are based on nationwide national averages:

- Decrease in travel times by 8 to 15 percent
- Increase in travel speeds by 14 to 22 percent
- Decrease in vehicle stops up to 35 percent
- Decrease in delays and congestion by 17 to 37 percent
- Decrease in fuel consumption by 6 to 12 percent

An Iowa study of traffic signal improvements conducted in the late 1980's found that the benefit to cost ratio of coordinating traffic signals along arterial streets in 16 Iowa cities averaged about 14 to 1.

Costs:

This project will cost approximately $375,000 per year in Years 2-5, for a total of $1,500,000, which will cover approximately 30 intersections in the Cedar Rapids area. In addition to the signal upgrades, the cost of communications can run as high as $50,000 per mile for installation of fiber optic cable. It is estimated that approximately 20 miles of communications will be needed at a cost of an additional $1,000,000.

In addition, operations and maintenance is estimated at approximately $5,000 per intersection or $150,000 for the entire project over Years 2-5.

The total cost of this project is estimated at approximately $2,875,000 over four years.

Project Schedule:

This project is proposed for Years 2-5.

Program Area 2: Travel and Traffic Management: Regional Signal Coordination

Project 2/5/5 – Waterloo/Cedar Falls Regional Signal Coordination

Brief Project Summary:

This project involves the improvement of arterial and highway traffic flow in the Waterloo/Cedar Falls area through communications links and integrated control strategies that enable integrated inter-jurisdictional traffic control.

Background:

A signal optimization study is beginning in the Waterloo-Cedar Falls metro area. Currently 90 percent of signals in Waterloo are interconnected, but Cedar Falls has little interconnection. University Avenue in Cedar Falls and San Marnin Drive in Waterloo are probably the main areas where interconnection is needed. This project will be addressed in the Waterloo/Cedar Falls Area Regional ITS Plan

Actions:

This project provides 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. Under this effort, approximately 30 intersections will be upgraded in the Waterloo/Cedar Falls area.

Benefits:

Traffic signal coordination ensures appropriate traffic signal progression, which enables motorists to experience less congestion and delay. Upon completion of the coordination of a traffic control system the following benefits may be realized. These benefits are based on nationwide national averages:

- Decrease in travel times by 8 to 15 percent
- Increase in travel speeds by 14 to 22 percent
- Decrease in vehicle stops up to 35 percent
- Decrease in delays and congestion by 17 percent to 37 percent
- Decrease in fuel consumption by 6 to 12 percent

An Iowa study of traffic signal improvements conducted in the late 1980's found that the benefit to cost ratio of coordinating traffic signals along arterial streets in 16 Iowa cities averaged approximately **14 to 1.**

Costs:

This cost of signals alone will be approximately $375,000 per year in Years 2-5, for a total of $1,500,000. This will cover approximately 30 intersections in the Waterloo/Cedar Falls area. Continued operations and maintenance of these signals is estimated at $375,000 in Years 2-5.

In addition to the signal upgrades, the cost of communications can run as high as $50,000 per mile for installation of fiber optic cable. It is estimated that approximately 20 miles of communications will be needed at a cost of an additional $1,000,000.

The total cost of this project is estimated at approximately $2,875,000 over four years.

Schedule:

This project is proposed for Years 2-5.

Program Area 2: Travel and Traffic Management: Regional Signal Coordination

<u>**Project 2/5/6 – Sioux City Area Regional Signal Coordination**</u>

Brief Project Summary:

This project involves the improvement of arterial and highway traffic flow in the Sioux City region through communications links and integrated control strategies that enable integrated inter-jurisdictional traffic control.

Background:

Sioux City's current traffic signal system has been in place since 1982. The system contains 131 signals. Seven of these signals were intended to have a ten year life expectancy. Minor parts upgrades in 1989 have kept the system functioning longer than expected. The system can no longer be upgraded. The proposed ITS Infrastructure will transfer data via a fiber optic infrastructure. This effort will be coordinated with the Sioux City ITS Plan.

Project Actions:

This project provides 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. This is a very high priority for the region.

Project Benefits:

Traffic signal coordination ensures appropriate traffic signal progression, which enables motorists to experience less congestion and delay. Upon completion of the coordination of a traffic control system the following benefits may be realized. These benefits are based on nationwide national averages:

- Decrease in travel times by 8 to 15 percent
- Increase in travel speeds by 14 to 22 percent
- Decrease in vehicle stops up to 35 percent
- Decrease in delays and congestion by 17 to 37 percent
- Decrease in fuel consumption by 6 to 12 percent

An Iowa study of traffic signal improvements conducted in the late 1980's found that the benefit to cost ratio of coordinating traffic signals along arterial streets in 16 Iowa cities averaged approximately **14 to 1.**

Project Costs:

The improvement of signals under this effort will cost approximately $375,000 per year in Years 2-5, for a total of $1,500,000. This will cover approximately 30 intersections in the region. In addition to the signal upgrades, the cost of communications can run as high as $50,000 per mile for installation of fiber optic cable. It is estimated that approximately 20 miles of communications will be needed at a cost of an additional $1,000,000.

In addition, operations and maintenance of these signals is estimated at an additional $375,000 over Years 2-5.

The total cost of this project is estimated at approximately $2,875,000 over four years.

Project Schedule:

This project is proposed for Years 2-5.

Program Area 2: Travel and Traffic Management: Highway-Rail Operations and Safety

<u>Project 2/7/1 – Highway-Railroad Safety and Delay Study</u>

This project will focus on the growing problem of safety and operations where surface streets and highways meet rail corridors. The major issues surrounding rail-highway intersections possible specific advanced technologies to be utilized will be looked at through the completion of this study in Years 6-10.

Program Area 2: Travel and Traffic Management: Crash Investigation Systems

Project 2/8/1 – Total Stations Project Expansion

Crash investigation technologies will be utilized in the Des Moines area as part of the traffic and incident management activities pursued during the Interstate 235 reconstruction activities in Years 2-10. Specifics of this effort can be found in Section 6.3. Depending on results of other ITS plans, further applications of crash investigation systems will be utilized in other metro areas of Iowa in Years 6-10.

Program Area 3: Traveler Information: Metropolitan Area Changeable Message Signs

Project 3/1/1 – Statewide/Regional Portable Changeable Message Signs

Brief Project Summary:

This project will involve the use of changeable message signs for special traffic events across the state. Under this project, a pool of portable CMS will be established at Iowa DOT regional centers for use by different cities and counties for different events or incidents.

Background:

Portable changeable message signs (CMS) are used closely with traffic management and incident management activities to relay information to travelers about a variety of information, including delays, weather, and tourist information. These technologies are used together to improve traffic movement and safety. Specifically in Iowa, CMS will be used in different numbers in each of the cities, depending on local conditions and needs. Currently, there is a portable CMS pool utilized by the Iowa DOT.

Actions:

This project funds a pool of changeable message signs to be used at special events and construction sites across the state. Both the DOT and cities and counties will keep the signs at regional DOT centers for use. Each year in Years 2-5, ten signs will be acquired to supplement this pool.

Benefits:

Portable changeable message signs, by themselves, do not provide quantifiable benefits. Portable changeable message signs are components of larger integrated systems such as smart work zones/portable traffic management systems, incident warning systems, and advanced traffic management/traveler information systems. Assessment of benefits is more meaningful at the system or application level.

Costs:

Each portable CMS is estimated to cost $20,000, with a total for the four years of $800,000. Operations and maintenance cost for these signs is estimated at $200,000 in Years 2-5 for a total of $80,000 for the forty signs.

This project is estimated to cost a total of $1,000,000 over Years 2-5.

Schedule:

This project is proposed for deployment in Years 2-5.

Program Area 3: Traveler Information: Interactive Internet Information

Project 3/2/1 – ITS Weather Information on the Iowa DOT Web Site

Brief Project Summary:

This project has been divided into phases. Phase I involves the integration of elements of the Iowa Department of Transportation Road Weather Information System (RWIS) and a limited amount of Automated Weather Observing Stations (AWOS) data into the current Iowa DOT web site. The Iowa DOT Highway Division maintains the RWIS. The Iowa DOT Planning and Programming Division maintain the AWOS. This phase will provide the public, through the Internet, with the same RWIS data as the Iowa DOT receives internally and a limited amount of AWOS data. In later stages, this data would be more specifically packaged for public consumption. This first phase also involves upgrading six RWIS sensors to enable collection of precipitation data.

Phase II involves the expansion of the current concept maintenance vehicle project and the integration of project operations with the Tracking Resources with Automated Capabilities (TRAC) initiative in Story County. The concept vehicle project began as a joint venture with the Minnesota DOT and Michigan DOT. The focus of this effort to date has been building and testing an advanced snowplow to improve the safety, efficiency, and quality of snow fighting efforts. The vision guiding this project is to develop an advanced vehicle and interface it with ITS. This activity will include upgrades and expansion of capabilities of the current vehicle. This vehicle will eventually feed data into a centralized decision center where decisions about traveler information and plow routing can be made.

Phase III is very similar to Phase I, but would include providing all the AWOS data to pilots and the general public through the Iowa DOT web site.

Background:

Concerning Phase I and Phase III, a growing trend in ITS today is the awareness of the availability of weather data by the public. The public is very concerned about dangerous driving conditions and recognizes that atmospheric weather forecasts are much different than pavement driving conditions. For this reason, the Iowa DOT has made major investments in its Road Weather Information System (RWIS). The Iowa DOT currently has fifty RWIS stations located throughout the state. Each of these sites collects real-time air, pavement, and sub-surface temperature information. They also collect wind speed and direction, relative humidity, and have a variety of precipitation sensors. These stations are also capable of operating cameras, stream gauging equipment, air quality devices, and other atmospheric monitoring devices that could be combined with current weather information data collected at each site.

At 38 rest areas throughout the state, weather information is provided via satellite with an emphasis on the needs of the traveler. Currently, the rest areas are the only locations where the public can access this information. The information displayed here includes near-real-time radar images, regional and national temperatures, regional and national wind speeds and directions, roadway conditions forecasts, and severe weather advisories.

The National Weather Service and the Iowa DOT also have the ability to change one of the screens at the rest areas to warn the public of emergency road closures or weather advisories. The Iowa DOT has also worked to combine the winter road condition report with a display of summer construction projects to add to the rest area displays.

Concerning Phase II, the concept maintenance vehicle project has been underway for four years with an early version of the vehicle being tested over the past two winters. To date, media coverage has been good, and the vehicle has been well received by Iowa DOT officials and the public. The future direction of the concept maintenance vehicle project is to make the vehicle increasingly "smart and versatile" by expanding certain capabilities of the vehicle and sharing real time road condition information with the public via the Iowa DOT web site.

Actions:

Phase I will be a joint effort of the Iowa DOT Highway Division and Information Technology Division and will involve the integration of relevant elements of the current Iowa DOT RWIS into the Iowa DOT Internet web site.

This project phase will involve three distinct actions. These are:

- Installation of a T-1 line
- Creation of a firewall
- Modification of the server to accept and convert outside data

This integration will be done through the use of current consultant services, and should be completed by mid-October 1999, in order to be ready for winter. The system will initially provide the public with the same data as the Iowa DOT receives internally, but in later stages would be more conveniently packaged for public consumption.

Phase II will be a pilot test for Story County lead by the Iowa DOT Highway Division. This phase will focus on developing software and communication interfaces to aid in getting the information from the vehicle into the hands of Iowa DOT maintenance and operational central dispatch staff and providing a thermal trace of where maintenance vehicles have traveled to the general public. In addition, this software development will integrate the concept vehicle operations with the TRAC initiative currently underway in Story County.

Phase III will involve providing the additional AWOS data to pilots and the general public through the Internet. This will be accomplished through upgrading the 31 AWOS sensors and computers, additional design and programming for the Iowa DOT web site, a new computer server for collection and display of data, and a virtual private network for rest areas and airports.

Benefits:

Providing information from all phases of this project over the Internet will allow many more travelers to access important and relevant traveler information before leaving for their destinations, which will increase safety for motorists and road workers and help travelers save time by alerting them to possible delays. It is very important to inform the public of road closings during winter storms and flooding via Internet and rest area kiosks. The system in the rest areas is the same system used in nearly every Iowa DOT maintenance garage since 1995 and has proven to be almost maintenance free.

Costs:

Under Phase I, the estimated cost for development of an Internet web site to integrate the RWIS data and some of the AWOS data is $150,000. Current Iowa DOT staff would maintain the system, as well as perform tasks such as creating firewalls.

In addition, programming costs to combine RWIS data with the limited amount of AWOS data that is currently available are approximately $35,000. The upgrading of six RWIS sensors to collect precipitation data is estimated at $30,000.

Under Phase II, the estimated cost for software development to integrate this program with the TRAC initiative is approximately $30,000 per year for 4 years, totaling $120,000.

The Iowa DOT web site will also require some additional design and programming assistance at a cost of $50,000 for the first year the project is implemented.

Under Phase III, the estimated cost to upgrade the Iowa DOT's 31 existing AWOS sensors is approximately $424,000.

The Iowa DOT web site will also require some additional design and programming assistance at a cost of $50,000 for the first year the project is implemented. The computers connected to the AWOS sensors need to be upgraded for better graphic capabilities at a cost of $50,000.

A new computer server for collection and display of data would cost approximately $50,000 and the creation of a virtual private network for rest areas and airports would cost $75,000.

In addition, the communication costs to collect this data from the sensors would need to be researched to determine the most cost effective method depending on the number of times per day it is needed. Operations and maintenance costs are included in this project cost.

The total cost of this project is $1,034,000.

Schedule:

Phase I of this project is proposed for deployment in Year 1.

Phase II is proposed for deployment in Years 2-5, in order to complete the concept vehicle testing and begin fleet production.

Phase III will be deployed in Years 2-5.

Program Area 3: Traveler Information: Interactive Internet Information

Project 3/2/2 – Expanded Internet Traveler Information

Brief Project Summary:

This project focuses on the use of the Internet to disseminate traveler information. Through this type of project, travelers can obtain current information regarding traffic conditions, transit services, traveler services, ride share/ride match, parking management, pricing information, and several other topics.

Background:

This project would build on the efforts of Project 3/2/1 – ITS Weather Information on the Iowa DOT Web Site.

Actions:

In Iowa, this project involves enhancement of the current Internet traveler information system provided by the Iowa DOT, and will involve the use of real time information provided by the CARS and Foretell projects.

Benefits:

This project will provide motorists with better pre-trip traveler information.

The four proposed Advanced Traveler Information Systems (ATIS) projects together improve drivers' access to weather and traffic condition information. The goal of these projects is to improve the accuracy of the information available and increase market penetration.

In general, such a system reduces congestion, travel time, and fuel consumption. It also reduces driver disorientation. By informing drivers of travel conditions, ATIS applications increase traveler satisfaction. As a stand-alone service, traveler information systems have been quite successful when measured in terms of improved customer satisfaction. There have, however, been few attempts to put a dollar value on the observed levels of customer satisfaction.

The U.S. federal government continues to support ATIS services in several metropolitan areas, particularly through its Model Deployment Initiative. These applications are larger in scope, and are expected to reach more users, with better information than what has been available so far. In addition to the fact that it is difficult to quantify customer satisfaction, it is perhaps too soon to draw final conclusions about the effectiveness of ATIS.

These traveler information systems will be integral components of the traffic and incident management systems planned for both Council Bluffs and Des Moines. Once traveler information is readily available and considered accurate by the traveling public, these systems will effectively divert traffic away from incident or construction related bottlenecks.

Costs:

This effort will cost approximately $150,000.

This cost estimate includes operations and maintenance costs.

Schedule:

This project is proposed for deployment in Years 3-5.

Program Area 3: Traveler Information: Interactive Internet Information: Automated Telephone Traveler Information

Project 3/3/1 – Updated Telephone Traveler Information System

Brief Project Summary:

This project focuses on the use of an automated telephone traveler information system to disseminate traveler information. Automated telephone traveler information systems can disseminate up-to-the-minute, route specific, and on-demand information from anywhere via the telephone.

Background:

By using either pre-recorded, up-to-date traffic reports provided by operators or by using software users can make a phone call and, through a series of menu choices, receive traffic and travel information for the areas of interest. Currently, there is a system in use in South Dakota that might have elements that could be helpful to Iowa.

Actions:

The objective of this project is to develop an automated telephone traveler information system that can disseminate up to the minute, route specific, and on-demand information from anywhere via the telephone. Through a series of menu choices, the caller would receive traffic and travel information for the areas of interest. This program will be administered on a statewide basis, but will provide information on conditions in specific areas of the state.

Benefits:

The four Advanced Traveler Information Systems (ATIS) projects together improve drivers' access to weather and traffic condition information. The goal of these projects is to improve the accuracy of the information available and increase market penetration.

In general, such a system reduces congestion, travel time, and fuel consumption. It also reduces driver disorientation. By informing drivers of travel conditions, ATIS applications increase traveler satisfaction. As a stand-alone service, traveler information systems have been quite successful when measured in terms of improved customer satisfaction. There have, however, been few attempts to put a dollar value on the observed levels of customer satisfaction.

The U.S. federal government continues to support ATIS services in several metropolitan areas, particularly through its Model Deployment Initiative. These applications are larger in scope, and are expected to reach more users, with better information than what has been available so far. In addition to the fact that it is difficult to quantify customer satisfaction, it is perhaps too soon to draw final conclusions about the effectiveness of ATIS.

These traveler information systems will be integral components of the traffic and incident management systems planned for both Council Bluffs and Des Moines. Once traveler information is readily available and considered accurate by the traveling public, these systems will effectively divert traffic away from incident or construction related bottlenecks.

Costs:

This effort will cost approximately $150,000.

This cost estimate includes operations and maintenance costs.

Project Schedule:

This project is proposed for deployment in Years 3-5.

Program Area 3: Traveler Information: Television and Radio Traveler Information

Project 3/4/1 – Broadcast Traveler Information Expansion

Brief Project Summary:

This project focuses on the collection of traffic conditions, advisories, general public transportation, and parking information and the near real-time dissemination of this information over a wide area through existing television and radio infrastructure.

Background:

This strategy provides more sophisticated digital broadcast service. Successful deployment of this strategy relies on availability of real-time transportation data.

Actions:

In Iowa, this strategy will focus on the expansion and upgrading of the current television and radio broadcast information services. The objective of this project is to refine the way in which traveler information is gathered, packaged, and provided to radio and television media in the larger cities of Iowa. This effort will be closely tied to the Foretell initiative. Improved data collection and management will also benefit the other nine statewide traveler information initiatives.

Benefits:

The four Advanced Traveler Information Systems (ATIS) projects together improve drivers' access to weather and traffic condition information. The goal of these projects is to improve the accuracy of the information available and increase market penetration.

In general, such a system reduces congestion, travel time, and fuel consumption. It also reduces driver disorientation. By informing drivers of travel conditions, ATIS applications increase traveler satisfaction. As a stand-alone service, traveler information systems have been quite successful when measured in terms of improved customer satisfaction. There have, however, been few attempts to put a dollar value on the observed levels of customer satisfaction.

The U.S. federal government continues to support ATIS services in several metropolitan areas, particularly through its Model Deployment Initiative. These applications are larger in scope, and are expected to reach more users, with better information than what has been available so far. In addition to the fact that it is difficult to quantify customer satisfaction, it is perhaps too soon to draw final conclusions about the effectiveness of ATIS.

These traveler information systems will be integral components of the traffic and incident management systems planned for both Council Bluffs and Des Moines. Once traveler information is readily available and considered accurate by the traveling public, these systems will effectively divert traffic away from incident or construction related bottlenecks.

Costs:

This effort will cost approximately $150,000.

This cost estimate includes operations and maintenance costs.

Project Schedule:

This project is proposed for deployment in Years 3-5.

Program Area 3: Traveler Information: Metropolitan Area Highway Advisory Radio

Project 3/5/1 – Statewide Metropolitan Area Highway Advisory Radio

This project, scheduled for deployment in Years 6-10, involves the development of a statewide pool of highway advisory radio units designated for use in metropolitan areas.

Program Area 3: Traveler Information: Rural Highway/Freeway Changeable Message Signs

Project 3/6/1 – Rural Highway Changeable Message Sign Pool

This project, scheduled for deployment in Years 6-10, involves the development of a statewide pool of changeable message signs designated for use in rural areas.

Program Area 3: Traveler Information: In-Vehicle Signing / Route Guidance

Project 3/7/1 – Statewide In-Vehicle Signage and Route Guidance Study

This project, scheduled for Years 6-10 involves an in-vehicle signage and route guidance study that will explore the potential role the Iowa DOT would play in the future of this technology.

Program Area 3: Traveler Information: Rural Highway/Freeway HAR /Tourist Information

Project 3/8/1 – Statewide Rural Highway HAR Pool

This project, to be deployed in Years 6-10, involves a statewide pool of HAR units that will be acquired to provide traveler information during specific events or construction outside of the major metropolitan areas.

Program Area 3: Traveler Information: Traveler Information at Rest Areas

Project 3/9/1 – Expanded Traveler Information at Rest Areas

Brief Project Summary:

This project involves providing traveler information, including real-time weather information, to travelers via kiosks at rest areas around Iowa.

Background:

Currently, there are personal computers installed at Interstate rest areas that are linked to the Iowa DOT weather information. Future efforts will focus on upgrading these current systems with the same improved weather and roadway information being utilized by other traveler information outlets.

Actions:

This project will involve the upgrading and enhancement of the current information provided at Iowa's rest areas. This effort also involves information provided through the CARS and Foretell initiatives, and this will determine when to upgrade the current system.

Benefits:

The four Advanced Traveler Information Systems (ATIS) projects together improve drivers' access to weather and traffic condition information. The goal of these projects is to improve the accuracy of the information available and increase market penetration.

In general, such a system reduces congestion, travel time, and fuel consumption. It also reduces driver disorientation. By informing drivers of travel conditions, ATIS applications increase traveler satisfaction. As a stand-alone service, traveler information systems have been quite successful when measured in terms of improved customer satisfaction. There have, however, been few attempts to put a dollar value on the observed levels of customer satisfaction.

The U.S. federal government continues to support ATIS services in several metropolitan areas, particularly through its Model Deployment Initiative. These applications are larger in scope, and are expected to reach more users, with better information than what has been available so far. In addition to the fact that it is difficult to quantify customer satisfaction, it is perhaps too soon to draw final conclusions about the effectiveness of ATIS.

The traveler information systems will be integral components of the traffic and incident management systems planned for both Council Bluffs and Des Moines. Once traveler information is readily available and considered accurate by the traveling public, these systems will effectively divert traffic away from incident or construction related bottlenecks.

Costs:

This effort will cost approximately $150,000.

This cost estimate includes operations and maintenance costs.

Schedule:

This project is proposed for deployment in Years 3-5.

Program Area 4: Commercial Vehicle Operations: Electronic Clearance / Weigh-In-Motion / License Plate Readers

Project 4/1/1 – Expanded CVO Electronic Clearance/WIM

Under this project, which is to be deployed in Years 6-10, advanced technologies will be utilized to speed the weighing and clearance of commercial vehicles along the major trucking routes in Iowa. Efforts under this project will be coordinated with the Iowa DOT ITS/CVO Business Plan and will be lead by the Iowa DOT Motor Vehicle Division.

Program Area 4: Commercial Vehicle Operations: CVO Traveler Information

Project 4/2/1 – Updated Commercial Vehicle Information System

This project, which will be deployed in Years 6-10, will involve the implementation of a dedicated information system that would provide necessary information on several aspects of CVO activity, including permitting, repairs, accommodations, fuel, and other services. This system is discussed in the Des Moines Metropolitan Area ITS Plan.

Program Area 5: Public Transportation Management: Urban Area Transit AVL / Tracking

Project 5/1/1 – Waterloo/Cedar Falls Transit AVL

Brief Project Summary:

This project involves the implementation of automatic vehicle location (AVL) technology on the metropolitan area transit system in the Waterloo/Cedar Falls area. The Metro Transit Authority (MTA) will use this technology to track transit vehicles. Real-time location information for their fleet will allow the transit authority to optimize their routing and scheduling.

Background:

Through the use of AVL, vehicle position may be determined either by the vehicle and relayed to the infrastructure or may be determined directly by the communications infrastructure. A two-way wireless communication link is used for relaying vehicle position and control measures. Fixed route transit systems may also employ beacons along the route to enable position determination and facilitate communications with each vehicle at fixed intervals. MTA has already purchased scheduling software in 1993. This software has proven to be a good investment for the system. AVL technology will enhance this current system.

Actions:

Under this project, automatic vehicle location (AVL) technology will be deployed on the metropolitan area transit system in the Waterloo/Cedar Falls area. MTA will use this technology to track transit vehicles to their daily routing and scheduling.

Benefits:

Public transit systems use ITS technologies to manage their fleets more efficiently. Several metropolitan areas have reaped the benefits of this technology. After an extended analysis of travel times, Kansas City, Missouri, was able to reduce up to 10 percent of the equipment required for some bus routes using an AVL in combination with a computer aided dispatch system. The system allows fewer buses to serve those routes with no reduction in service. In Milwaukee, the use of AVL has been attributed with raising on-time performance from 90 percent to 94 percent. Other transit systems have reported reductions in fleet size between 4 percent to 10 percent due to the greater efficiency and bus utilization.

The benefit to cost ratio is based on the assumption that an AVL system will allow the Waterloo/Cedar Falls Transit system to reduce the fleet size, and thus the operating budget by 9 percent or $267,000 while maintaining the same level of service.

The benefit to cost ratio for the proposed Waterloo/Cedar Falls Transit AVL System is estimated to be **1.4 to 1.** Details of the benefit/cost calculation can be found in Appendix E.

Costs:

This project deployment is estimated to cost $1,320,000 over Years 2-5. This estimate includes all necessary hardware and software, as well as accommodates 80 transit vehicles. In addition, operations and maintenance of the system for Years 2-5 is estimated to be $480,000.

The total cost of this effort is estimated at $1,800,000.

Schedule:

This project is proposed for deployment in Years 2-5.

Program Area 5: Public Transportation Management: Urban Area Transit AVL / Tracking

Project 5/1/2 Expanded Cedar Rapids Transit AVL

This project, which will be deployed in Years 6-10, will involve the expansion of the current transit automatic vehicle location system in the Cedar Rapids area.

Project 5/1/3 – Council Bluffs Transit AVL

This project, which will be deployed in Years 6-10, will involve the deployment of a transit automatic vehicle location system in the Council Bluffs area.

Project 5/1/4 – Quad Cities Transit AVL

This project, which will be deployed in Years 6-10, will involve the deployment of a transit automatic vehicle location system in the Quad Cities area.

Project 5/1/5 – Expanded Sioux City Transit AVL

This project, which will be deployed in Years 6-10, will involve the deployment of a transit automatic vehicle location system in the greater Sioux City area.

Program Area 5: Public Transportation Management: Urban Area Transit Traffic Signal Priority

Project 5/2/1 – Des Moines Area Transit Signal Priority

Brief Project Summary:

This project involves the use of traffic signal priority for transit vehicles. This technology involves equipping selected traffic signals with automated signal control systems that are activated by authorized transit vehicles.

Background:

Currently, the Des Moines area does not utilize traffic signal priority. By giving priority to buses, this system is optimizing the throughput of people rather than the throughput of vehicles.

Actions:

This project involves the use of traffic signal priority for transit vehicles. This technology involves equipping selected traffic signals with automated signal control systems. Under this project, as a transit vehicle approaches the intersection, the transit vehicle will send a message to the signal that either turns a traffic light green or extends a green light until the vehicle has cleared the intersection. After the vehicle has cleared the intersection, the traffic signal returns to its regular cycle.

Benefits:

This project will provide better transit service in the Des Moines region, especially during the upcoming I-235 reconstruction. Public transit systems that have adopted priority treatment at traffic signals have reported a number of benefits. These include reduced variability in travel times, reduced operating costs due to improved fuel consumption performance, increased ridership and better utilization of fleet. Portland, Oregon has integrated a bus priority system with the traffic signal system on a major arterial. By allowing buses to either extend green time or shorten red time by only a few seconds, the bus travel time was reduced by between 5 percent and 8 percent. In addition to the travel time-savings, this approach allows the use of fewer vehicles to serve the route.

Buses on transit routes on arterial streets spend, on average, 30 percent of their run time at red traffic signals. With prioritization, run times can be reduced by 15 percent. Delay savings of only five minutes for one bus per weekday would result in an annual benefit of $10,000. In a series of 20 case studies of signal prioritization throughout Europe, priority treatment systems provided an economic payback equal to their capital costs in three to sixteen months.

Costs:

The cost of this effort is estimated at approximately $375,000 in Years 2-5. This estimate includes $300,000 for system deployment as well as $75,000 for operations and maintenance.

Schedule:

This project is proposed for deployment in Years 2-5.

Program Area 5: Public Transportation Management: Urban Area Transit Traffic Signal Priority

<u>**Project 5/2/2 – Cedar Rapids Transit Signal Priority**</u>

This project involves the implementation of a transit signal priority system for the greater Cedar Rapids area in Years 6-10. Specific elements and costs of this system will be determined through the Cedar Rapids Area ITS Plan to be completed in Years 2-5.

<u>**Project 5/2/3 – Council Bluffs Transit Signal Priority**</u>

This project involves the implementation of a transit signal priority system for the Council Bluffs area in Years 6-10. This system will be coordinated with efforts in Omaha, Nebraska.

<u>**Project 5/2/4 – Sioux City Transit Signal Priority**</u>

This project involves the implementation of a transit signal priority system for the greater Sioux City area in Years 6-10. Specific elements and costs of this system will be determined through the Sioux City Area ITS Plan to be completed in Years 2-5.

Program Area 5: Public Transportation Management: Regional/Rural Demand Response Transit

Project 5/3/1 – Statewide Rural Transit ITS Cost Assessment Study

Brief Project Summary:

This project involves an assessment to determine the need and potential costs of rural ITS transit applications across the state. Specifically, this study will provide technical assistance to Iowa's regional transit systems to determine which ITS components are desired or needed in their areas and what the costs will be to accomplish this given the current state of technology in each area.

Background:

Stakeholder input has shown a strong desire for regional rural transit ITS implementation in Iowa. Currently, transit operators throughout the state are implementing, and requesting funding for, several ITS technologies (including automatic vehicle location, computer-aided scheduling and dispatch, and mobile data terminals). An effort is underway to launch a statewide effort that would encompass 11 of 16 regional transit operations. There is a concern that this effort is premature, since a successful model has not yet emerged from the pilot deployments in Cedar Rapids and Ottumwa.

Actions:

Under this effort, a statewide model for rural/regional transit ITS will be developed. The Iowa DOT's involvement will focus first on the communications requirements. A statewide approach or solution should be sought to this problem. The Iowa DOT should also be involved in the Transit Communications Interface Profile, an ongoing effort. From this study, and through lessons learned from current efforts, a statewide rural transit model will be established. This study will include an accurate assessment of the costs that will be involved in implementing rural transit ITS.

Benefits:

This project will modernize current rural transit operations in Iowa, and ultimately provide better rural transit service across the state. A Regional Rural Transit Feasibility Study will set objectives, define and prioritize projects, develop a timeline for deployment, and develop a regional ITS architecture.

Costs:

The plan and model development will cost approximately $200,000. There are no additional operations and maintenance costs associated with this project.

Schedule:

This project is proposed for Year 2.

Program Area 5: Public Transportation Management: Regional/Rural Demand Response Transit

Project 5/3/2 – Rural Transit Deployment – Phase I Pilot Projects

Brief Project Summary:

This project involves the implementation of rural ITS transit technologies on selected regional rural transit operations in Iowa as a result of the findings of the statewide study, Project 5/3/1.

Background:

Approximately 40 percent of the regional rural transit agencies are ready for the deployment of this technology and will be included in Phase I. Another 30 percent of the agencies will be included in Phase II in Years 6-10.

Actions:

This project involves the implementation of rural ITS transit technologies on selected regional rural transit operations in Iowa as a result of the findings of the statewide study. Specifically, the project involves the deployment of technologies such as computer-aided dispatch and automated vehicle location systems by selected regional rural transit operations

Benefits:

This project will modernize current rural transit operations in Iowa, and ultimately provide better rural transit service across the state. Specific ITS technologies to be deployed by rural transit agencies in Iowa have yet to be selected. Public transportation providers in rural areas will operate more efficiently if they are able to increase the number of riders. Computer-assisted dispatch allows same day ride requests to be granted. Rural transit authorities have seen their ridership increase dramatically with the introduction of AVL, CAD, and the ability to fulfill same day ride requests.

A transit area on the rural fringes of the Washington D.C. used AVL and CAD technology to switch from fixed route to demand-responsive. They realized savings of 40 percent.

The computer-aided dispatching system in Sweetwater County, Wyoming, which allows same-day ride requests increased its ridership from 5,000 to 9,000 monthly while reducing the operational expense by 50 percent over a 5-year period, on a per passenger-mile basis.

Costs:

This effort will cost approximately $500,000 per agency. Two agencies will be outfitted per year in Years 3-5, for a total of six agencies.

Continuing operations and maintenance of these systems is estimated to be $600,000 for years 3-5. The total cost of this effort is $3,600,000.

Schedule:

This project is proposed for deployment in Years 3-5.

Program Area 5: Public Transportation Management: Regional/Rural Demand Response Transit

Project 5/3/3 – Rural Transit Deployment – Phase II Pilot Projects

This project, which will be deployed in Years 6-10, will involve the further implementation of ITS advanced technologies on selected regional rural transit agencies. The regions to be selected will be based on the results of Project 5/3/1 – Statewide Rural Regional Transit Feasibility Study/Model.

Program Area 6: Emergency Management: Consolidated Urban Area EMS Communications

Project 6/1/1 – Quad Cities EMS Communications System

Brief Project Summary:

This project will provide EMS agencies with a better communication system. Specifically, this project involves finding a communications solution to allow for fire, ambulance, and police units to communicate with one another.

Background:

An integrated voice communication system among emergency responders improves coordination. A shared communication channel that is both reliable and clear is an essential component of an overall incident management system.

Actions:

Specifically, this project involves finding a communications solution to allow for fire, ambulance, and police units in the area jurisdictions to talk to each other using a common system or types of systems. Under this effort, the use of 800 MHz technology will be stressed.

Benefits:

This project will provide EMS agencies with better communications capabilities and will improve response to emergencies. Integrating the communication system will allow emergency personnel to reduce response time. If successful, the project will also reduce incident related delay.

Costs:

This project will cost approximately $100,000, or $25,000 per year, to implement. In addition, operations and maintenance costs are estimated at approximately 10 percent of deployment costs, or $25,000 for Years 2-5.

Therefore, the total cost for this effort in Years 2-5 is $110,000.

Schedule:

This project is proposed for deployment in Years 2-5.

Program Area 6: Emergency Management: Consolidated Urban Area EMS Communications

Project 6/1/2 – Des Moines Area EMS Communications System

This project, which will be implemented in Years 6-10, will provide EMS agencies in the Des Moines area with a better communication system. Specifically, this project involves finding a communications solution to allow for fire, ambulance, and police units to communicate with one another.

Project 6/1/3 – Omaha/Council Bluffs Area EMS Communications Enhancements

Consolidation of EMS communication was identified as a high priority in the Omaha Early Deployment Plan. Council Bluffs is currently implementing an 800 MHz system. This project would involve the updating or enhancement of that system in Years 6-10.

Project 6/1/4 – Cedar Rapids EMS Communications System

This project, which will be implemented in Years 6-10, will provide EMS agencies in the Cedar Rapids area with a better communication system. Specifically, this project involves finding a communications solution to allow for fire, ambulance, and police units to communicate with one another.

Project 6/1/5 – Sioux City EMS Communications System

This project, which will be implemented in Years 6-10, will provide EMS agencies in the Sioux City area with a better communication system. Specifically, this project involves finding a communications solution to allow for fire, ambulance, and police units to communicate with one another.

Project 6/1/6 – Waterloo/Cedar Falls EMS Communications System Expansion

This project, which will be implemented in Years 6-10, will provide EMS agencies in the Waterloo/Cedar Falls area with a more efficient communication system. Specifically, this project involves supplementing communications to allow for fire, ambulance, and police units to communicate with one another.

Program Area 6: Emergency Management: Metropolitan EMS Preemption / Routing / Response

Project 6/2/1 – Des Moines EMS Signal Preemption

This project, which will be deployed in Years 6-10, will provide EMS agencies in the Des Moines area with signal preemption on selected signals in the region.

Project 6/2/2 – Council Bluffs EMS Signal Preemption

This project, which will be deployed in Years 6-10, will provide EMS agencies in the Omaha/Council Bluffs area with signal preemption on selected signals in the region. This effort will be coordinated with EMS and signal preemption efforts in Nebraska.

Project 6/2/3 – Quad Cities EMS Signal Preemption

This project, which will be deployed in Years 6-10, will provide EMS agencies in the Quad Cities area with signal preemption on selected signals in the region.

Project 6/2/4 – Cedar Rapids EMS Signal Preemption

This project, which will be deployed in Years 6-10, will provide EMS agencies in the Cedar Rapids area with signal preemption on selected signals in the region.

Project 6/2/5 – Sioux City EMS Signal Preemption

This project, which will be deployed in Years 6-10, will provide EMS agencies in the Sioux City area with signal preemption on selected signals in the region.

Project 6/2/6 – Waterloo/Cedar Falls EMS Signal Preemption Enhancements

Currently, the Waterloo fire and rescue is phasing in preemptive signal equipment, but law enforcement cannot afford it. The fire department would like to speed the implementation of the preemption equipment but lacks the funding. This project, which will be deployed in Years 6-10, will provide area EMS agencies with more signal preemption capability on selected signals in the region.

Program Area 6: Emergency Management: Rural EMS / Mayday Response

Project 6/3/1 – Rural EMS Mayday Communications Plan

This project, which will be implemented in Years 6-10, involves the development of a Rural EMS / Mayday Communications Plan.

7.0

Deployment Schedule and Costs

7.1 Schedule

The projects listed in Section 6.3 will be deployed systematically over the next 10 years in accordance with the goals and objectives set forth by the Iowa DOT and in the specific program area objectives. More detail was provided for the Years 1-5 projects, due to the fact that conditions for deployment of these projects and the entire ITS environment are changing rapidly. With the program update process outlined in Section 8.0, these future projects will be re-evaluated and details will be added.

7.2 Costs

Costs for each of the Years1-5 projects are included in each project description in Section 6.3. Table 7-1, on the following pages, shows the schedule for the first five (5) years of Iowa's Statewide ITS Program.

Table 7-1: Summary of Years 1-5 Implementation Schedule and Costs

Project	Schedule	Year 1 Costs	Year 2 Costs	Years 3 Costs	Year 4 Costs	Year 5 Costs
1/1/1 - Iowa DOT Statewide Communications Plan	Year 1	• $300,000 (plan development)	• N/A	• N/A	• N/A	• N/A
1/1/2 - National Model Expansion	Year 1	• $600,000 (software development)	• N/A	• N/A	• N/A	• N/A
1/1/3 - Integrated Database Development and Packaging	Years 1-5	• $90,000 (development, integration and packaging) • $9,000(operations and maintenance)	• $90,000 (development, integration and packaging) • $18,000 (operations and maintenance)	• $90,000 (development, integration and packaging) • $27,000 (operations and maintenance)	• $90,000 (development, integration and packaging) • $36,000 (operations and maintenance)	• $90,000 (development, integration and packaging) • $45,000 (operations and maintenance)
1/1/4 - Speed Processing of Crash Data	Years 1-5	• $400,000 (implementation)	• $400,000 (implementation)	• $400,000 (implementation)	• $400,000 (implementation)	• $400,000 (implementation)
1/2/1 - Quad Cities Area Regional ITS Plan	Year 2	• N/A	• $275,000 (ITS plan)	• N/A	• N/A	• N/A
1/2/2 - Cedar Rapids Area Regional ITS Plan	Year 3	• N/A	• N/A	• $275,000 (ITS plan)	• N/A	• N/A
1/2/3 - Sioux City Area Regional ITS Plan	Year 3	• N/A	• N/A	• $275,000 (ITS plan)	• N/A	• N/A
1/2/4 - Waterloo/ Cedar Falls Area Regional ITS Plan	Year 3	• N/A	• N/A	• $275,000 (ITS plan)	• N/A	• N/A

Project	Schedule	Year 1 Costs	Year 2 Costs	Years 3 Costs	Year 4 Costs	Year 5 Costs
1/3/1 - Statewide ITS Marketing and Education	Years 1-5	• $125,000 (production and implementation) • $50,000 (consultant services)	• $125,000 (production and implementation) • $50,000 (consultant services)	• $125,000 (production and implementation) • $50,000 (consultant services)	• $125,000 (production and implementation) • $50,000 (consultant services)	• $125,000 (production and implementation) • $50,000 (consultant services)
2/1/1 - Des Moines Area Traffic Management System	Years 2-5	• N/A	• $2,750,000 (system implementation)	• $2,750,000 (system implementation) • $550,000 (maintenance and 3 FTE)	• $2,750,000 (system implementation) • $805,000 (maintenance and 3 FTE)	• $2,750,000 (system implementation) • $1,100,000 (maintenance and 3 FTE)
2/1/2 - Council Bluffs Area Traffic Management System	Years 2-5	• N/A	• $410,000 (system implementation) • $41,000 (maintenance and operations)	• $410,000 (system implementation) • $82,000 (maintenance and operations)	• $410,000 (system implementation) • $123,000 (maintenance and operations)	• $410,000 (system implementation) • $164,000 (maintenance and operations)
2/2/1 - Des Moines Area Incident/Event Management Program	Year 2	• N/A	• $90,000 (plan and software development)	• N/A	• N/A	• N/A
2/2/2 - Council Bluffs Area Incident/Event Management Program	Year 2	• N/A	• $50,000 (plan and procedures development)	• N/A	• N/A	• N/A
2/3/1 - Smart Work Zones / Portable Traffic Management Systems	Years 2-5	• N/A	• $255,000 (3 PTMS units) • $12,750 (maintenance of 3 units)	• $255,000 (3 PTMS units) • $25,500 (maintenance of 6 units)	• $170,000 (2 PTMS units) • $34,000 (maintenance of 8 units)	• $170,000 (2 PTMS units) • $42,500 (maintenance of 10 units)

Project	Schedule	Year 1 Costs	Year 2 Costs	Years 3 Costs	Year 4 Costs	Year 5 Costs
2/4/1 - Incident Warning System on Interstate 74 Bridge	Years 1-5	• $100,000 (design)	• 125,000 implementation, operations and maintenance)	• 125,000 implementation, operations and maintenance)	• 125,000 implementation, operations and maintenance)	• 125,000 implementation, operations and maintenance)
2/4/2 - Expanded Incident Warning Systems	Years 2-5	• N/A	• $100,000 (design of first site)	• $450,000 (implementation of first site) • $100,000 (design of second site) • $45,000 (operations and maintenance)	• $450,000 (implementation of second site) • $90,000 (operations and maintenance)	• N/A
2/4/3 - Automated Bridge Anti-icing System Pilot Project	Years 1-5	• $100,000 (design)	• 125,000 (implementation, operations, and maintenance)	• 125,000 (implementation, operations and maintenance)	• 125,000 (implementation, operations and maintenance)	• 125,000 (implementation, operations and maintenance)
2/4/4 - Expanded Automated Bridge Anti-Icing Systems	Years 2-5	• N/A	• $100,000 (design of first site)	• $200,000 (implementation, operation and maintenance of first site) • $100,000 (design of second site)	• $200,000 (implementation, operation and maintenance of second site)	• N/A
2/4/5 - Concept Maintenance Vehicle Expansion	Year 3-5	• N/A	• N/A	• $150,000 (project enhancements)	• $150,000 (project enhancements)	• $150,000 (project enhancements)
2/5/1 - Expanded Des Moines Area Regional Traffic Signal Coordination	Years 2-5	• N/A	• $500,000 (signals) • $375,000 (fiber optics) • $50,000 (operations and maintenance)	• $500,000 (signals) • $375,000 (fiber optics) • $100,000 (operations and maintenance)	• $500,000 (signals) • $375,000 (fiber optics) • $150,000 (operations and maintenance)	• $500,000 (signals) • $375,000 (fiber optics) • $200,000 (operations and maintenance)

Project	Schedule	Year 1 Costs	Year 2 Costs	Years 3 Costs	Year 4 Costs	Year 5 Costs
2/5/2 - Council Bluffs Area Traffic Signal Coordination	Years 2-5	• N/A	• $150,000 (signals) • $112,500 (fiber optics) • $15,000 (operation and maintenance)	• $150,000 (signals) • $112,500 (fiber optics) • $30,000 (operation and maintenance)	• $150,000 (signals) • $112,500 (fiber optics) • $45,000 (operation and maintenance)	• $150,000 (signals) • $112,500 (fiber optics) • $60,000 (operation and maintenance)
2/5/3 - Quad Cities Area Regional Traffic Signal Coordination	Years 2-5	• N/A	• $250,000 (signals) • $187,500 (fiber optics) • $25,000 (operations and maintenance)	• $250,000 (signals) • $187,500 (fiber optics) • $50,000 (operations and maintenance)	• $250,000 (signals) • $187,500 (fiber optics) • $75,000 (operations and maintenance)	• $250,000 (signals) • $187,500 (fiber optics) • $100,000 (operations and maintenance)
2/5/4 - Cedar Rapids Area Regional Traffic Signal Coordination	Years 2-5	• N/A	• $375,000 (signals) • $250,000 (fiber optics) • $37,500 (operations and maintenance)	• $375,000 (signals) • $250,000 (fiber optics) • $75,000 (operations and maintenance)	• $375,000 (signals) • $250,000 (fiber optics) • $112,500 (operations and maintenance)	• $375,000 (signals) • $250,000 (fiber optics) • $150,000 (operations and maintenance)
2/5/5 - Waterloo/Cedar Falls Area Regional Traffic Signal Coordination	Years 2-5	• N/A	• $375,000 (signals) • $250,000 (fiber optics) • $37,500 (operations and maintenance)	• $375,000 (signals) • $250,000 (fiber optics) • $75,000 (operations and maintenance)	• $375,000 (signals) • $250,000 (fiber optics) • $112,500 (operations and maintenance)	• $375,000 (signals) • $250,000 (fiber optics) • $150,000 (operations and maintenance)
2/5/6 - Sioux City Area Regional Traffic Signal Coordination	Years 2-5	• N/A	• $375,000 (signals) • $250,000 (fiber optics) • $37,500 (operations and maintenance)	• $375,000 (signals) • $250,000 (fiber optics) • $75,000 (operations and maintenance)	• $375,000 (signals) • $250,000 (fiber optics) • $112,500 (operations and maintenance)	• $375,000 (signals) • $250,000 (fiber optics) • $150,000 (operations and maintenance)

Project	Schedule	Year 1 Costs	Year 2 Costs	Years 3 Costs	Year 4 Costs	Year 5 Costs
2/6/1 - Red Light Running Demonstration Program	Years 1-5	• $100,000 (equipment procurement and program development)	• N/A	• N/A	• N/A	• N/A
2/6/2 - Expanded Red Light Running Program	Years 2-5	• N/A	• $150,000 (implementation at three intersections in first city) • $15,000 (operations and maintenance)	• $150,000 (implementation at three intersections in second city) • $30,000 (operations and maintenance)	• $100,000 (implementation at two intersections in first city) • $40,000 (operations and maintenance)	• $100,000 (implementation at two intersections in second city) • $50,000 (operations and maintenance)
3/1/1 - Statewide Portable Changeable Message Signs	Years 2-5	• N/A	• $200,000 (10 portable CMS) • $20,000 (operations and maintenance)	• $200,000 (10 portable CMS) • $40,000 (operations and maintenance)	• $200,000 (10 portable CMS) • $60,000 (operations and maintenance)	• $200,000 (10 portable CMS) • $80,000 (operations and maintenance)
3/2/1 - ITS Weather Information on the Iowa DOT Web Site	Years 1-5	• $150,000 (development and integration) – Phase I • $35,000 (programming) – Phase I • $30,000 (upgrade of RWIS sensors) – Phase I	• $30,000 (software development and implementation for TRAC integration) – Phase II • $50,000 (DOT web site re-design) – Phase II	• $30,000 (software for TRAC integration) – Phase II • $424,000 (AWOS sensor upgrade) – Phase III • $50,000 (site design and programming) – Phase III	• $30,000 (software for TRAC integration) – Phase II • $50,000 (computer upgrades) – Phase III • $50,000 (server) – Phase III	• $30,000 (software for TRAC integration) – Phase II • $75,000 (virtual private network creation) – Phase III
3/2/2 - Expanded Internet Traveler Information	Years 3-5	• N/A	• N/A	• $50,000 (system enhancements)	• $50,000 (system enhancements)	• $50,000 (system enhancements)

Project	Schedule	Year 1 Costs	Year 2 Costs	Years 3 Costs	Year 4 Costs	Year 5 Costs
3/3/1 - Updated Telephone Traveler Information System	Years 3-5	• N/A	• N/A	• $50,000 (system enhancements)	• $50,000 (system enhancements)	• $50,000 (system enhancements)
3/4/1 - Broadcast Traveler Information	Years 3-5	• N/A	• N/A	• $50,000 (system enhancements)	• $50,000 (system enhancements)	• $50,000 (system enhancements)
3/9/1 - Expanded Traveler Information at Rest Areas	Years 3-5	• N/A	• N/A	• $50,000 (system enhancements)	• $50,000 (system enhancements)	• $50,000 (system enhancements)
5/1/1 - Waterloo/Cedar Falls Transit AVL System	Years 2-5	• N/A	• $1,000,000 (hardware and software) • $80,000 (initial 20 vehicles) • $108,000 (operations and maintenance)	• $80,000 (20 vehicles) • $116,000 (operations and maintenance)	• $80,000 (20 vehicles) • $124,000 (operations and maintenance)	• $80,000 (20 vehicles) • $132,000 (operations and maintenance)
5/2/1 - Des Moines Transit Signal Priority System	Years 2-5	• N/A	• $75,000 (implementation) • $7,500 (operations and maintenance)	• $75,000 (implementation) • $15,000 (operations and maintenance)	• $75,000 (implementation) • $22,500 (operations and maintenance)	• $75,000 (implementation) • $30,000 (operations and maintenance)
5/3/1 - Statewide Rural Transit ITS Cost Assessment Study	Years 2	• N/A	• $200,000 (study and model development)	• N/A	• N/A	• N/A
5/3/2 - Rural Transit Deployment	Years 2-5	• N/A	• N/A	• $1,000,000 (2 systems) • $100,000 (operations and maintenance)	• $1,000,000 (2 systems) • $200,000 (operations and maintenance)	• $1,000,000 (2 systems) • $300,000 (operations and maintenance)

Project	Schedule	Year 1 Costs	Year 2 Costs	Years 3 Costs	Year 4 Costs	Year 5 Costs
5/1/1 - Quad Cities EMS Communications	Years 2-5	• N/A	• $25,000 (budget estimate) • $2,500 (operations and maintenance) ”	• $25,000 (budget estimate) • $5,000 (operations and maintenance)	• $25,000 (budget estimate) • $7,500 (operations and maintenance)	• $25,000 (budget estimate) • $10,000 (operations and maintenance)
Total Costs		• **$2,089,000**	• **$8,157,250**	• **$13,109,250**	• **$12,039,000**	• **$11,787,000**
Funded (Immediate-Term Projects)		• **$2,090,000**	• **$1,005,000**	• **$1,429,000**	• **$1,055,000**	• **$1,030,000**
Remaining Costs (Years 2-5 Projects)		• **$0**	• **$9,819,250**	• **$11,174,250**	• **$10,005,000**	• **$9,310,000**

Total 5-Year Cost = $49,934,000

Total Currently Funded = $6,609,000

Total To Be Funded = $43,325,000

8.0

Program Management

This section describes how the Iowa DOT's ITS program will be managed, both in terms of organizational structure and process.

8.1 Overall Approach – A Phased Strategy

An effective organizational structure must respond to its environment, and since conditions change, organizational structures must change over time as well. This is especially true in ITS, where conditions are changing even faster than in the more traditional areas of DOT activity. In recognition of these considerations, a phased strategy is recommended relative to the Iowa DOT's ITS organizational structure and programming process. A specific approach is recommended in the near term (at least the first five to 10 years), based on specific conditions, and a potential long-term strategy is identified that may be appropriate if and when certain conditions prevail. The decision of whether to, when to, and how to transition from the near-term approach to some other long-term approach will be one of the important issues considered during each update of the statewide ITS plan.

Table 8-1 summarizes existing and potential future characteristics of the ITS environment and outlines a recommended near-term, and a potential long-term, organizational structure and programming process. The near-term recommendations are discussed in greater detail in sections 8.2 and 8.3. Figure 8-1 graphically summarizes the phased approach to Iowa DOT ITS organizational structure and strategy.

8.2 Near-Term Organizational Structure

As noted in Table 8-1, the current and expected near-term ITS environment warrants a fairly structured, fairly centralized ITS organizational structure. This structure and centralization is necessary during at least the early years of the ITS program to establish overall strategic direction, promote integration of ITS activities and to overcome technical and other challenges that demand a focused and coordinated application of resources. Despite the centralization of the ITS Program, a balanced perspective is maintained through active participation in the ITS program by representatives of each DOT Division, and selected other organizations.

It is recommended that the near-term organizational structure be maintained for at least five to ten years, in order to get the program off to a solid start, maintain continuity and avoid excessive organizational restructuring during a short period of time.

Table 8-1: Summary of Overall Phased Strategy fo

Near-Term Conditions and Sts and Strategy
Conditions:
ITS is typically viewed as a related but separate aS" is no longer widely used. widely used to describe these separate activities.
Knowledge of ITS applications and their role in sortation problems is generally high, and fairly highly variable, among transportation professionastate, and ITS applications are routinely considered as part of overall solutions.
Most local and regional transportation plans do nmponent and/or do explicitly consider ITS. consider ITS.
ITS applications are not well understood or suppce and "just another way to solve transportation makers. al public and decision-makers.
ITS technology applications are emerging very qu, the pace has slowed and, based on long-term ineffective, not cost-effective, politically infeasiblorted group of "core" or "standard" applications curve). e public. (i.e., we are relatively high on the
Few ITS institutional arrangements have been weessful models for ITS institutional arrangements several competing models exist and approaches arience. lessons learned (i.e., we are still relatively low on
ITS standards are incomplete and are not widely ometimes modified, national ITS standards are gners.
There are dedicated sources of ITS funding availat the state or federal level.
Despite some outstanding ITS work and some suation of ITS across modes and throughout the among Divisions, or between the DOT and other s a well-established track record for guided by clear, widely embraced objectives. and between the DOT and other organizations.
In so much as ITS represents a deviation from stans are considered as a standard matter of course which will require a focused, targeted expenditure familiarity and experience with ITS has been "champions" and structure. rtation agency staff, support for ITS has
Recommended Organizational Structure and I
Establishment of a dedicated, state-level ITS fund
Development of a statewide ITS plan and architecesses and tools and implement ITS projects mple, ITS solutions are routinely considered as lighting, signage and other features.
Use of the statewide ITS plan to program and coobroader efforts. processes, e.g., within the Engineering and
Targeted ITS education and outreach program focd support staff, including potential elimination ersons throughout the DOT.
Establishment of an organizational structure to coility for planning and coordinating ITS. Coordinator with a small support staff, an ITS De Divisions, and ITS working groups composed of : and devoted to specific ITS issues (e.g., traffic ma
Coordinate ITS-related research with the broader process and structure.

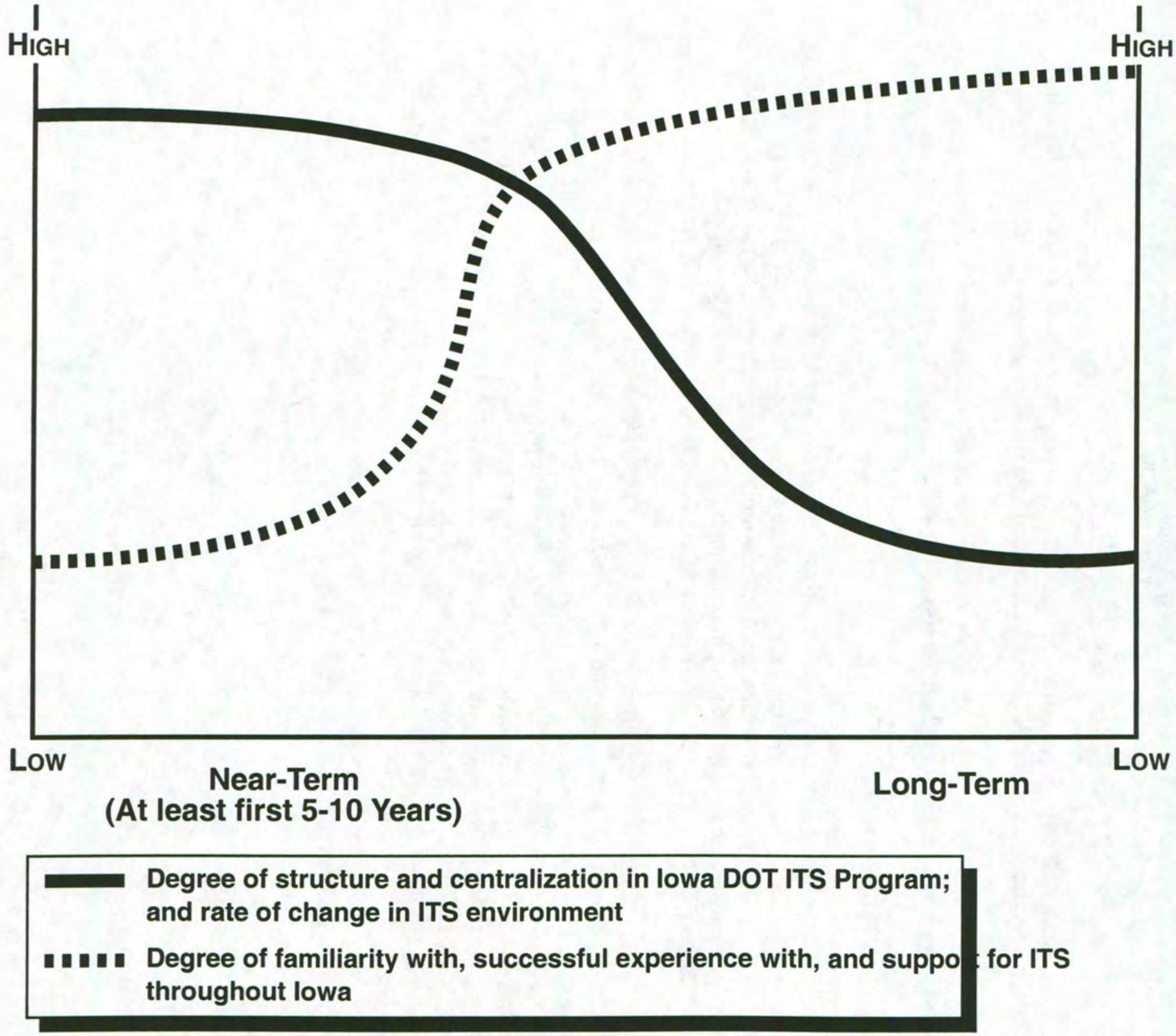


Figure 8-1
Rationale for Phasing of DOT ITS Organizational Structure and Programming Process

BRW, Inc., January 2000

The near-term DOT ITS organizational structure consists of four major components:

1. The **Planning and Programming Division**, where the near-term ITS program will reside.

2. A **Statewide ITS Coordinator** staff position and supporting staff positions.

3. An **ITS Deployment Committee** composed of representatives from each DOT Division, and representatives from selected other key organizations.

4. ITS **Working Groups**, composed of individuals from throughout the DOT, and from selected other key organizations, organized around specific ITS program areas and issues.

Each of these components is described in greater detail in the sections that follow, and are portrayed graphically on Figure 8-2 on the following page.

Planning and Programming Division

The Iowa DOT ITS program will be directed by the Planning and Programming Division of the DOT, in the sense that the statewide ITS Coordinator and supporting staff will reside in that division. The ITS program has been placed within the Planning and Program Division because that division is best suited to provide the integration, coordination, strategic direction and multi-modal and statewide oversight that is so critical to the ITS Program in it's early stages.

Of course, timely successful implementation of visible and effective ITS "early winner" projects is also critical to the success of the ITS Program. For this reason, responsibilities for implementing ITS projects will reside in the "front line" DOT divisions that fulfill those roles for "traditional" (i.e., non-ITS) projects, including the Highway and Motor Vehicles divisions. Given the importance of communications and information systems for ITS, the Information Technology Division will also play an important role in implementing ITS projects. In addition to retention of ITS project implementation responsibilities, the other DOT divisions will also be provided substantial opportunities for influencing the ITS Program through: representation on the ITS Deployment Committee, working groups, and the ITS program support staff, which will include employees from other divisions assigned to ITS on a part-time basis, and through participation in updates to the Statewide ITS Plan.

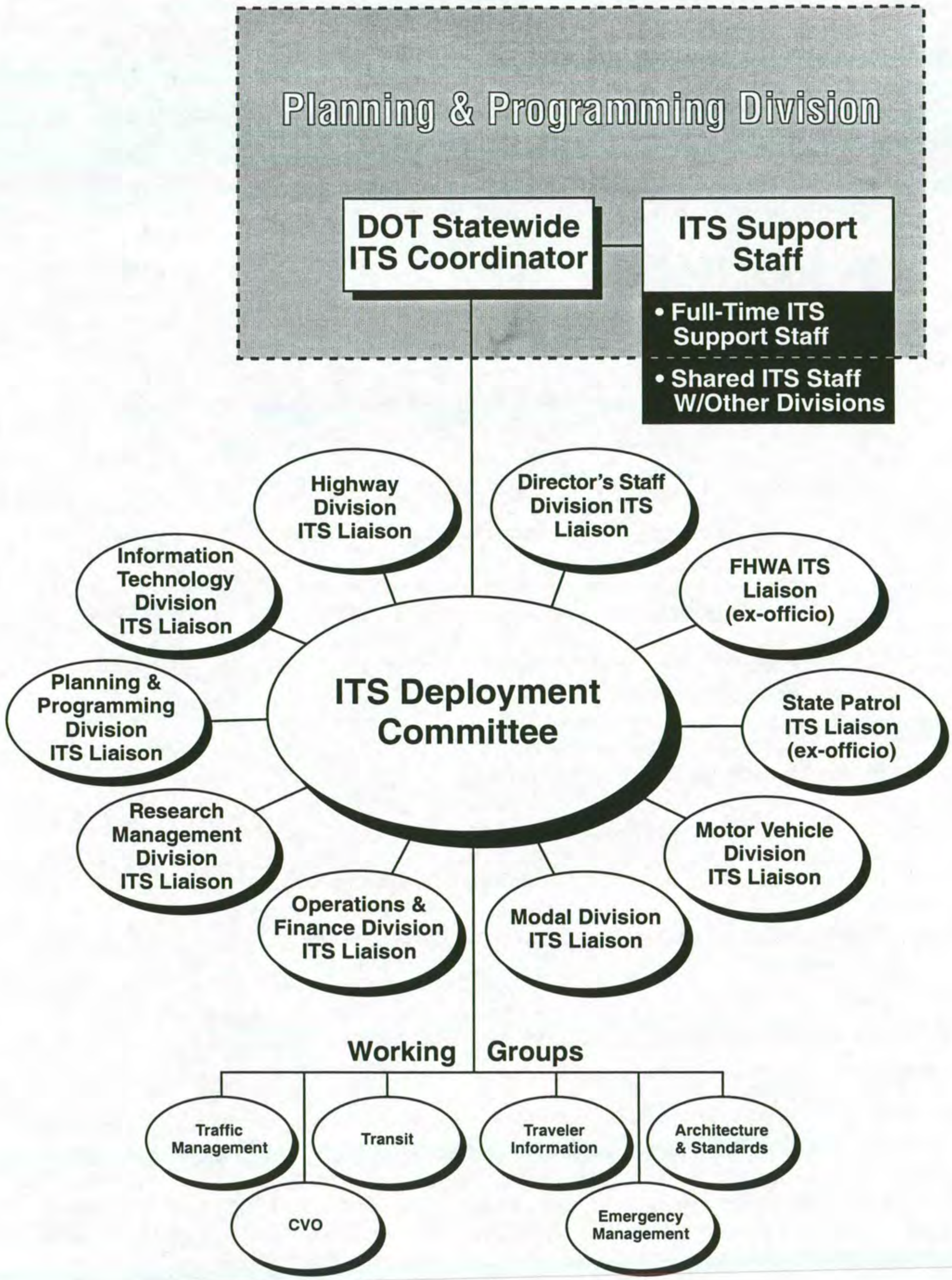


Figure 8-2
Near-Term DOT ITS Program Organizational Structure

Statewide ITS Coordinator and Support Staff

Statewide ITS Coordinator

The Statewide ITS Coordinator will be a full-time staff position within the Planning and Programming Division, devoted solely to the ITS Program. Responsibilities of the Statewide ITS Coordinator include the following:

- Focal point for ITS activities statewide, guided by the ITS Deployment Committee
- Promote coordination and integration of ITS activities across divisions, modes and Transportation Centers
- Lead the preparation of annual ITS work programs (with participation by the ITS Deployment Committee)
- Represent the Iowa ITS Program to legislators through legislative liaisons
- Oversee development and implementation of Statewide ITS funding strategies
- Lead updates and revisions of the statewide ITS Plan (with participation by the ITS Deployment Committee)
- Coordinate requests for federal ITS funds
- Provide high-level oversight and direction for ITS operations and maintenance practices
- Oversee development of ITS policy positions
- Coordinate project and program level evaluations
- Provide input to Director's Staff Division on ITS marketing and outreach
- Coordinate ITS planning projects (e.g., statewide and local)
- Promote and support public-private partnerships
- Coordinate statewide ITS training
- Architecture coordination

The Statewide ITS Coordinator is a critical component of the overall ITS Program, and a key to success. The experiences of other DOT's that have been successful with ITS suggest that although the design of the program structure and processes can do much to promote success, the characteristics and performance of the Statewide ITS Coordinator him or herself, are also extremely important. A knowledgeable, enthused, positive and perseverant individual is a tremendous asset in this position.

As the primary promoter and representative of the ITS Program, the Statewide ITS Coordinator will work closely with the Director's Staff Division on ITS education and marketing activities. The Statewide ITS Coordinator will also lead, with direction from the Deployment Committee, the development of policies and objectives regarding the involvement of the private sector in the Iowa ITS program.

ITS Program Support Staff

The staff that will support the Statewide ITS Coordinator will consist, initially, of approximately two full-time equivalent (FTE) positions (total program staff = 3, counting the Statewide ITS Coordinator). Of the two support staff positions, it is recommended that one FTE be accounted for by a single, full-time staff position that would work exclusively in the ITS Program. The remaining FTE position should be divided into several part-time positions, utilizing individuals who also hold responsibilities in other areas. Utilization of these part-time staff members provides another opportunity to coordinate with and involve other portions of the DOT that are important to ITS and should help direct the program. The staffing needs of the ITS Program are expected to fluctuate over time and should be assessed on a regular basis. Table 8-2, on the following page, summarizes a likely initial configuration of the ITS Program Staff.

Table 8-2: Illustrative Initial Configuration of ITS Program Staff

Position	**Full-Time Equivalent Positions**
Statewide ITS Coordinator (Full-time)	1.0
ITS Support Staff (Full-time)	1.0
ITS Support Staff (Part-time, e.g., share with Highway)	0.50
ITS Support Staff (Part-time, e.g., share with Research)	0.25
ITS Support Staff (Part-time, e.g., share with Motor Vehicles)	0.25
Total Staff Positions (FTE's)	**3.0**

ITS Deployment Committee

The ITS Deployment Committee will be composed, initially, of representatives of each DOT division, plus ex-officio (non-voting) representatives from the State Patrol and Federal Highway Administration. Representation on the committee can be adjusted over time if necessary depending on the focus of ITS activities. The purpose of the committee is to provide direction and decision-making support to the Statewide ITS Coordinator.

The Deployment Committee represents a continuation and an evolution of the ITS Steering Committee that has guided the development of this Statewide ITS Plan. However, the specific individuals representing the various DOT divisions on the Deployment Committee will, in some cases, be different. It is desirable to include individuals who are closer to implementation and operation on the Deployment Committee. The ITS Deployment Committee will meet on a monthly basis. The Deployment Committee plays a very important role in the overall ITS Program by ensuring that all divisions have input to the process, thus promoting a balanced and integrated program.

Responsibilities of the ITS Deployment Committee include the following:

- Provide direction on planning, including participation in the preparation of annual ITS work programs
- Provide direction to updates of the Statewide ITS Plan
- Provide direction on ITS policy positions
- Provide direction to the activities of the working groups
- Provide direction to the development of operations and maintenance procedures

ITS Working Groups

As shown in Figure 8-2, several ITS working groups will support the ITS Deployment Committee. The number and composition of the ITS working groups will change over time, depending on the current focus of ITS activities. The working groups can include DOT, local, regional and even private sector representatives who will play a role in the specific area of ITS deployment covered by each group. For example, the Traffic and Incident Management Working Group will include traffic engineers, emergency management coordinators, police and fire representatives, etc. Initially, the following six working groups are recommended:

1. Traffic and Incident Management
2. Commercial Vehicle Operations
3. Transit
4. Traveler Information
5. Emergency Management
6. System Architecture and Standards

The responsibilities of the working groups include the following:

- Address specific ITS technical issues, including project-specific and non-project specific/statewide. These activities include ITS-related research.
- Coordinate implementation of specific programs and projects in respective subject areas, including development of RFP's, participation in procurement/consultant selection, etc.
- Foster coordination and information exchange among practitioners throughout the DOT and at the regional and local level (e.g., bring professionals together to exchange ITS-related information, lessons learned, etc.).

The specific activities of the working groups will vary over time. Each working group will be encouraged to develop an informal annual work program, closely linked to the projects from the statewide ITS plan that are being deployed in that year. The working groups can set their own schedules, but it is recommended that the groups meet at least quarterly.

8.3 Recommended Near-Term Planning and Programming Process

Plan Updates

During the critical first five to 10 years of the Iowa DOT's ITS Program, the plan should be updated every two years, and more substantially reassessed and revised every other update (i.e., every four years). During the biennial plan "updates," the focus will be on making only those adjustments that are necessary to reflect major lessons learned and advancements. During the biennial updates major stakeholder involvement should not be necessary—although the need for structured stakeholder involvement will depend in part on the success of the ITS education and outreach activities and the extent of local agency participation in the recommended annual ITS project programming process (see next session).

During the more substantial plan revisions, to be conducted every four years, the process used to develop this plan should be repeated, including the stakeholder involvement process, and major strategic direction should be reassessed. Located on the following pages, Figure 8-3 graphically illustrates the recommended plan update and revision process and Table 8-3 highlights the focus areas for the two types of plan updates.

Table 8-3: Focal Areas for Bi-Annual Plan "Updates" vs. Plan "Revisions" (Every Four Years)

Plan Updates (every 2 years)	Plan Revisions (every 4 years)
Update benefit-cost analysis to reflect lessons learned through implementation	Reassess vision, goals and objectives
Update project phasing based on implementation experience	Reassess/re-prioritize ITS strategies
Update and expand system architecture and standards	Reassess project recommendations and phasing
Incorporate stakeholder input informally	Reassess organizational structure and programming process
	Incorporate stakeholder input through structured process

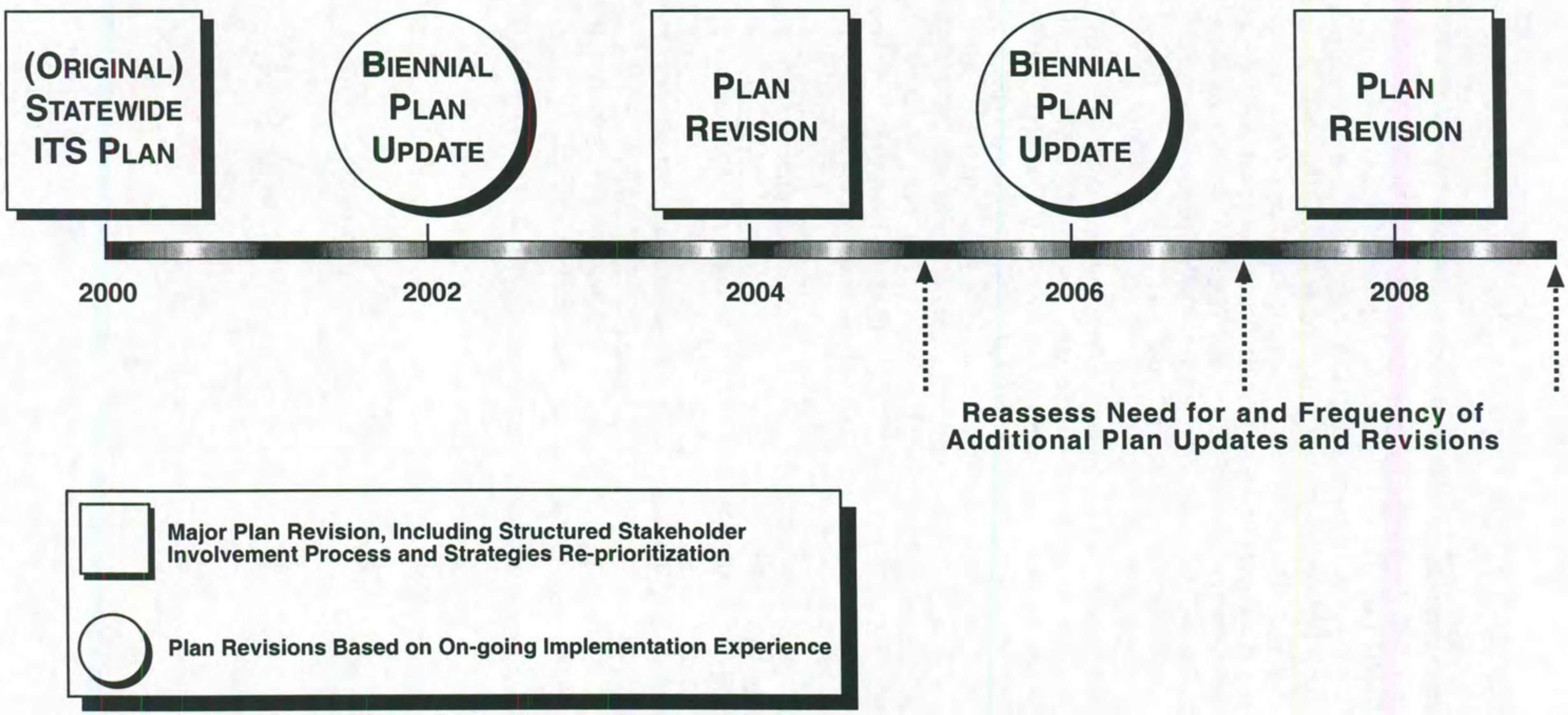


Figure 8-3
Plan Update and Revision Schedule

As with the Iowa DOT ITS organizational structure, in the long-term, "mainstreaming" or decentralization of ITS responsibilities may at some point make a separate ITS plan unnecessary, or may reduce the frequency of plan updates. The need for continued, frequent plan updates and revisions will depend on how quickly and successfully ITS becomes integral to the broader, traditional transportation process. As a result, the issue should be considered after the first two updates/revisions, i.e., during preparations for the 2006 plan update.

In the early stages of the ITS program, frequent plan updates are required for several reasons:

1. The ITS environment is changing quickly, more quickly than other more traditional areas of DOT involvement, such as road building. New technologies, applications and institutional arrangements, including public and private sector ITS implementation and operation roles and responsibilities, are emerging at a rapid pace. The current plan represents a snapshot that captures current conditions and our best forecast of the foreseeable future. As conditions change, the plan must be reassessed.

2. Specific transportation needs and priorities change. Although it is likely that major objectives such as "improving safety" will not change, the need for and interest level in specific ITS applications will.

3. Many of the recommended ITS projects and activities represent relatively new endeavors for the DOT and other implementing agencies. As a result, many important "lessons learned" will emerge during the first several years of ITS implementation. Also, these lessons are rapidly emerging from ITS deployments around the United States and world. The plan needs to synthesize those lessons and adjust appropriately.

4. In the programming process (see the next section), a large amount of significance is placed on whether or not a proposed project is included in the statewide plan. Therefore, it's important that project proponents be provided an opportunity to get their project included in the plan at regular intervals.

The Three-step Annual ITS Project Programming Process

The ITS project programming process will, on an annual basis, select individual projects for funding. The preparation of the annual ITS work program will be administered by the Statewide ITS Coordinator, with participation by the ITS Deployment Committee. The process begins with determination of the available dedicated ITS funds for the year in question. The remainder of the programming process consists of three basic steps:

1. Identification of candidate projects for funding.

2. Apportionment of the funding available for the current year into the six statewide ITS program areas (see Section 6.0.)

3. Selection of individual projects for funding.

Each of these three basic steps is described below. The overall annual programming process is summarized graphically in Figure 8-4, and the steps are summarized in a tabular fashion in Table 8-4.

Step 1: Identification of Candidate Projects for Funding

Potential ITS projects include both those identified in the statewide ITS plan as well as those that are not included in the plan, but for which a project proponent or sponsor exists. For any given funding year, there are three types of projects from the statewide plan: those that are continuing (in a planning, design or construction phase) from a previous year, those identified in the plan for implementation in the year in question, and those that are identified in the plan for implementation in a future year. As shown in Figure 8-4, projects that are continuing a multi-year implementation (not operation or maintenance) process begun in a previous year, including program-level activities such as ITS marketing that have indefinite time frames, are automatically funded at planned levels. The only exceptions would be in cases where project milestones or other criteria for continued funding have not been met, project sponsorship has disappeared or other similar concerns have materialized.

From among the potential ITS projects, candidates for funding in a given year will be identified through a "request for project funding requests" process. Project sponsors from within the Iowa DOT, and representing local government organizations, will be invited to submit project funding requests. To be considered viable, a project-funding request must include the following, at a minimum:

- Description of the project
- Identification of the problem to be solved through implementation
- Identification of the participants and their general roles and responsibilities
- Estimated project cost and requested funding amount
- Operations and maintenance plan
- Proposed approach to project evaluation
- Commitment to meet local funding match requirement (20% minimum)

The project funding requests that satisfy these requirements will be carried forward into the second stage of the programming process.

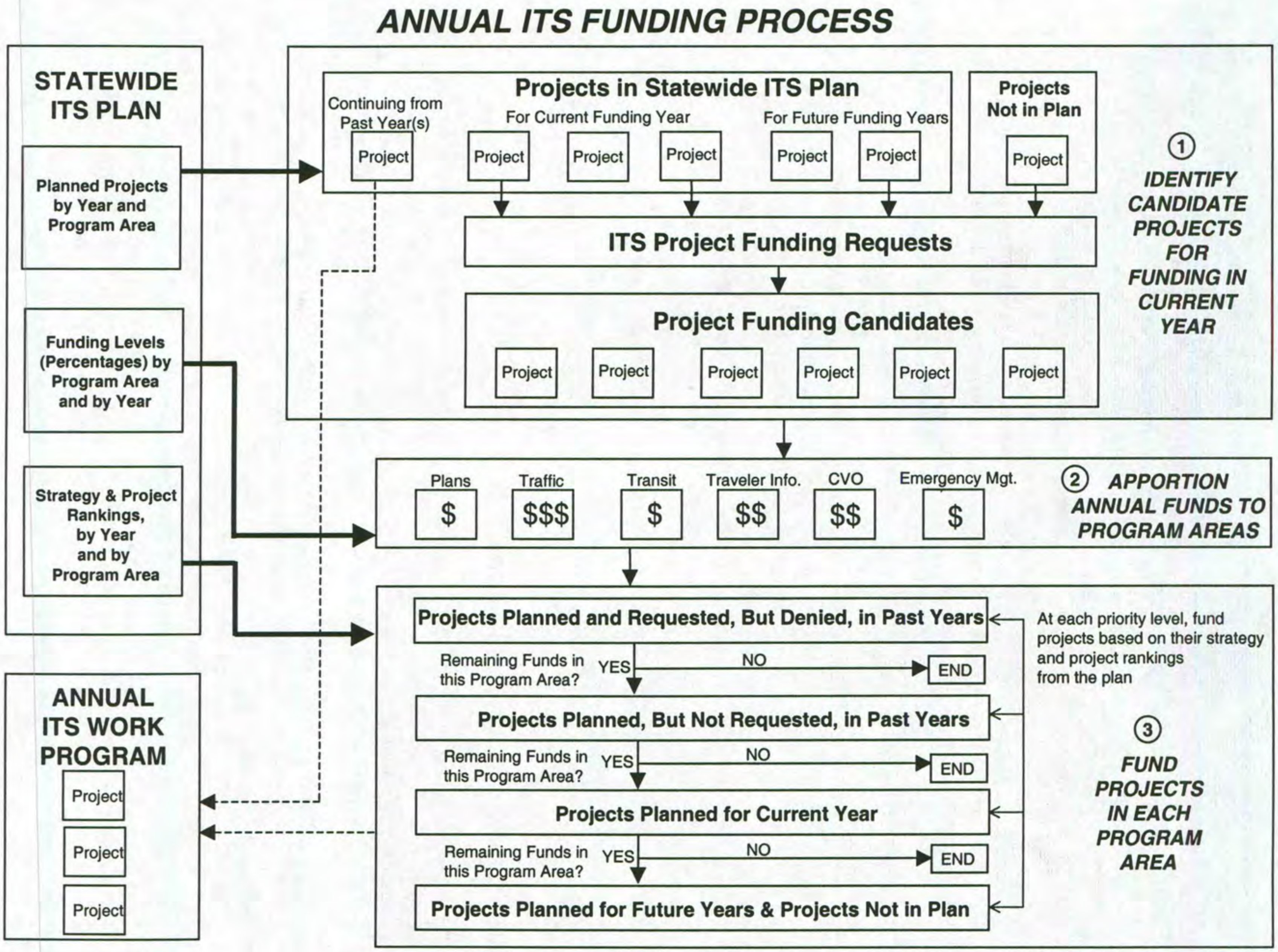


FIGURE 8-4
THREE-STEP ANNUAL ITS PROGRAMMING PROCESS

Table 8-4: Summary of Three-Step Annual ITS Projects Programming Process

Step	Procedure
1. Identification of Candidate Projects for Funding	a. Invite project sponsors to submit project funding requests
	b. Fund the continuation of multi-year planning / implementation efforts initiated in previous years and shown in the plan to continue.
	c. Carry forward those projects with viable funding requests.
2. Apportionment of Funding into ITS Program Areas	a. Divide available annual funding into the six program areas, following the appropriate annual investment guideline percentages (see Table 8.5).
3. Selection of Projects for Funding	a. Within each program area, fund projects that are planned for a previous year, that were requested during that previous year, but that were not funded. Within this group, fund projects based on the rank order of the strategies to which they belong.
	b. If funds remain, within each program area, fund projects that are planned for a previous year but were not requested. Within this group, fund projects based on the rank order of the strategies to which they belong.
	c. If funds remain, within each program area, fund projects planned for the current year. Within this group, fund projects based on the rank order of the strategies to which they belong.
	d. If funds remain, within each program area, fund projects planned for future years, or projects that are not in the plan.

<u>Step 2: Apportionment of Funding Into ITS Program Areas</u>

Leaving the project funding requests aside, the next step divides the funding available for the year in question into the six Program Areas identified in the statewide ITS plan: planning, marketing and administration; travel and traffic management; CVO traveler information; public transportation management; emergency management; and commercial vehicle operations.

As noted in Section 4.4, the relative priority and corresponding resource allocation to the various program areas will vary over the course of the ten-year planning period. During the early years, greater emphasis will be placed on those program areas that are most responsive to the priority problems, and on "enabling" activities that support future project success, such as preparation of plans and ITS marketing. Over time, after projects targeting the most urgent problems are underway, the level of investment in program areas responsive to mid-priority problems will increase. Also, the relative expenditures on plans, marketing and similar support functions will decrease as the focus of the program shifts more toward implementation and as support for ITS increases.

Table 8-5 identifies the annual investment guidelines, in round percentages, that will be used to apportion available annual ITS funds into the six program areas.

Table 8-5: Annual ITS Program Resource Allocation Guidelines

Program Area	**Approximate Percentage of Total Annual Dedicated ITS Resources by Year**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Planning, Marketing, Administration	60	40	40	20	20	20	20	20	15	15
Traffic Management	20	20	20	20	20	20	20	20	20	20
Traveler Information	20	20	20	20	20	20	20	20	20	20
Commercial Vehicles				10	10	10	10	10	15	15
Transit		10	10	20	20	20	20	20	20	20
Emergency Management		10	10	10	10	10	10	10	10	10
Total	100	100	100	100	100	100	100	100	100	100

Step 3: Selection of Projects for Funding

After the candidate projects have been identified, and the available funding assigned to the various program areas, individual projects will be identified for funding in each program area. The selection of projects will be based on two fundamental criteria:

1. Timing - the year that the project is identified for implementation (in the statewide ITS plan)

2. Ranking – ranking of the project versus other projects within the program area.

The applications of these two criteria are described below.

Project Timing Criteria

Figure 8-4 illustrates the four priority levels that correspond to the timing of the project in the plan. As indicated in Figure 8-4, within each program area, projects will be selected for funding that were identified in the statewide plan for funding in a previous year, and which were requested for funding by project sponsors in that previous year. The rationale is that these projects are "behind schedule" given their identified relative priority. Next, if funds remain, projects will be funded that were planned in a previous year but were not requested in the previous year, that is, that did not have a project sponsor. Next, if funds remain, projects will be funded that are planned for implementation (in the statewide plan) in the current year. Finally, if funds still remain within the given program area, requested projects shown in the statewide plan for implementation in future years, as well as requested projects that are not included in the plan at all, will be funded. Alternatively, funds could be moved to another program area. This determination should be made based on, among other factors, achievement of balance between urban and rural areas and between planning and implementation.

Project Ranking Criteria

At each of the four steps described above under the timing criteria, the selection of individual projects will be governed by their rank within the program area. For example, when selecting projects at the first priority level—those that were planned and requested in a previous year but were denied—individual projects satisfying this criteria will be *funded according to the ranking of the strategy group to which they belong, and their ranking relative to other projects within that strategy.*

In Section 6.1, it was explained that the first step in the process to develop projects was to identify and rank ***ITS strategies***, which are non-location specific applications of individual ITS technologies or techniques, e.g., regional traffic signal coordination. Each strategy was scored on a number of criteria, yielding a single overall numeric score. Later, individual projects were developed within each strategy, typically denoting the particular location where the strategy would be pursued. In selecting projects for funding in a given year, in a given program area, all projects from the highest ranking strategy should be funded before moving on to projects in the next highest-ranking strategy.

If funding runs out midway down the list of specific projects within a given strategy, projects should be funded in the order they are listed within that strategy. As explained in Section 6.1, the order of projects within a strategy group reflects their relative priority. In cases where there are no clear distinctions between two competing projects, a set of tiebreaker criteria should be applied. Potential tiebreaker criteria are shown in Table 8.6. These criteria can also be applied to break ties between two strategy categories with similar ranks (e.g., with 5%), in cases where funding "runs out" between two similar rated strategies.

Table 8-6: Potential Projects/Strategy Tie-Breaking Criteria

Local match percentage (the higher the better)
Project inclusion in a local/regional transportation plan
Private sector participation (and magnitude of participation)
Economic development impact
Urban/rural balance considerations

These are the basic provisions of the three-step annual ITS programming process. The next section identifies additional factors and guidelines that will be considered in conjunction with the basic three-step programming process.

Additional Project Programming Considerations

As explained in Section 4.0, ITS resources are intended to support a balanced program of activities, spanning research, implementation and planning/support, and balancing investments across the state and between urban and rural areas. In any given program year, it is unlikely that there will be sufficient resources to implement the full range of projects identified in the plan, and therefore the basic three-step programming process will produce a mix of projects that do not adequately reflect the desired balance. In light of these concerns, two additional criteria are identified that if needed can be applied, as an overlay, in the three-step programming process to promote balance in resource allocation in a given year. These criteria consist of a per project funding limit, and a target proportion of DOT-sponsored to non-DOT-sponsored projects.

Maximum Annual Per Project Funding Limit

It is recognized that the available dedicated ITS funds will be far from sufficient to fully fund all desired, and even all planned projects. Rather, it is expected that in many cases the dedicated funds will help jump-start projects and/or leverage other resources. In keeping with this philosophy, in cases where the mix of projects produced through the three-step programming process is deemed too narrow—a subjective assessment to be made by the ITS Deployment Committee in conjunction with the Statewide ITS Coordinator—a maximum per project annual funding limit of $500,000 may be invoked.

Proportion of Funding to DOT-Sponsored Vs. Locally-Sponsored Projects

As with the maximum per project funding limit, in cases where the mix of projects identified through the three-step programming process is deemed to narrow, in terms of the proportion of resources devoted to DOT versus local government ITS projects, the mix of projects may be adjusted. These adjustments will be made based on the guideline that, in any given year, no more than 70% of resources should be devoted to either DOT or local ITS projects.

Project Initiation

After a project has been approved for funding, project managers should first discuss any coordinated database and data linear referencing system issues with Bill Schuman. Also, project managers should plan to utilize the Iowa DOT's GEOMEDIA WEBMAP software for their mapping. Project managers should also discuss their data needs with Peggi Knight (representing Pat Cain from Transportation Data), to avoid redundancy in data collection efforts.

Appendices

The following pages include the various appendices for this plan. The order and contents of these sections are listed below.

Appendix A

Subsystem and Equipment Package Descriptions

Descriptions of the 15 subsystems and the equipment packages below, are taken directly from the ITS National Architecture CD Rom version 2.0.

1. **Commercial Vehicle Administration (SS)**
   The Commercial Vehicle Administration Subsystem will operate at one or more fixed locations within a region. This subsystem performs administrative functions supporting credentials, tax, and safety regulations. It issues credentials, collects fees and taxes, and supports enforcement of credential requirements. This subsystem communicates with the Fleet Management Subsystems associated with the motor carriers to process credentials applications and collect fuel taxes, weight/distance taxes, and other taxes and fees associated with commercial vehicle operations. The subsystem also receives applications for, and issues special Oversize/Overweight and HAZMAT permits in coordination with other cognizant authorities. The subsystem coordinates with other Commercial Vehicle Administration Subsystems (in other states/regions) to support nationwide access to credentials and safety information for administration and enforcement functions. This subsystem supports communications with Commercial Vehicle Check Subsystems operating at the roadside to enable credential checking and safety information collection. The collected safety information is processed, stored, and made available to qualified stakeholders to identify carriers and drivers that operate unsafely.

   - **CV Information Exchange (EP)**
     This equipment package supports the exchange of safety and credentials data among jurisdiction. The package also supports the exchange of safety and credentials data between agencies (for example, an administrative center and the roadside check facilities) within a single jurisdiction. Data are collected from multiple authoritative sources and packaged into snapshots (top-level summary and critical status information) and profiles (detailed and historical data).

   - **CV Safety Administration**
     This Equipment package augments the Credentials and Taxes Administration Equipment package with safety data. This package ensures that safety criteria are available for automated roadside safety checks. Supports the collection and review of carrier safety data and determines the carrier safety rating based on criteria supplied by Government Administration.

   - **Credentials and Taxes Administration (EP)**
     This Equipment package provides administrative capabilities for commercial vehicle operations including database management and administrator-to-roadside and administrator-to-administrator interfaces. For example, this Equipment package would manage the electronic credentials database for a state, perform reconciliation of mileage and fuel taxes (possibly post trip), and interface with roadsides performing credential checks. This equipment package communicates with similar packages in other CVAS locations to exchange credentials database information. Example locations would be state agency or regional offices that are involved with commercial vehicle operations.

2. **Commercial Vehicle Check (SS)**
   The Commercial Vehicle Check Subsystem supports automated vehicle identification at mainline speeds for credential checking, roadside safety inspections, and weigh-in-motion using two-way data exchange. These capabilities include providing warnings to the commercial vehicle drivers, their fleet managers, and proper authorities of any safety problems that have been identified, accessing and examining historical safety data, and automatically deciding whether to allow the vehicle to pass or require it to stop with operator manual override. The Commercial Vehicle Check Subsystem also provides supplemental inspection services to current capabilities by supporting expedited brake inspections, the use of operator hand-held devices, on-board safety database access, and the enrollment of vehicles and carriers in the electronic clearance program.

   - **Citation and Accident Electronic Recording (EP)**
     The equipment package documents violations and forwards the information to the Commercial vehicle if available and to the CVAS for processing as part of the normal credentials processing package.

   - **Roadside Electronic Screening (EP)**
     This Equipment package provides the Commercial Vehicle Check Subsystem the capabilities for two-way communication with approaching properly equipped commercial vehicles at mainline speeds, reading tags for automated vehicle identification and credential checking. There will be a capability to appropriately screen all vehicles, not just those that are equipped. This Equipment package shall be able to process the data from the commercial vehicles along with accessed database information to determine whether a pull-in message is needed or to generate random pull-in messages with provisions for facility operators and enforcement officials to have manual override capabilities. Support shall be provided to both interstate and intrastate carriers.

3. **Commercial Vehicle (SS)**
   This subsystem resides in a commercial vehicle and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient commercial vehicle operations. The Commercial Vehicle Subsystem provides two-way communications between the commercial vehicle drivers, their fleet managers, and roadside officials, and provides HAZMAT response teams with timely and accurate cargo contents information after a vehicle incident. This subsystem provides the capability to collect and process vehicle, cargo, and driver safety data and status and alert the driver whenever there is a potential safety problem. Basic identification and safety status data are supplied to inspection facilities at mainline speeds. In addition, the subsystem will automatically collect and record mileage, fuel usage, and border crossings.

- **On-board Cargo Monitoring (EP)**
  This Equipment package provides the Commercial Vehicle Subsystem the capability to monitor both interstate and intrastate cargo safety such that enforcement and HAZMAT response teams can be provided with timely and accurate information. This includes only the equipment on board the cargo container such as a communication device, possibly the addition of a cell-based radio, and equipment for the processing and storage of cargo material. This can also include optional sensors for temperature, pressure, load leveling, or acceleration depending upon the items monitored. It is already expected that the cargo location devices such as GPS equipment and an integration processor already exist. These items are presented as part of the On-board Trip Monitoring Equipment package.

- **On-board CV Electronic Data (EP)**
  This Equipment package provides the Commercial Vehicle Subsystem the capability for two-way data exchange between the vehicle and the roadside facility with the transmission of information such as status of driver, vehicle, and carrier IDs and cargo information. The driver, vehicle and carrier are identified via the tag so that actual weight from roadside mainline weigh-in-motion may be checked. This includes only the equipment on the commercial vehicle including a processor/tag for identification, especially a HAZMAT identification. The actual reading and processing required for the credential checking and weigh-in-motion will be performed by the roadside.

- **On-board CV Safety (EP)**
  This Equipment package provides the Commercial Vehicle Subsystem the capability to collect and process on board vehicle and driver safety information to monitor the safety status and supply this information to the roadside facilities both at mainline speeds and while stopped for inspections. The capability to alert the commercial vehicle driver whenever there is a critical safety problem or potential emergency shall also be provided. These capabilities include only the equipment on the commercial vehicle including the sensors and processors to monitor the vehicle and driver with the information stored on the vehicle. When the information is transmitted to the roadside facility or after the trip, it will utilize the communication devices already in place. The package will also support onboard driver safety log maintenance and checking.

4. **Emergency Management (SS)**

- **Emergency Response Management (EP)**
  This Equipment package develops and stores emergency response plans and manages overall coordinated response to emergencies. It tracks the availability of resources and assists in the appropriate allocation of these resources for a particular emergency response. This Equipment package provides coordination between multiple allied agencies before and during emergencies to implement emergency response plans and track progress through the incident. It provides vital communications linkages which provide real-time information to emergency response personnel in the field.

- **Emergency Mayday and E-911 I/F (EP)**
  This Equipment package receives Mayday messages, determines an appropriate response, and either uses internal resources or contacts a local agency to provide that response. The nature of the emergency is determined based on the information in the mayday message as well as other inputs. This package effectively serves as an interface between automated mobile mayday systems and the local public safety answering point for messages which require a public safety response.

5. **Emergency Vehicle (SS)**
   This subsystem resides in an emergency vehicle and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient emergency response. The Emergency Vehicle Subsystem includes two-way communications to support coordinated response to emergencies in accordance with an associated Emergency Management Subsystem. Emergency vehicles are equipped with automated vehicle location capability for monitoring by vehicle tracking and fleet management functions in the Emergency Management Subsystem. Using these capabilities, the appropriate emergency vehicle to respond to each emergency is determined. Route guidance capabilities within the vehicle enable safe and efficient routing to the emergency. In addition, the emergency vehicle may be equipped to support signal preemption through communications with the roadside subsystem.

   - **On-board EV Incident Management Communication (EP)**
     This Equipment package provides a direct interface between the emergency vehicle and incident management personnel.

6. **Fleet and Freight Management (SS)**
   The Fleet and Freight Management Subsystem provides the capability for commercial drivers and dispatchers to receive real-time routing information and access databases containing vehicle and cargo locations as well as carrier, vehicle, cargo, and driver information. In addition, the capability to purchase credentials electronically shall be provided, with automated and efficient connections to financial institutions and regulatory agencies, along with post-trip automated mileage and fuel usage reporting. The Fleet Management Subsystem also provides the capability for Fleet Managers to monitor the safety of their commercial vehicle drivers and fleet. The subsystem also supports application for Hazmat credentials and makes information about Hazmat cargo available to agencies as required.

   - **Freight Administration and Management (EP)**
     This equipment package provides the communication necessary to track cargo from source to destination via links to intermodal freight shippers and depots. There are also communication links to cargo routing services.

- **Fleet Credentials and Taxes Management and Reporting (EP)**
  This Equipment package provides the Fleet and Freight Management Subsystem the capabilities to purchase credentials and file trip reports electronically by the fleet managers, to perform automated enrollment at the roadside facilities, and electronically manage the credentials checking by the roadside commercial vehicle inspectors. The electronic purchase shall be performed in accordance with developing standards such that a single integrated system for electronic payments might develop ensuring that deployment across multiple agency political boundaries is performed without degradation. Inherent to credential management shall be the management of the vehicles, with a prerequisite of the vehicle tracking software from the Fleet Administration Equipment package.

- **Fleet HAZMAT Management (EP)**
  This Equipment package provides the Fleet and Freight Management Subsystem the capabilities to enhance the Fleet Administration Equipment package functions by adding HAZMAT tracking. The additional requirements to perform this function include enhanced processing and enhanced fleet management software. In order to effectively track HAZMAT cargo, communication interfaces to Information Service Providers, and Emergency Management Subsystems shall be provided, including additional communication software.

7. **Information Service Provider (SS)**
   This subsystem collects, processes, stores, and disseminates transportation information to system operators and the traveling public. The subsystem can play several different roles in an integrated ITS. In one role, the ISP provides a general data warehousing function, collecting information from transportation system operators and redistributing this information to other system operators in the region and other ISPs. In this information redistribution role, the ISP provides a bridge between the various transportation systems that produce the information and the other ISPs and their subscribers that use the information. The second role of an ISP is focused on delivery of traveler information to subscribers and the public at large. Information provided includes basic advisories, real time traffic condition and transit schedule information, yellow pages information, ridematching information, and parking information. The subsystem also provides the capability to provide specific directions to travelers by receiving origin and destination requests from travelers, generating route plans, and returning the calculated plans to the users. In addition to general route planning for travelers, the ISP also supports specialized route planning for vehicle fleets. In this third role, the ISP function may be dedicated to, or even embedded within, the dispatch system. Reservation services are also provided in advanced implementations. The information is provided to the traveler through the Personal Information Access Subsystem, Remote Traveler Support Subsystem, and various Vehicle Subsystems through available communications links. Both basic one-way (broadcast) and personalized two-way information provision is supported. The subsystem provides the capability for an informational infrastructure to connect providers and consumers, and gather that market information needed to assist in the planning of service improvements and in maintenance of operations.

- **Basic Information Broadcast (EP)**
  This Equipment package provides the capabilities to collect, process, store, bill, and disseminate traveler information including traveler, transit, ridematching, traffic, and parking information. The traveler information shall include maintaining a database of local area services available to travelers with up-to-the-minute information and providing an interactive connectivity between, sponsors, and providers of services. The transit information shall include the latest available information on transit routes and schedules, transit transfer options, transit fares, and real-time schedule adherence. The traffic information shall include latest available information on traffic and highway conditions, and current situation information in real-time including incidents, road construction, recommended routes, current speeds on specific routes, current parking conditions in key areas, schedules for any current or soon to start events, and current weather situations. This Equipment package shall also provide users with real-time travel related information while they are traveling, and disseminate to assist the travelers in making decisions about transfers and modification of trips. These capabilities shall be provided using equipment such as a fixed facility with a communications system such as a data subcarrier multiplexing device.

- **Interactive Infrastructure Information (EP)**
  This Equipment package shall have as prerequisite the capabilities of the Basic Information Broadcast Equipment package. This Equipment package augments the Basic Information Broadcast Equipment package by providing the capabilities for interactive traveler information.

- **Infrastructure Provided Route Selection (EP)**
  This Equipment package shall have as prerequisite the capabilities of the Interactive Infrastructure Information Equipment package. In addition, this Equipment package provides the capability to provide specific directions to travelers by receiving origin and destination requests from travelers, generating route plans, returning the calculated plans to the users, and then potentially logging the route plans with Traffic Management Subsystem. This additional capability shall be provided using equipment such as a workstation type processor and software for route planning and traffic measurements along with additional communications capabilities including dialup lines, PCS telephones, and wireless data transceivers.

- **EM Route Plan Information Dissemination (EP)**
  This Equipment package provides route plan information for the Emergency Management Subsystem. Routes are computed based on the request for route plan and current traffic conditions. Special algorithms are employed which take into account the special needs and capabilities (e.g., traveling along normally non-navigable links) of dispatched emergency vehicles. Special security, logging, and performance requirements may also be associated with the operation of this equipment package.

8. Personal Information Access (SS)

This subsystem provides the capability for travelers to receive formatted traffic advisories from their homes, place of work, major trip generation sites, personal portable devices, and over multiple types of electronic media. These capabilities shall also provide basic routing information and allow users to select those transportation modes that allow them to avoid congestion, or more advanced capabilities to allow users to specify those transportation parameters that are unique to their individual needs and receive travel information. This subsystem shall provide capabilities to receive route planning from the infrastructure at fixed locations such as in their homes, their place of work, and at mobile locations such as from personal portable devices and in the vehicle or perform the route planning process at a mobile information access location. This subsystem shall also provide the capability to initiate a distress signal and cancel a prior issued manual request for help.

- **Personal Basic Information Reception (EP)**

  This Equipment package shall provide the capability for travelers to interface with the ISP Subsystem Basic Information Broadcast Equipment package and receive formatted traffic advisories including accurate traveling information concerning available travel options and their availability, and congestion information from their Personal Information Access Subsystem to include their homes, place of work, major trip generation sites, personal portable devices, and over multiple types of electronic media such as facsimile machines, portable AM/FM radios, and a pager processor.

- **Personal Interactive Information Reception (EP)**

  This Equipment package shall provide the capability for travelers to interface with the ISP Subsystem Infrastructure Equipment packages including the Interactive Infrastructure Information Equipment package, and the Infrastructure Provided Route Selection, Yellow Pages and Reservation, and Dynamic Ridesharing Equipment packages. These capabilities shall be provided using the Personal Information Access Subsystem equipment such as cellular telephone, interactive TV, Personal Computer, and pager with alpha display using communication medium and equipment such as two-way radio, CATV, and wireless data transceivers.

- **Personal Provider-Based Route Guidance**

  This Equipment package coordinates with an ISP-Based route planning service to select a suggested route plan that is tailored to the traveler's preferences. Coordination may continue during the trip so that the route plan can be modified to account for new information. Many equipment configurations are possible including systems that provide a basic route plan to the traveler as well as more sophisticated systems that can provide transition by transition guidance to the traveler along a multi-modal route plan.

- **Personal Mayday I/F**

  This Equipment package shall provide the capability to initiate a distress signal and cancel a prior issued manual request for help using the Personal Information Access Subsystem. This capability shall be provided using equipment such as a processor to automatically dial the Emergency Management Subsystem and provide location.

9. **Planning (SS)**
The Planning Subsystem provides a data archiving and analysis function for the National ITS Architecture. It collects historical, current, and predicted transportation information from the other center subsystems. The collected information is used in analysis and evaluation of current transportation system performance and in planning for future transportation improvements. The broad data interfaces supported by this subsystem make transportation data available to researchers and planners to facilitate the deployment and operation of ITS services.

- Data Collection and ITS Planning (EP)
  This service collects data from all center functions in support of ITS planning activities.

10. **Remote Traveler Support (SS)**
This subsystem provides access to traveler information at transit stations, transit stops, other fixed sites along travel routes, and at major trip generation locations such as special event centers, hotels, office complexes, amusement parks, and theatres. Traveler information access points include kiosks and informational displays supporting varied levels of interaction and information access. At transit stops, simple displays providing schedule information and imminent arrival signals can be provided. This basic information may be extended to include multi-modal information including traffic conditions and transit schedules along with yellow pages information to support mode and route selection at major trip generation sites. Personalized route planning and route guidance information can also be provided based on criteria supplied by the traveler. In addition to traveler information provision, this subsystem also supports public safety monitoring using CCTV cameras or other surveillance equipment and emergency notification within these public areas. Fare card maintenance, and other features that enhance traveler convenience may also be provided at the discretion of the deploying agency.

- **Remote Basic Information Reception (EP)**
  This Equipment package shall provide the capability for travelers to interface with the ISP Subsystem Basic Information Broadcast Equipment package and receive formatted traffic advisories including accurate traveling information concerning available travel options and their availability, and congestion information at Remote Traveler Support.

- **Remote Interactive Information Reception (EP)**
  This Equipment package shall provide the capability for travelers to interface with the ISP Subsystem Infrastructure Equipment packages including the Interactive Infrastructure Information Equipment package, the Infrastructure Provided Route Selection, Yellow Pages and Reservation, and Dynamic Ridesharing Equipment packages. These capabilities shall be provided using the Remote Traveler Support Subsystem equipment such as interactive TV and kiosk using communication medium and equipment such as CATV and wireline and wireless data transceivers.

- **Remote Transit Fare Management (EP)**
  This Equipment package provides the capability for the traveler to use a common fare medium for all applicable surface transportation services, to pay without stopping, have payment media automatically identified as void and/or invalid and eligibility verified. This may be implemented as a payment instrument reader at a kiosk. In addition, capability to provide expansion into other uses for payment medium such as retail and telephone and for off-line billing for fares paid by agencies shall be supported.

- **Remote Mayday I/F (EP)**
  This Equipment package provides the capability to report an emergency and summons assistance. The equipment includes a traveler interface that facilitates generation of a distress signal under duress and wireline communications that carries this distress signal and allows follow-up verification and determination of the nature of the emergency and the required response. This equipment package notifies either Emergency Management or Transit Management depending on the implementation.

11. Roadway (SS)

This subsystem includes the equipment distributed on and along the roadway which monitors and controls traffic. Equipment includes highway advisory radios, variable message signs, cellular call boxes, CCTV cameras and video image processing systems for incident detection and verification, vehicle detectors, traffic signals, grade crossing warning systems, and freeway ramp metering systems. This subsystem also provides the capability for emissions and environmental condition monitoring including weather sensors, pavement icing sensors, fog etc. HOV lane management and reversible lane management functions are also available. In advanced implementations, this subsystem supports automated vehicle safety systems by safely controlling access to and egress from an Automated Highway System through monitoring of, and communications with, AHS vehicles. Intersection collision avoidance functions are provided by determining the probability of a collision in the intersection and sending appropriate warnings and/or control actions to the approaching vehicles.

- **Roadway Basic Surveillance (EP)**
  This Equipment package provides the capabilities to monitor traffic flow in major intersections and on main highways for urban areas and to monitor road conditions using fixed equipment such as loop detectors and wireline communication.

- **Roadway Signal Control (EP)**
  This Equipment package provides the capabilities to control traffic signals at major intersections and on main highways for urban areas. This Equipment package is generally constrained to a single jurisdiction.

- **Roadway Freeway Control (EP)**
  Ramp meters, CMS and other freeway controllers that will control traffic on freeways.

- **Roadway Incident Detection (EP)**
  This Equipment package provides incident detection capability to reside at the roadside. For example, advanced CCTV's with built-in incident detection algorithms would allow the actual detection function to be roadside rather than transmitting images to a center for visual or automated detection.

- **Roadway Traffic Information Dissemination (EP)**
  This Equipment package provides the roadside elements of traffic information dissemination including DMS and HAR.

- **Roadside Signal Priority (EP)**
  This Equipment package shall provide the capability to receive vehicle signal priority requests and control roadside signals accordingly.

- **Roadway In-Vehicle Signing (EP)**
  This Equipment package provides the capability to detect local traffic flow conditions, corroborate them with a traffic management subsystem, and distribute them to the user over a short-range interface such as a radio beacon.

12. Traffic Management (SS)

The Traffic Management Subsystem operates within a traffic management center or other fixed location. This subsystem communicates with the Roadway Subsystem to monitor and manage traffic flow. Incidents are detected and verified and incident information is provided to the Emergency Management Subsystem, travelers (through Roadway Subsystem Highway Advisory Radio and Dynamic Message Signs), and to third party providers. The subsystem supports HOV lane management and coordination, road pricing, and other demand management policies that can alleviate congestion and influence mode selection. The subsystem monitors and manages maintenance work and disseminates maintenance work schedules and road closures. The subsystem also manages reversible lane facilities, and processes probe vehicle information. The subsystem communicates with other Traffic Management Subsystems to coordinate traffic information and control strategies in neighboring jurisdictions. It also coordinates with rail operations to support safer and more efficient highway traffic management at highway-rail intersections. Finally, the Traffic Management Subsystem provides the capabilities to exercise control over those devices utilized for AHS traffic and vehicle control.

- **Collect Traffic Surveillance (EP)**
  This Equipment package collects, stores, and provides electronic access to the traffic surveillance data.

- **TMC Basic Signal Control (EP)**
  This Equipment package provides the capability for traffic managers to monitor and manage the traffic flow at signalized intersections. This capability includes analyzing and reducing the collected data from traffic surveillance equipment and developing and implementing control plans for signalized intersections. Control plans may be developed and implemented that coordinate signals at many intersections under the domain of a single traffic management subsystem. In advanced implementations, this package collects route planning information and integrates and uses this information in predicting future traffic conditions and optimizing the traffic control strategy for these conditions. These capabilities are achieved through real-time communication of logged routes from an Information Service Provider. The planned control strategies can be passed back to the Information Service Provider so that the intended strategies can be reflected in future route planning.

- **Traffic Maintenance (EP)**
  This Equipment package provides monitoring and remote diagnostics of field equipment to detect field equipment failures, issues problem reports, and tracks the repair or replacement of the failed equipment.

- **TMC Freeway Management (EP)**
  Control system for efficient freeway management including integration of surveillance information with freeway road geometry, vehicle control such as ramp metering, CMS, HAR. Interface to coordinated traffic subsystems for information dissemination to the public.

- **TMC Incident Detection (EP)**
  This Equipment package provides the capability to traffic managers to detect and verify incident. This capability includes analyzing and reducing the collected data from traffic surveillance equipment, including predicted incidents and hazardous conditions.

- **TMC Traffic Information Dissemination (EP)**
  This Equipment package provides the capability to disseminate incident related information to travelers, potential travelers, and private information service providers. These capabilities shall be provided using a workstation type processor within a facility connected to traveler information providers by utilizing existing wireline links.

- **TMC Regional Traffic Control (EP)**
  This Equipment package provides capabilities in addition to those provided by the TMC Basic Signal Control Equipment package for analyzing, controlling, and optimizing area-wide traffic flow. These capabilities provide for wide area optimization integrating control of a network signal system with control of freeway, considering current demand as well as expected demand with a goal of providing the capability for real-time traffic adaptive control while balancing inter-jurisdictional control issues to achieve regional solutions. These capabilities are best provided using a Traffic Management Center (TMC) to monitor and manage freeway ramp meters and intersection traffic signals and software to process traffic information and implement traffic management measures (e.g., ramp metering, signalization, and traffic coordination between both local and regional jurisdiction). The TMC shall be able to communicate with other TMCs in order to receive and transmit traffic information on other jurisdictions within the region.

- **TMC Incident Dispatch Coordination/Communication (EP)**
  This Equipment package provides the capability for an incident response formulation function minimizing the incident potential, incident impacts, and/or resources required for incident management including proposing and facilitating the dispatch of emergency response and service vehicles as well as coordinating response with all appropriate cooperating agencies.

- **TMC Road Weather Monitoring (EP)**
  This equipment package assimilates current and forecast road conditions and weather information using a combination of weather service information and an array of environmental sensors deployed on and about the roadway. The collected road weather information is monitored and analyzed to detect and forecast environmental hazards such as icy road conditions and dense fog. This information can be used to more effectively deploy road maintenance resources, issue general traveler advisories, and support location specific warnings to drivers.

- **TMC Input to In-Vehicle Signing (EP)**
  This Equipment package shall provide the capability to allow traffic managers input to operation and maintenance of the roadway vehicle signing devices.

- **TMC Multi-Modal Coordination (EP)**
  This Equipment package provides the capability of signal control at the traffic management subsystem to provide signal priority for transit vehicles.

13. **Transit Management (SS)**

The transit management subsystem manages transit vehicle fleets and coordinates with other modes and transportation services. It provides operations, maintenance, customer information, planning and management functions for the transit property. It spans distinct central dispatch and garage management systems and supports the spectrum of fixed route, flexible route, and paratransit services. The subsystem's interfaces allow for communication between transit departments and with other operating entities such as emergency response services and traffic management systems. This subsystem receives special event and real-time incident data from the traffic management subsystem. It provides current transit operations data to other center subsystems. The Transit Management Subsystem collects and stores accurate ridership levels and implements corresponding fare structures. It collects operational and maintenance data from transit vehicles, manages vehicle service histories, and assigns drivers and maintenance personnel to vehicles and routes. The Transit Management Subsystem also provides the capability for automated planning and scheduling of public transit operations. It furnishes travelers with real-time travel information, continuously updated schedules, schedule adherence information, transfer options, and transit routes and fares. In addition, the monitoring of key transit locations with both video and audio systems is provided with automatic alerting of operators and police of potential incidents including support for traveler activated alarms.

- **Transit Center Tracking and Dispatch (EP)**

  This Equipment package provides the capabilities for monitoring transit vehicle locations and determining vehicle schedule adherence. The Equipment package shall also furnish users with real-time travel related information, continuously updated with real-time information from each transit system within the local area of jurisdiction, inclusive of all transportation modes, from all providers of transportation services, and provide users with the latest available information on transit routes, schedules, transfer options, fares, real-time schedule adherence, current incidents conditions, weather conditions, and special events. This Equipment package also supports the capability for two-way voice communication between the transit vehicle driver and a facility, two-way data communication between the transit vehicles and a facility.

- **Transit Center Fixed Route Operations (EP)**

  This Equipment package enhances the planning and scheduling associated with fixed route transit services. The package allows fixed-route services to develop, print and disseminate schedules and automatically updates customer service operator systems with the most current schedule information. Current vehicle schedule adherence and optimum scenarios for schedule adjustment shall also be provided.

- **Transit Center Paratransit Operations (EP)**
  This Equipment package provides the capability to automate the planning and scheduling, allowing improvements in paratransit routes and services to develop, printing and disseminating schedules, and automatically updating customer service operator systems with the most current schedule. In addition, this Equipment package provides the capability to assign drivers to routes in a fair manner while minimizing labor and overtime services, including driver preferences and qualifications, and automatically tracking and validating the number of work hours performed by each individual driver. These capabilities shall be provided through the utilization of dispatch and fleet management software running on a workstation type processor.

- **Transit Center Multi-modal Coordination (EP)**
  This Equipment package provides the transit management subsystem the capability to determine the need for transit priority on routes and at certain intersections and request transit vehicle priority at these locations. It also supports schedule coordination between transit properties and coordinates with other surface and air transportation modes.

14. Transit Vehicle (SS)

This subsystem resides in a transit vehicle and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient movement of passengers. The Transit Vehicle Subsystem collects accurate ridership levels and supports electronic fare collection. An optional traffic signal prioritization function communicates with the roadside subsystem to improve on-schedule performance. Automated vehicle location functions enhance the information available to the Transit Management Subsystem enabling more efficient operations. On-board sensors support transit vehicle maintenance. The Transit Vehicle Subsystem also furnishes travelers with real-time travel information, continuously updated schedules, transfer options, routes, and fares.

- **On-board Fixed Route Schedule Management (EP)**
  This Equipment package provides the capabilities for automated planning and scheduling, by collecting data for schedule generation. Capability shall also be provided to automatically determine optimum scenarios for schedule adjustment. This Equipment package also supports the capability for two-way voice communication between the transit vehicle driver and a facility, two-way data communication between the transit vehicles and a facility, on-board safety sensor data to be transmitted from the transit vehicles to a facility, and data transmission from individual facilities to a central facility for processing/analysis if desired.

- **On-board Maintenance (EP)**
  This Equipment package provides the capability to use transit vehicle mileage data to automatically generate preventative maintenance schedules for each specific bus by utilizing vehicle tracking data and storing with a trip computer. It also provides the capability for real-time condition monitoring on board the vehicle, and transmission of this information via two-way communication to the management center.

- **On-board Paratransit Operations (EP)**
  This equipment package forwards paratransit dispatch requests to the driver and forwards acknowledgements to the center. It coordinates with, and assists the driver in managing multi stop runs associated with demand responsive, flexibly routed transit services.

- **On-board Transit Signal Priority (EP)**
  This Equipment package provides the capability for transit vehicles to request signal priority through short range communication directly with traffic control equipment at the roadside.

15. Vehicle (SS)

This subsystem resides in an automobile and provides the sensory, processing, storage, and communications functions necessary to support efficient, safe, and convenient travel by personal automobile. Information services provide the driver with current travel conditions and the availability of services along the route and at the destination. Both one-way and two-way communications options support a spectrum of information services from low-cost broadcast services to advanced, pay for use personalized information services. Route guidance capabilities assist in formulation of an optimal route and step by step guidance along the travel route. Advanced sensors, processors, enhanced driver interfaces, and actuators complement the driver information services so that, in addition to making informed mode and route selections, the driver travels these routes in a safer and more consistent manner. Initial collision avoidance functions provide "vigilant co-pilot" driver warning capabilities. More advanced functions assume limited control of the vehicle to maintain safe headway. Ultimately, this subsystem supports completely automated vehicle operation through advanced communications with other vehicles in the vicinity and in coordination with supporting infrastructure subsystems. Pre-crash safety systems are deployed and emergency notification messages are issued when unavoidable collisions do occur.

- **Basic Vehicle Reception (EP)**
  This Equipment package shall provide the capability for drivers to interface with the ISP Subsystem Basic Information Broadcast Equipment package and receive formatted traffic advisories including accurate traveling information concerning available travel options and their availability, and congestion information in their vehicle. These capabilities shall be based upon the reception of infrastructure information using in-vehicle devices such as an in-vehicle AM/FM radio with data subcarrier connected with the existing audio system and a dash-mounted LCD.

- **Interactive Vehicle Reception (EP)**
  This Equipment package shall provide the capability for drivers to interface with the ISP Subsystem Infrastructure Equipment packages including the Interactive Infrastructure Information Equipment package, the Infrastructure Provided Route Selection, Yellow Pages and Reservation, and Dynamic Ridesharing packages. These capabilities shall be provided using the Vehicle Subsystem equipment.

- **In-Vehicle Signing System (EP)**
  This Equipment package shall provide the capability to assist individuals with impaired vision, individuals needing local guidance in areas that the driver is unfamiliar, and implemented in a manner that augments existing signs. This package shall also provide the capability to customize warnings, utilize data from roadside environmental sensors, and provide travelers with information on road conditions and with precautionary reminder messages. These capabilities shall be provided through the use of equipment such as an interface to active tag reader and processor to display the information from the active tag.

- **Vehicle Provider-Based Route Guidance (EP)**
  This Equipment package coordinates with an ISP-Based route planning service to select a suggested route plan that is tailored to the driver's preferences. Coordination continues during the trip so that the route plan can be modified to account for new information and vehicle probe data can be returned to the ISP. Many equipment configurations are possible including basic systems that provide only a route plan to the driver as well as systems that include the necessary on-board equipment to provide turn by turn route guidance following the selected route.

- **Driver Visibility Improvement System (EP)**
  The Equipment package shall provide the capability to augment the vehicle operator's ability to see objects in the vehicle path in conditions where driving visibility is poor (e.g., bad weather, night driving, etc.). These capabilities shall be provided using equipment such as on-board sensor system (e.g., an infrared sensor system) to create images that in turn could be relayed to the driver using a heads-up display. The on-board systems to implement this Equipment package shall include a local sensor system, an image creation and processing capability, and a visual display to the driver.

- **Vehicle Mayday I/F (EP)**
  This Equipment package shall provide the capability for an in-vehicle manually initiated distress signal with cancel a prior issued manual request for help feature. This capability shall include automatically identifying that a collision had occurred using equipment such as collision detection sensors with interface to mayday type equipment that would automatically detect vehicle problems and for some cases, automatically send appropriate distress signals to the Emergency Management Subsystem.

Appendix B

Architecture Flows and their Descriptions

Note: The descriptions listed below are taken directly from the National ITS Architecture from the Physical Architecture Table 2.3-6: Physical Architecture Data Flow Descriptions. The items in **BOLD** are the Architecture flows and the flow descriptions are listed below each respective architecture flow. These have not been modified from the original table and the list below only identifies the architecture flows that have been identified in the subsystem flow diagrams.

Assigned Route
Route provided to vehicle by dispatcher

Bad Tag List
List of invalid charge or value card numbers

Broadcast Information
Common link travel times, advisories, transit schedule expectations, other traveler information

Cargo Data Request
Request for cargo information

CVO Weight and Presence
WIM message to indicate presence of CV and its weight

Demand Management Price Change Request
Request to change the pricing of the road facility use based on demand

Demand Management Price Change Response
Response to change request indicating level of compliance with request

Demand Responsive Transit Plan
Plan regarding overall schedules and deployment of demand responsive system

Demand Responsive Transit Request
Request for Paratransit support

Emergency Acknowledge
Acknowledge request for emergency assistance and provide additional details regarding actions and verification requirements

Emergency Dispatch Requests
Dispatch information from Emergency Management Center to Emergency Vehicle

Emergency Notification
Mayday notification by a traveler. Could be on foot, or in any vehicle. Routing is eventually to an Emergency Management Center but maybe forwarded by any other organization. Message may contain location and nature of emergency.

Emergency Vehicle Driver Inputs
Emergency Vehicle driver request for route plan, current status, etc.

Emergency Vehicle Driver Status Update
Additional status information provided by vehicle driver.

Emergency Vehicle Greenwave Request
Request for greenwave for emergency vehicle

Emergency Vehicle Route
Routing for emergency vehicle including greenwave paths

Emergency Vehicle Route Request
Special routing instructions and signal priority for emergency vehicles

Emergency Vehicle Tracking Data
Additional emergency vehicle data including status of emergency

Fare and Payment Status
Status of cash box on transit vehicle

Freeway Control Data
Control information for freeway signals

Freeway Control Status
Status of controls on freeway, e.g. ramp meters and DMS

HAZMAT Information
Information about particular HAZMAT load including nature of load and unloading instructions. May also include HAZMAT vehicle route update information.

HAZMAT Information Request
Request for information about a particular HAZMAT load

HOV Data
HOV data from roadside indicating information regarding vehicle occupancy in HOV lanes.

HRI Control Data
Data required for HRI information transmitted at railroad grade crossings and within railroad operations

HRI Request
A request for highway-rail intersection status or a specific control request intended to modify HRI operation

HRI Status
Status of the highway-rail intersection equipment including both the current state or mode of operation and the current equipment condition

Incident Data
Incident imagery and other data from roadside

Incident Information
Notification of existence of incident and expected severity, location, and nature of incident. Similar information for ERMS, Media, TMS, E911

Incident Information and Greenwave Request
Information about incidents plus requests for green wave of emergency vehicle

Incident Information Request
Request for incident information, clearing time, severity

Incident Notification
Notification of an incident on the roadway through emergency network

Incident Response Status
Status of currently occurring incident

Intersection Blockage Notification
Notification that a highway-rail intersection is obstructed and supporting information

Intersection Status
Status of intersection congestion, approaching vehicles, etc.

Local Traffic Flow
Traffic flow over local streets

Lock Tag Data Request
Request to supply lock information on cargo lock for retransmission to international border crossing station

Logged Route Plan
Route plan which may be used for demand management or optimal routing

Operational Data
Statistical data used for planning purposes

Planning Data
Data to Transportation Planners

Probe Data
Aggregate data from probe vehicles including location, speed for a given link or collection of links

Processed Cargo Data
Information about cargo

Request for Bad Tag List
Request for list of bad fare card id numbers

Request for Traffic Information
Request issued to agency which collects traffic data for traffic conditions

Request for Transit Signal Priority
Request for signal priority either through roadside or directly to TMS

Request Tag Data
Request for tag information including credit identity, stored value cash card, etc

Route Plan
Route provided by ISP in response to specific request

Route Request
Request for route and status of vehicle

Schedules, Fares Info Request
Transit requests

Security Alarms
Alarms located in public transit stops or on transit vehicles indicating an incident

Signage Data
Information sent to vehicles about traffic

Signal Control Data
Control information to surface street signals

Signal Control Status
Status of surface street signal controls

Signal Priority Request
Request for priority at signal either generated by emergency vehicle or transit vehicle. Maybe dealt with at roadside or forwarded to TMC

Surveillance Control
Control signals for surveillance devices

Tag Data
Unique id for the purposes of payment of services

Tag Update
Update data to tag which can be read at another screening

TMC Information
Traffic information exchanged between TMC□s. Normally could include congestion data, traffic data, signal timing plans, real-time signal control information.

Traffic Information
Congestion, pricing, and incident information

Transit and Fare Schedules
Specific schedules from transit management

Transit Emergency Coordination Data
Data exchanged between parties dealing with transit incident

Transit Information Request
Request for transit schedule information

Transit System Data
Transit system operational data to be used for demand management within the traffic management functions

Traveler Information
Traveler routing, yellow pages, etc

Traveler Information Request
Request for any type of traveler information

Trip Confirmation
Acknowledgement of acceptance of route

Trip Plan
A sequence of links and special instructions indicating efficient ways of navigating the links. Normally coordinated with traffic conditions, other incidents, preemption an prioritization plans

Trip Request
Request for special routing

Vehicle Measures
Sensing information from vehicle sensors

Vehicle Probe Data
Single vehicle probe data indicating link time and location

Appendix C

Logical Architecture Data Flow Dictionary

The table below presents the detailed Data Dictionary Entry (DDE) for each data flow identified on Figure xxx (17). These descriptions were pulled in their entirety from the National ITS Architecture, version 2.0.

DDE Name	DDE Description	DDE Definition
advanced_tolls_ and_charges_ roadside_ confirm	This data flow is used within the Provide Electronic Payment Services function and contains the result of the requested advanced payment transaction from a traveler (as a transit user) at the roadside, i.e. a transit stop. It consists of the following data items each of which is defined in its own DDE:	advanced_charges_confirm + advanced_tolls_confirm + confirmation_flag.
advanced_tolls_ and_charges_ roadside_request	This data flow is used by the Manage Transit function to transfer requests for advanced payments for toll and parking lot charges from the traveler (as a transit user) fare payment interface at the roadside, i.e. a transit stop, to the Provide Electronic Payment Services function for subsequent processing. The size of the data flow has been set at less than the sum of the two constituent flows to allow for the fact that they will both not be present for every data transfer. It consists of the following data items each of which is defined in its own DDE:	advanced_charges + advanced_tolls.
advanced_tolls_ and_charges_ vehicle_confirm	This data flow is used within the Provide Electronic Payment Services function and contains the result of the requested advanced payment transaction from a traveler (as a transit user) in a transit vehicle. It consists of the following data items each of which is defined in its own DDE:	advanced_charges_confirm + advanced_tolls_confirm + confirmation_flag.
advanced_tolls_ and_charges_ vehicle_request	This data flow is used by the Manage Transit function to transfer requests for advanced payments for toll and parking lot charges from the traveler (as a transit user) fare payment interface in a transit vehicle to the Provide Electronic Payment Services function for subsequent processing. The size of the data flow has been set at less than the sum of the two constituent flows to allow for the fact that they will both not be present for every data transfer. It consists of the following data items each of which is defined in its own DDE:	advanced_charges + advanced_tolls.
advanced_	This data flow is used within the Provide	confirmation_flag + stored_credit

DDE Name	DDE Description	DDE Definition
traveler_fares_ confirm	Electronic Payment Services function to show whether advanced fare payment by a traveler planning a trip has been refused or cleared. The traveler will be using facilities in the Provide Driver and Traveler Services function to generate the trip request. The data flow consists of the following data items each of which is defined in its own DDE:	+ transit_fare + traveler_identity.
advanced_ traveler_fares_ request	This data flow is used within the Provide Electronic Payment Services function to request that a transit fare be paid for in advance by a traveler who is planning a trip using facilities in the Provide Driver and Traveler Services function. It consists of the following items each of which is defined in its own DDE:	credit_identity + stored_credit + transit_route_origin + transit_route_destination + transit_journey_date + traveler_identity.
advanced_ traveler_tolls_ request	This data flow is used within the Provide Electronic Payment Services function to request that a toll be paid for in advance by a traveler who is planning a trip. It consists of the following data items each of which is defined in its own DDE:	credit_identity + stored_credit + toll_route_segments + vehicle_identity.
bad_tag_list_ request	This data flow is sent from the Manage Transit fare billing on vehicle facility to the Provide Electronic Payment Services function. It requests that a new copy of the list of bad transit tags be provided for use in fare transaction processing on-board a transit vehicle. The data flow consists of the following data item which is defined in its own DDE:	transit_vehicle_identity.
bad_tag_list_ update	This data flow is sent from the Provide Electronic Payment Services function to the Manage transit function. It contains a list of current transit user tags that have been found to be bad. This means that a fare payment transaction in which they were involved has failed, or the tag has been invalidated by the financial institution to which it belongs. The data flow consists of the following data items each of which is defined in its own DDE:	transit_vehicle_identity + list_size + list_size{credit_identity}.
cf_enrollment_ information	This data flow is used within the Manage Commercial Vehicles function and contains the data for enrollment on a particular route produced from data supplied by the commercial fleet manager. It contains the following data items each of which is defined in its own DDE:	cv_route_number + cv_taxes_and_duties + route + route_type + cv_border_enrollments.

DDE Name	DDE Description	DDE Definition
cf_enrollment_ payment_ confirmation	This data flow is used within the Manage Commercial Vehicles function to confirm that a payment of the taxes and duties for the enrollment of a particular commercial vehicle cargo, weight and type on a particular route from the commercial fleet manager has been accepted. It consists of the following data items each of which is defined in its own DDE:	cv_route_number + cv_account_number + cv_amount_billed.
cf_enrollment_ payment_ request	This data flow is used within the Manage Commercial Vehicles function to request payment for the enrollment of a particular commercial vehicle cargo, weight and type on a particular route by the commercial fleet manager. The number of sets of taxes and duties has been set at fourteen (14) for the definition, but has been set to one and a half (1.5) for the size expression as this is a more typical value. The data flow consists of the following items each of which is defined in its own DDE:	cf_manager_credit_identity + cv_account_number + cv_route_number + 1{cv_taxes_and_duties}14.
cf_enrollment_ request	This data flow is used within the Manage Commercial Vehicles function and contains the data needed to obtain enrollment information for a particular commercial vehicle cargo, type and weight on a particular route as provided by the commercial fleet manager. It consists of the following data items each of which is defined in its own DDE:	cv_credentials_details + cv_route_data + cv_route_number + cv_trip_classification_data + cv_trip_identity + route_type + border_crossing_request.
cf_hazmat_ request	This data flow is sent from the Manage Emergency Services function to the Manage Commercial Vehicles function and contains a request for information about hazardous materials that are being or about to be carried by commercial vehicles.	
cf_hazmat_ route_ information	This data flow is sent from the Manage Commercial Vehicles function to the Manage Emergency Services function and contains information about the route about to be used or planned for a commercial vehicle that will carry hazardous materials. This information may cause the Emergency Services to raise an incident for all or part of the vehicle's route. The data flow consists of the following data items each of which is define in its own DDE:	cv_route_number + route.
cf_hazmat_	This data flow is sent from the Manage	hazmat_load_data + hazmat_vehicle_data.

DDE Name	DDE Description	DDE Definition
vehicle_ information	Commercial Vehicles function to the Manage Emergency Services function and contains information about hazardous materials that are on-board the vehicle and details of the vehicle itself. The data flow consists of the following data items each of which is defined in its own DDE:	
cf_manager_ credit_identity	This data flow is sent from the Provide Electronic Payments Services function to the Manage Commercial Vehicles function and contains the credit identity or the amount of stored credit currently stored on the payment instrument being used by a commercial vehicle manager. It consists of the following data items each of which is defined in its own DDE:	credit_identity + stored_credit.
cf_manager_ enrollment_cost	This data flow is sent from the Manage Commercial Vehicles function to the Provide Electronic Payment Services function. It contains the cost of the electronic credential filing and taxes, payment of which was previously requested by the commercial vehicle manager, and is only sent when the cost is to be deducted from the credit stored on the payment instrument being used by the driver. The data flow consists of the following data items each of which is defined in its own DDE:	cv_amount_billed + stored_credit.
cf_on_board_ vehicle_data	This data flow is used within the Manage Commercial Vehicle function and contains data collected on-board a commercial vehicle output of which has been requested by the commercial vehicle manager. It consists of the following data items each of which is defined in its own DDE:	cv_on_board_data + cv_general_output_message + vehicle_location_for_cv.
cf_reports	This flow consists of reports of roadside fleet activity and safety compliance, generated by commercial vehicle administration for commercial fleet managers. It consists of the following data flows, each of which is defined in its own DDE.	cf_roadside_activity_report + cf_periodic_activity_report.
cf_request_ activity_report	This data flow is used within the Manage Commercial Vehicles function and contains a request from the commercial vehicle manager for one of two types of activity report to be provided. This may be either a specific one time report of clearance safety activity at	cv_credentials_details +cv_roadside_activity_report frequency + date + list_size + list_size{cv_roadside_ facility_identity}.

DDE Name	DDE Description	DDE Definition
	roadside facilities, or a request that periodic summary reports to be sent on a regular basis. The reports will only relate to the carrier, driver, vehicle combination specified in the request, although it will be possible for all the vehicles and drivers related to a specific carrier to be requested. The data flow contains the following data items each of which is defined in its own DDE:	
cf_request_on_board_vehicle_data	This data flow is used within the Manage Commercial Vehicles function. It contains a request from the commercial vehicle manager for the commercial vehicle to output the on-board data it has collected, plus any general message data from the driver. The data flow consists of the following data items each of which is defined in its own DDE:	cv_on_board_data_required + cv_general_input_message.
cf_route	This data flow is sent from the Provide Driver and Traveler Services function to the Manage Commercial Vehicles function. It contains details of a dynamic route provided for a commercial vehicle the request for which originated with the commercial vehicle fleet manager. The data flow consists of the following data items each of which is defined in its own DDE:	cv_route_data + cv_route_number.
cf_route_request	This data flow is sent from the Manage Commercial Vehicles function to the Provide Driver and Traveler Services function. It is used to request the preparation of a dynamic route for a commercial vehicle and originates with the commercial vehicle fleet manager. The data flow consists of the following items each of which is defined in its own DDE:	constraint_on_acceptable_travel_time + constraint_on_eta_change + constraint_on_load_classification + constraint_on_ahs_lanes + constraint_on_interstate + constraint_on_urban + constraint_on_vehicle_type + cv_route_number + destination + departure_time + desired_arrival_time + modes + origin + preferred_routes + preferred_alternate_routes + preferred_route_segments + preferred_weather_conditions.
cf_tag_data	This data flow is used within the Manage Commercial Vehicles function. It contains the output of the data currently being held by a	cv_credentials_details + cv_trip_identity.

DDE Name	DDE Description	DDE Definition
	commercial vehicle tag. The data flow consists of the following data items each of which is defined in its own DDE:	
cf_tag_ initialization_ data	request for the initialization of the specified commercial vehicle tag with its on-board data. The data flow consists of the following data items each of which is defined in its own DDE:	tag_identity + cv_credentials_details + cv_trip_identity.
cf_tax_audit_ data	This data flow is used within the Manage Commercial Vehicles function. It contains tax data and audit filings not related to specific credentials application and is generated as a result of input from the commercial vehicle manager.	
cv_admin_data_ for_roadside	This data flow is used within the Manage Commercial Vehicle function. It contains data that is being sent from the commercial vehicle trips and clearances administration facility to the commercial vehicle roadside checkstation facility. The data flow consists of the following data items each of which is defined in its own DDE:	cv_border_database_update +cv_credentials_database_ update + cv_credentials_information_ response + cv_safety_database_update + cv_safety_information_ response.
cv_driver_ credit_identity	This data flow is sent from the Provide Electronic Payments Services function to the Manage Commercial Vehicles function. It contains the credit identity of a commercial vehicle driver or the amount of stored credit obtained from the payment instrument terminator and consists of the following data items each of which is defined in its own DDE:	credit_identity + stored_credit.
cv_driver_ enrollment_cost	This data flow is sent from the Manage Commercial Vehicles function to the Provide Electronic Payment Services function. It contains the cost of the electronic credential filing and taxes, payment of which was previously requested by the commercial vehicle driver acting in the role of fleet manager, and is only sent when the cost is to be deducted from the credit stored on the payment instrument being used by the driver. The data flow consists of the following data items each of which is defined in its own DDE:	cv_amount_billed + stored_credit.
cv_electronic_ clearance_data	This data flow is used within the Manage Commercial Vehicles and Provide Electronic Payment Services functions. It contains data that has been stored on a commercial vehicle	cv_on_board_tag_data + cv_lock_tag_data.

DDE Name	DDE Description	DDE Definition
	tag to enable its identification at commercial vehicle roadside checkstation facilities for the purposes of electronic clearance, and/or safety inspection, and/or border clearance, as well as at toll plazas for toll payment collection. The data flow consists of the following data items each of which is defined in its own DDE:	
cv_enrollment_ information	This data flow is used within the Manage Commercial Vehicles function and contains the data for enrollment on a particular route produced from data supplied by the commercial vehicle driver. It contains the following data items each of which is defined in its own DDE:	cv_route_number + cv_taxes_and_duties + route + route_type + cv_border_enrollments.
cv_enrollment_ payment_ confirmation	This data flow is used within the Manage Commercial Vehicles function to confirm that a payment of the taxes and duties for the enrollment of a particular commercial vehicle cargo, weight and type on a particular route from the commercial vehicle driver has been accepted. It consists of the following data items each of which is defined in its own DDE:	cv_account_number + cv_amount_billed + cv_driver_credit_identity + cv_route_number.
cv_enrollment_ payment_request	This data flow is used within the Manage Commercial Vehicles function to request payment for the enrollment of a particular commercial vehicle cargo, weight and type on a particular route by the commercial vehicle driver acting in the role of the commercial fleet manager. The number of sets of taxes and duties has been set at fourteen (14) for the definition, but has been set to one and a half (1.5) for the size expression as this is a more typical value. The data flow consists of the following items each of which is defined in its own DDE:	cv_account_number + cv_driver_credit_identity + cv_route_number + 1{cv_taxes_and_duties}14.
cv_enrollment_ request	This data flow is used within the Manage Commercial Vehicles function and contains the data needed to obtain enrollment information for a particular commercial vehicle cargo, type and weight on a particular route as provided by the commercial vehicle driver. It consists of the following data items each of which is defined in its own DDE:	cv_credentials_details + cv_route_data + cv_route_number + cv_trip_classification_data + cv_trip_identity + route_type + border_crossing_request.
cv_inspection_ data_output	This data flow is used within the Manage Commercial Vehicle function and contains the results of the commercial vehicle roadside	

DDE Name	DDE Description	DDE Definition
	inspection. These are down loaded for storage on-board the vehicle.	
cv_on_board_ data	This data flow is used within the Manage Commercial Vehicles function to send on-board commercial vehicle data from the vehicle to a commercial vehicle roadside facility. It contains the following data items each of which is defined in its own DDE:	cv_identity_details + cv_credentials + cv_driver_credentials + cv_driver_license_citations + cv_repairs_and_service_ records + cv_inspection_data + cv_inspection_ activities_data + cv_fuel_purchase_data +cv_safety_systems_ diagnostics_results + cv_vehicle_log + cv_log_data + cv_not_pulled_in.
cv_on_board_ vehicle_data	This data flow is used within the Manage Commercial Vehicle function and contains data collected on-board a commercial vehicle output of which has been requested by the commercial vehicle driver. It consists of the following data items each of which is defined in its own DDE:	Cv_on_board_data + vehicle_location_for_cv.
cv_operational_ data	This data is sent from the Manage Commercial Vehicle function to the Plan System Deployment function. It contains data about the number of commercial vehicles passing each roadside checking facility and how many are passing or failing their checks. The data is obtained from the roadside facility log, with details of vehicle identities is removed by the Manage Commercial Vehicles function before the data is sent.	Cv_credentials_details.
cv_provide_ credentials_data_ for_inspections	This data flow is used within the Manage Commercial Vehicles function and contains the commercial vehicle's credentials data. This data flow makes that data available for downloading to the roadside as part of the on-board vehicle safety data requested by an inspector using a hand held terminal. This data flow consists of the following data item which is defined in its own DDE:	
cv_request_on_ board_data	This data flow is used within the Manage Commercial Vehicles function by the commercial vehicle roadside processing to request on-board data from a commercial vehicle. It contains the following data items each of which is defined in its own DDE:	Cv_roadside_facility_identity + cv_roadside_facility_ address.

DDE Name	DDE Description	DDE Definition
cv_request_on_board_vehicle_data	This data flow is used within the Manage Commercial Vehicle function and contains a request from the commercial vehicle driver for the commercial vehicle to output the on-board data it has collected, plus any general message data from the driver. This data is sent to the commercial vehicle driver who is acting in the role of commercial vehicle manager, i.e. is an owner driver. The data flow consists of the following data item which is defined in its own DDE:	Cv_on_board_data_required.
cv_roadside_data_for_admin	This data flow is used within the Manage Commercial Vehicle function. It contains data that is being sent from the commercial vehicle roadside checkstation facility to the commercial vehicle trips and clearances administration facility. The data flow consists of the following data items each of which is defined in its own DDE:	cv_credentials_information_request + cv_roadside_daily_log + cv_border_daily_log + cv_safety_information_request + cv_update_safety_problems_list.
cv_roadside_data_for_vehicle	This data flow is used within the Manage Commercial Vehicle function. It contains data that is being sent from a commercial vehicle roadside checkstation or border crossing facility to the commercial vehicle. The data flow consists of the following data items each of which is defined in its own DDE:	cv_on_board_border_record +cv_request_electronic_clearance_data + cv_on_board_screening_record.
cv_route	This data flow is sent from the Provide Driver and Traveler Services function to the Manage Commercial Vehicles function. It contains details of a dynamic route provided for a commercial vehicle the request for which originated with the commercial vehicle driver acting in the role of fleet manager. The data flow consists of the following data items each of which is defined in its own DDE:	cv_route_data + vehicle_identity.
cv_route_request	This data flow is sent from the Manage Commercial Vehicles function to the Provide Driver and Traveler Services function. It is used to request the preparation of a dynamic route for a commercial vehicle and originates with the commercial vehicle driver acting in the role of fleet manager. The data flow consists of the following items each of which is defined in its own DDE:	constraint_on_acceptable_travel_time + constraint_on_eta_change +constraint_on_load_classification + constraint_on_ahs_lanes + constraint_on_interstate + constraint_on_urban + constraint_on_vehicle_type + destination + departure_time + desired_arrival_time

DDE Name	DDE Description	DDE Definition
		+ modes + origin + preferred_routes + preferred_alternate_routes + preferred_route_segments + preferred_weather_ conditions + vehicle_identity.
cv_vehicle_ data_for_ roadside	This data flow is used within the Manage Commercial Vehicle function. It contains data that is being sent from the commercial vehicle to the commercial vehicle roadside checkstation facility. The data flow consists of the following data items each of which is defined in its own DDE:	Cv_electronic_clearance_data.
cv_violation_ data	This data flow is sent from the Manage Commercial Vehicles function to the Manage Emergency Services function. It contains details of commercial vehicles that have committed violations at roadside checking facilities. These may be caused by failure to stop, or by failure to provide on-board data, the on-board data itself being in error, or failure of a roadside check.	
confirm_ roadside_fare_ payment	This data flow is sent from the Provide Electronic Payment Services function to the Manage transit function to confirm that transaction processing of the payment of a transit fare from the roadside, i.e. a transit stop, has been completed. It consists of the following data items each of which is defined in its own DDE:	Confirmation_flag + transit_roadside_fare_ collection_identity.
confirm_ vehicle_fare_ payment	This data flow is sent from the Provide Electronic Payment Services function to the Manage transit function to confirm that transaction processing of the payment of a single transit fare (interactive operation) or of a group of fares (batch mode) from on-board the vehicle has been completed. If the transaction processing was in batch mode, the transit user's tag identity will be set to zero (0), otherwise it will be set to the identity provided in the transaction request. The data flow consists of the following data items each of which is defined in its own DDE:	Confirmation_flag +transit_user_vehicle_tag_ identity + transit_vehicle_identity.
cv_data_for_ payments	This data flow is sent from the Manage Commercial Vehicles function to the Provide	Financial_request.

DDE Name	DDE Description	DDE Definition
	Electronic Payment Services function. It contains data that will be used to transact financial payments for commercial vehicles, including the payment of tolls. The data flow consists of the following items each of which is defined in its own DDE:	
cv_driver_ credit_identity	This data flow is sent from the Provide Electronic Payments Services function to the Manage Commercial Vehicles function. It contains the credit identity of a commercial vehicle driver or the amount of stored credit obtained from the payment instrument terminator and consists of the following data items each of which is defined in its own DDE:	Credit_identity + stored_credit.
cv_driver_ enrollment_cost	This data flow is sent from the Manage Commercial Vehicles function to the Provide Electronic Payment Services function. It contains the cost of the electronic credential filing and taxes, payment of which was previously requested by the commercial vehicle driver acting in the role of fleet manager, and is only sent when the cost is to be deducted from the credit stored on the payment instrument being used by the driver. The data flow consists of the following data items each of which is defined in its own DDE:	Cv_amount_billed + stored_credit.
cv_payments_ results_data	This data flow is sent from the Provide Electronic Payment Services function to the Manage Commercial Vehicles function. It contains data that provides the results of financial payments for commercial vehicles. The data flow consists of the following item which is defined in its own DDE:	Financial_response.
cv_route_input	This data flow is sent from the Manage Commercial Vehicle function to the Provide Driver and Traveler Services function and contains route and vehicle location data. It consists of the following data items each of which is defined in its own DDE:	cf_route_request + cv_route_request.
cv_route_outputs	This data flow is sent from the Provide Driver and Traveler Services function to the Manage Commercial Vehicle function and contains route and vehicle location data. It consists of the following data items each of which is defined in its own DDE:	cf_route + cv_route + vehicle_location_for_cv.

DDE Name	DDE Description	DDE Definition
fare_violation_ information	This data is used by the Provide Electronic Payment Services functions to send data about a violator of the transit fare collection processes to the Manage Emergency Services function. This data will contain a digitized video image of the traveler trying to violate the toll collection process, plus information about the transit fare and the vehicle or roadside location from which payment was being attempted. The data flow consists of the following data items each of which is defined in its own DDE:	Credit_identity + transit_fare + transit_route_number + transit_route_segment_ number + transit_route_use_time + transit_user_category + transit_user_roadside_image + transit_user_vehicle_image + traveler_identity.
financial_data_ for_system_ development	This data flow is sent from the Provide Electronic Payment Services function to the Plan System Deployment function. It contains data about toll and other payment transactions that may be useful to transportation planners developing the travel network served by the ITS functions. The data flow consists of the following data items each of which is defined in its own DDE:	payment_transaction_reports + toll_operational_data.
financial_ request	This data flow is sent by the Manage Commercial Vehicles function to the Provide Electronic Payment Services function to request payment of permits and duties required for a commercial vehicle to complete its planned journey. It contains the following items each of which is defined in its own DDE:	cf_manager_enrollment_cost + cv_driver_enrollment_cost + duty_cost + permit_cost.
financial_ response	This data flow is sent by the Provide Electronic Payments Services function to the Manage Commercial Vehicles function and contains the response to the request for payment of permits and duties made by either the commercial fleet manager or the commercial vehicle driver acting in the role of fleet manager. It consists of the following items each of which is defined in its own DDE:	cf_manager_credit_identity + cv_driver_credit_identity + authorization_code.
from_ commercial_ vehicle	This data flow is sent from a commercial vehicle to the Manage Commercial Vehicles and Provide Vehicle Monitoring and Control functions. It contains data that has been collected on-board a commercial vehicle for processing by sensors before being used within the functions. The data flow consists of the following items each of which is defined in its own DDE:	fcv-brake_condition + fcv-cargo_data + fcv-cargo_safety_status + fcv-distance_travelled + fcv-driver_safety_status + fcv-driver_status + fcv-lock_tag_data + fcv-vehicle_safety_status + fcv-weight + fcv-vehicle_characteristics.

DDE Name	DDE Description	DDE Definition
from_ commercial_ vehicle_driver	This data flow is sent from the commercial vehicle driver to the Manage Commercial Vehicles function and contains data that has been input by a driver acting either as a driver, or acting as a commercial vehicle manager. It consists of the following data items each of which is defined in its own DDE:	fcvd-activity_request + fcvd-carrier_number + fcvd-driver_data_input + fcvd-driver_general_ message + fcvd-driver_input_type + fcvd-enrollment_payment_ request + fcvd-enrollment_request + fcvd-driver_number + fcvd-other_data_input + fcvd-request_routing_ instructions + fcvd-request_tag_data_ output + fcvd-route_data + fcvd-route_request + fcvd-trip_identity + fcvd-vehicle_number.
from_ commercial_ vehicle_manager	This data flow is sent from the commercial vehicle manager to the Manage Commercial Vehicles function and contains data that has been input by a commercial vehicle fleet manager. It consists of the following items each of which is defined in its own DDE:	Fcvm-carrier_number + fcvm-driver_number +fcvm-enrollment_payment_ request + fcvm-enrollment_request + fcvm-other_data_input + fcvm-preclearance_data + fcvm-request_driver_route_ instructions + fcvm-request_on_board_ vehicle_data + fcvm-request_tag_data_ output + fcvm-roadside_activity_ report_request + fcvm-route_data + fcvm-route_function_ request + fcvm-trip_identity + fcvm-update_driver_route_ instructions + fcvm-vehicle_number.
from_CVO_ information_ requestor	This data flow is sent to the commercial vehicle information requestor from the Manage Commercial Vehicle function. It contains a request for commercial vehicle operations information. The data flow consists of the following item which is defined in its own DDE:	Fcvoir- request_for_information.
from_driver	This data flow is sent from the driver to both the Provide Electronic Payment Services and the Provide Driver and Traveler Services functions. It contains data input by a driver for	fd-emergency_request + fd-guidance_data + fd-guidance_map_update_ request + fd-guidance_request

DDE Name	DDE Description	DDE Definition
	in-vehicle services such as guidance, travel advisory and automatic vehicle control. It consists of the following data items each of which is defined in its own DDE:	+ fd-guidance_route_accepted + fd-other_services_parking_ request + fd-other_services_toll_ request + fd-request_advisory_ information + fd-activate_vehicle_control.
from_ enforcement_ agency	This data flow is a response from an enforcement agency to a request for data from commercial vehicle administration.	Fea-cv_enforcement_agency_ response.
from_financial_ institution	This data flow is sent from the Financial Institution to the Provide Electronic Payment Services function and contains data about requests for payments that have been successfully made or otherwise. It consists of the following items each of which is defined in its own DDE:	ffi-bad_charges_payment_ updates + ffi-bad_fare_payment_ updates + ffi-bad_toll_payment_ updates + ffi-confirm_charges_ payment + ffi-confirm_fare_payment + ffi-confirm_toll_payment + ffi-cv_payment_confirm + ffi-driver_map_payment_ confirm + ffi-other_services_payment_ confirm + ffi-registration_payment_ confirm + ffi-traveler_display_ payment_confirm +ffi-traveler_map_payment_ confirm + ffi-traveler_other_services_ payments_confirm + ffi-traveler_rideshare_ payment_confirm.
from_ intermodal_ freight_depot	This data flow is used within the Manage Commercial Vehicles function and contains data about the movement of freight by means that may include methods other than commercial vehicles, e.g. heavy rail, air, sea, river, etc.	
from_ intermodal_ freight_shipper	This data flow is used within the Manage Commercial Vehicles function and contains data about the services available to ship freight by means other than commercial vehicles, e.g. heavy rail, air, sea, river, etc.	
from_other_ CVAS	This data flow is sent from the other commercial vehicle administration system from the Manage Commercial Vehicles function and	Focvas-commit_local_ enrollment + focvas-data_table

DDE Name	DDE Description	DDE Definition
	contains requests for data from and data provided against previous requests. It consists of the following data items each of which is defined in its own DDE:	+ focvas-enrollment_request + focvas-enrollment_confirmation + focvas-provide_data.
from_parking_service_provider	This data flow is sent from the parking lot services provider to the Provide Electronic Payment Services function and contains data on the use of parking lots or requests for transaction information. It consists of the following data items each of which is defined in its own DDE:	fpsp-confirm_advanced_parking_payment + fpsp-current_lot_state + fpsp-lot_occupancy + fpsp-parking_lot_charge_change_response + fpsp-parking_lot_data + fpsp-transaction_reports_request.
from_payment_instrument	This data flow is sent from the payment instrument to the Provide Electronic Payment Services function. It consists of the following data items each of which is defined in its own DDE:	fpi-commercial_manager_input_credit_identity + fpi-confirm_payment_at_parking_lot + fpi-confirm_fare_payment_at_roadside + fpi-confirm_fare_payment_on_transit_vehicle + fpi-confirm_payment_at_toll_plaza + fpi-driver_vehicle_input_credit_identity + fpi-parking_tag_data + fpi-toll_tag_data + fpi-transit_roadside_tag_data +fpi-transit_user_roadside_input_credit_identity + fpi-transit_user_vehicle_input_credit_identity + fpi-transit_vehicle_tag_data + fpi-traveler_personal_input_credit_identity + fpi-traveler_roadside_input_credit_identity.
from_rail_operations	This data flow is sent from a railroad operated operations center (or centers) to the ITS Manage Traffic function. It contains information about scheduled and/or predicted railroad events that may be relevant to ITS traffic management (e.g. train schedules through busy corridors, maintenance schedules for railroad owned and maintained grade crossing equipment, etc.). This is typically informational data and is not required for timely operation of grade crossing protection and safety devices. It is however the	fro-train_schedules + fro-maintenance_schedules + fro-incident_notification.

DDE Name	DDE Description	DDE Definition
	source of data for use in route planning, alternate route determination, railroad incident notifications, etc. This data flow consists of the following data items each of which is defined in its own DDE:	
from_toll_ operator	This data flow is sent to the Provide Electronic Payment Services function and contains input from a local operator at a toll plaza. It consists of the following data items each of which is defined in its own DDE:	fto-local_toll_price_variations.
from_toll_ service_provider	This data flow is sent to the provide Electronic Payment Services function by the toll service provider. It contains the response to requests for changes in toll prices, and advanced tolls, plus new toll price data. It consists of the following data items each of which is defined in its own DDE:	ftsp-confirm_advanced_toll + ftsp-toll_price_changes_ response + ftsp-toll_price_data.
from_vehicle_ characteristics	This data flow is sent from the vehicle characteristics terminator. It represents the presence of a vehicle near a sensor, which allows the sensor to create an output that can be used to identify a particular vehicle and its characteristics, such as the number of wheels, size, pollution parameters, etc., for toll payment and parking lot charging purposes. The sensor may also determine the visible characteristics of a vehicle and use that data to obtain information about toll and parking lot charge violators.	
from_wayside_ equipment	This data flow represents information received by HRI from railroad maintained and operated wayside interface equipment (track circuits, gate controllers, local connections to centralized sites via railroad communications networks, etc.). This is assumed to be a real-time, or near real-time interface capable of providing direct communications with (or otherwise detecting) approaching trains. This data flow consists of the following data items each of which is defined in its own DDE:	fwe-approaching_train_ announcement + fwe-train_data + few-wayside_equipment_ status.
Incident_data_ flow	This data flow is used to transfer data between the Manage Emergency Services function and the Provide Driver and Traveler Services function. It contains the following items of data each of which is defined in its own DDE:	Emergency_request_personal_ traveler_acknowledge +emergency_request_driver_ acknowledge + emergency_vehicle_route_ request + incident_information.

DDE Name	DDE Description	DDE Definition
incident_data_ request	This data flow is used to transfer data between the Provide Driver and Traveler Services function and the Manage Emergency Services function. It contains the following data items each of which is defined in its own DDE:	Emergency_vehicle_route +emergency_request_ personal_traveler_details + emergency_request_driver_ details + incident_information_ request + vehicle_location_for_ emergency_services.
network_data	This data flow is sent from the Manage Traffic function to the Plan System Deployment function and contains the current static data being used for managing traffic, the log of parking lot data and pollution data, plus a snap-shot of the current and historic state of traffic within the road and highway network. It contains the following data items each of which is defined in its own DDE:	current_traffic_static_data + current_incident_static_data + parking_lot_operational_ data + pollution_operational_data + traffic_data_for_ deployment.
network_updates	This data flow is sent from the Plan System Deployment function to the Manage Traffic function and contains the either new static data to be used for managing traffic or requests for traffic data and/or a copy of the current static data. It contains the following data items each of which is defined in its own DDE:	link_data + static_data_request + supply_incident_static_data + supply_traffic_static_data + traffic_data_deployment_ request.
other_services_ roadside_request	This data flow is sent from the Manage Transit function to the Provide Electronic Payment Services function and contains the transit user's request from the roadside, i.e. a transit stop, for other (yellow pages) services. It consists of the following data items each of which is defined in its own DDE :	traveler_identity + credit_identity + other_services_data.
other_services_ roadside_ response	This data flow is sent from the Provide Electronic Payment Services function to the Manage Transit function and contains the response to the transit user's request from the roadside, i.e. a transit stop, for other (yellow pages) services. It consists of the following data items each of which is defined in its own DDE :	traveler_identity + credit_identity + other_services_data.
other_services_ vehicle_request	This data flow is sent from the Manage Transit function to the Provide Electronic Payment Services function and contains the transit user's request from a transit vehicle for other (yellow pages) services. It consists of the following data items each of which is defined in its own DDE :	traveler_identity + credit_identity + other_services_data.

DDE Name	DDE Description	DDE Definition
other_services_ vehicle_response	This data flow is sent from the Provide Electronic Payment Services function to the Manage Transit function and contains the response to the transit user's request from a transit vehicle for other (yellow pages) services. It consists of the following data items each of which is defined in its own DDE :	traveler_identity + credit_identity + other_services_data.
parking_lot_ availability	This data flow is sent from the Provide Electronic Payment Services function to the Provide Driver and Traveler Services function. It contains details of the number of spaces available in the lot in response to a previous request for this data. The data flow consists of the following items each of which is defined in its own DDE:	parking_lot_identity + parking_lot_spaces + traveler_identity.
parking_lot_ charge_direct_ details	This data flow is contains the prices being charged by each parking lot for each of its spaces, together with the time and date for which they apply.	parking_lot_identity + parking_lot_price +parking_lot_charge_ application_time + vehicle_type_for_charges.
parking_lot_ charge_direct_ request	This data flow is sent from the Manage Traffic function to the Provide Electronic Payment Services function and contains a request for the current prices being charged for parking lot spaces.	
parking_lot_ charge_details	This data flow is sent from the Provide Electronic Payment Services function to the Manage Traffic function and contains the prices being charged by each parking lot for each of its spaces, together with the time and date for which they apply.	parking_lot_identity + parking_lot_price +parking_lot_charge_ application_time + vehicle_type_for_charges.
parking_lot_ charge_request	This data flow is sent from the Manage Traffic function to the Provide Electronic Payment Services function and contains a request for the current prices being charged for parking lot spaces.	
parking_lot_ data_request	This data flow is sent from the Provide Driver and Traveler Services function to the Provide Electronic Payment Services function and contains a request for data about the number of spaces that are available in a particular parking lot at the specified data and time. This data is requested as part of the process of putting together a proposed trip in response to a traveler's trip request. This data flow contains the following items each of which is defined in	Date + parking_lot_identity + time + traveler_identity.

DDE Name	DDE Description	DDE Definition
	its own DDE:	
parking_lot_tag_ data_input	This data flow is sent from the Provide Electronic Payment Services function to the Manage Traffic function. It contains the data from parking lot and toll tags on-board vehicles which will be used to calculate vehicle journey times for links in the road (surface street) and freeway network served by the Manage Traffic function. The data consists of a unique identity number which is assigned to each tag as it is read.	parking_lot_tag_data.
parking_lot_tag_ data_needed	This data flow is used within the Manage Traffic and Provide Electronic Payment Services functions to request the output of the data from a toll tag that may be on-board a vehicle. This data will be used to calculate vehicle journey times for links in the road (surface street) and freeway network served by the Manage Traffic function.	
payment_ request	This data flow is sent from the Provide Driver and Traveler Services function to the Provide Electronic Payment Services function and contains requests for payments to be made by travelers or requests for price information. It consists of the following data items each of which is defined in its own DDE:	Driver_advanced_payment_ for_map + driver_map_update_ payment_request + parking_lot_data_request + parking_lot_reservation_ request + request_prices + rideshare_payment_request + traveler_map_update_ payment_request + traveler_other_services_ payment_request + traveler_payment_request + traveler_personal_display_ update_cost + traveler_personal_display_ update_payment_request + traveler_personal_map_ update_cost + traveler_personal_trip_costs + traveler_roadside_trip_costs + yellow_pages_service_ provider_registration_ request.
payment_result	This data flow is sent by the Provide Electronic Payment Services function to the Provide Driver and Traveler Service function and contains responses to requests for payment by travelers, prices, probe data from vehicles	Driver_credit_identity +driver_map_update_ payment_response + parking_lot_availability +parking_lot_reservation_ confirm

DDE Name	DDE Description	DDE Definition
	paying tolls, or responses from parking lots. The data flow consists of the following data items each of which is defined in its own DDE:	+ prices + rideshare_payment_ confirmation + traveler_map_update_ payment_response + traveler_payment_response + traveler_personal_display_ update_payment_response + traveler_other_services_ payment_result + traveler_personal_credit_ identity + traveler_roadside_credit_ identity + vehicle_toll_probe_data + yellow_pages_service_ provider_registration_ response
price_data	This data flow contains data on the current prices being charged for tolls, parking lots and transit fares, plus the response to a request from the Manage Demand facility for changes in the current prices. It consists the following data items each of which is defined in its own DDE:	Parking_lot_charge_details + parking_lot_charge_direct_ details +parking_lot_charge_ change_response + probe_data_for_traffic + tag_data_inputs + transit_fare_details + transit_fare_direct_details + toll_price_changes_ response + toll_price_details + toll_price_direct_details.
price_request	This data flow is sent from the Manage Traffic function to the Provide Electronic Payment Service function. It is used to request the current prices for tolls, parking lot spaces and transit fares, to request changes to their current prices in order that the modal split of trips being undertaken by travelers can be changed, and to request parking lot and toll tag data for traffic journey time measurement. The data flow consists of the following data items each of which is defined in its own DDE:	Parking_lot_charge_change_ request + parking_lot_charge_request + parking_lot_charge_direct_ request + transit_fare_request + transit_fare_direct_request + tag_data_requests + toll_price_changes_request + toll_price_request + toll_price_direct_request.
prices	This data flow is sent from the Provide Electronic Payment Services function to the Provide Driver and Traveler Services function and contains data on the current prices being charged for tolls, parking lots and transit fares. It consists the following data items each of which is defined in its own DDE:	Toll_price_data + parking_lot_price_data + transit_fare_data.
probe_data_for_	This data flow is sent from the Provide	List_size + list_size{route_segment_

DDE Name	DDE Description	DDE Definition
traffic	Electronic Payment Services function to the Manage Traffic function and contains journey times between toll collection points for those vehicles equipped for electronic toll collection. It is used to calculate link journey times for use in adaptive traffic control techniques and route selection and guidance. The data flow consists of the following data items each of which is defined in its own DDE:	identity + route_segment_journey_time_from_tolls}.
request_prices	This data flow is sent from the Provide Driver and Traveler Services function to the Provide Electronic Payment Service function to request the current prices for tolls, parking lot spaces and transit fares.	
request_roadside_fare_payment	This data flow is sent from the Manage Transit function to the Provide Electronic Payment Services function to request payment of a transit fare from the roadside, i.e. a transit stop. It consists of the following data items each of which is defined in its own DDE:	Transit_fare +transit_roadside_fare_collection_identity + transit_user_roadside_tag_identity.
request_transit_user_roadside_image	This data flow is sent from the Provide Electronic Payment Services function to the Manage Transit function. It contains a request for the supply of the image of a transit user who has violated the transit fare payment process at a roadside fare collection point.	
request_transit_user_vehicle_image	This data flow is sent from the Provide Electronic Payment Services function to the Manage Transit function. It contains a request for the supply of the image of a transit user who has violated the transit fare payment process at an on-board vehicle fare collection point.	
request_vehicle_fare_payment	This data flow is sent from the Manage Transit fare billing on vehicle facility to the Provide Electronic Payment Services function. It requests payment processing of one or more transit fare transactions from on-board a transit vehicle. This flow provides for both batch (low value/high usage) fare transactions (e.g. city bus routes) and for high value/low volume, interactive, near real-time transactions (e.g. individualized flexible transit). The size assumption below is appropriate for the interactive mode of operation (one transaction	Transit_route_number + transit_vehicle_identity +transit_vehicle_fare_collection_method + list_size{transit_fare + transit_user_vehicle_tag_identity}.

DDE Name	DDE Description	DDE Definition
	per message) which can be assumed to present the greater stress on the transit vehicle communications process due to the higher frequency of operation. The data flow consists of the following data items each of which is defined in its own DDE:	
rideshare_ payment_ confirmation	This data flow is used by the Provide Electronic Payment Services function to confirm to the Provide Driver and Traveler Services function that payment for a traveler's request and confirmation of a successful rideshare match has been made.	
rideshare_ payment_request	This data flow is used by the Provide Driver and Traveler Services function to request that the Provide Electronic Payment Services function carries out the transactions needed for payment of charges necessary for a traveler to make use of ridesharing services. It consists of the following data items each of which is define in its own DDE:	Credit_identity + rideshare_cost.
route_reports	This data flow is sent from the Provide Driver and Traveler Services function to the Plan System Deployment function and contains a snap shot of the current usage travelers are making of roads and other (non-transit) methods of transport. It contains the following data items each of which is define in its own DDE:	Current_other_routes_use + current_road_network_use.
route_data	This data flow is used to transfer data between the Provide Driver and traveler Services function and the Manage Traffic function. It contains a wide variety of data covering road network use by guided vehicles and requests for current traffic data which can be presented to travelers, as well as a traveler profile for subscription of data. The data flow consists of the following data items each of which is defined in its own DDE:	Current_other_routes_use + current_road_network_use + current_transit_routes_use + logged_special_vehicle_ route + special_vehicle_priority_ routing + traffic_data_advisory_ request + traffic_data_guidance_ request + traffic_data_kiosk_request + traffic_data_personal_ request + traffic_data_ridesharing_ request + traveler_traffic_profile.
to_commercial_ vehicle	This data flow is sent to a commercial vehicle from the Manage Commercial Vehicles function. It contains a request for data to be	tcv-lock_tag_data_request.

DDE Name	DDE Description	DDE Definition
	provided by the commercial vehicle for use within the function. The data flow consists of the following items each of which is defined in its own DDE:	
to_commercial_ vehicle_driver	This data flow is sent to the commercial vehicle driver from the Manage Commercial Vehicle function and contains responses to requests for information or requests for further data to be input. It consists of the following data items each of which is defined in its own DDE:	tcvd-border_pull_in_output + tcvd-confirm_data_stored + tcvd-critical_safety_ problem + tcvd-data_input_request + tcvd-data_request + tcvd-enrollment_ confirmation + tcvd-enrollment_payment_ confirmation + tcvd-general_pull_in_output + tcvd-inspection_results + tcvd-on_board_pull_in_ output + tcvd-other_data_request + tcvd-output_data + tcvd-output_tag_data + tcvd-clearance_pull_in_ output + tcvd-route_data + tcvd-routing_instructions + tcvd-safety_pull_in_output + tcvd-type_input_request.
to_commercial_ vehicle_manager	This data flow is sent to the commercial fleet manager from the Manage Commercial Vehicles function and contains data to be output to the manager. It consists of the following data items each of which is defined in its own DDE:	tcvm-confirm_enrollment_ data_stored + tcvm-data_input_request + tcvm-driver_route_ instructions + tcvm-enrollment_ confirmation + tcvm-enrollment_payment_ confirmation + tcvm-other_data_request + tcvm-output_tag_data + tcvm-preclearance_results + tcvm-roadside_activity_ report + tcvm-route_data.
to_CVO_ information_ requestor	This data flow is sent from the commercial vehicle information requester to the Manage Commercial Vehicles function. It contains information produced in response to a previous data request. The data flow consists of the following item which is defined in its own DDE:	Tcvoir-carrier_or_vehicle_ information.
to_driver	This data flow is sent to the driver from the Provide Driver and Traveler Services, Manage Traffic and Provide Electronic Payment	td-advisory_information + td-broadcast_information + td-driving_guidance

DDE Name	DDE Description	DDE Definition
	Services functions. It contains output from traffic indicators (intersection and pedestrian controllers, signs, etc.), the results of payment transactions and on-line vehicle guidance data that has been requested by the driver. The data flow consists of the following data items each of which is defined in its own DDE:	+ td-guidance_input_request + td-guidance_map_update_ response + td-guidance_route_details + td-information_for_drivers_ in_traffic_FB + td-other_services_parking_ response + td-other_services_toll_ response + td-parking_lot_payment_ confirmed + td-parking_lot_payment_ invalid + td-toll_payment_confirmed + td-toll_payment_invalid.
to_enforcement_ agency	This data flow is sent from the Manage Emergency Services or Commercial Vehicle Operations functions to the enforcement agency and contains information about violations that have been detected by many of the other functions within ITS and requests for information from the enforcement agency. The data contained in each of these flows will enable the enforcement agency to carry out a prosecution of the offender if required and to provide access to its repository of information. The data flow consists of the following data item which is defined in its own DDE:	Tea-cv_violation_data + tea-fare_collection_ roadside_violation_data + tea-fare_collection_vehicle_ violation_data + tea-fare_payment_ violation_data + tea-parking_violation_data + tea-toll_violation_data + tea-traffic_violation_data + tea-cv_request_for_ information.
to_financial_ institution	This data flow is sent to the Financial Institution from the Provide Electronic Payment Services function and contains requests for payment to be made for services being requested by travelers or drivers, or details of those involved in bad transaction data. It consists of the following data items each of which is defined in its own DDE:	tfi-cv_payment_request + tfi-fare_payment_violator_ data + tfi-parking_lot_payment_ violator_data + tfi-request_charges_ payment + tfi-request_fare_payment + tfi-request_toll_payment + tfi-toll_payment_violator_ data + tfi-driver_map_payment_ request + tfi-other_services_payment_ request + tfi-registration_payment_ request + tfi-traveler_display_ payment_request + tfi-traveler_map_payment_ request + tfi-traveler_other_services_ payments_request

DDE Name	DDE Description	DDE Definition
		+ tfi-traveler_rideshare_ payment_request.
to_intermodal_ freight_depot	This data flow is a request for details of the movement of freight by means that may include methods other than commercial vehicles, e.g. heavy rail, air, sea, river, etc.	
to_intermodal_ freight_shipper	This data flow is a request for data about the services available to ship freight by means other than commercial vehicles, e.g. heavy rail, air, sea, river, etc.	
to_other_CVAS	This data flow is sent to the other commercial vehicle administration system from the Manage Commercial Vehicles function and contains requests for data from and data provided against previous requests. It consists of the following data items each of which is defined in its own DDE:	tocvas-commit_remote_ enrollment + tocvas-data_table + tocvas-enrollment_ confirmation + tocvas-enrollment_request + tocvas-provide_data.
to_parking_ service_provider	This data flow is sent from the Manage Traffic function and contains reports of the transactions that have taken place at a parking lot or a request for a space reservation for which advanced payment is being made. It consists of the following data items each of which is defined in its own DDE:	tpsp-change_lot_state + tpsp-parking_lot_charge_ change_request + tpsp-request_advanced_ parking_payment + tpsp-transaction_reports.
to_payment_ instrument	This data flow is sent to the payment instrument by the Provide Electronic Payment Services function. It consists of two types of data, that which requests payment for a service from the credit stored by the instrument itself, and that which gives notice that payment for the service will charged to the credit identity provided by the instrument. The data flow consists of the following data items each of which is defined in its own DDE:	tpi-debited_fare_payment_at_ roadside + tpi-debited_commercial_ manager_payment + tpi-debited_payment_at_ parking_lot + tpi-debited_payment_at_ personal_device + tpi-debited_transit_user_ payment_at_roadside + tpi-debited_transit_user_ payment_at_vehicle + tpi-debited_traveler_ payment_at_roadside + tpi-debited_payment_at_ toll_plaza + tpi-debited_driver_ payment_at_vehicle + tpi-debited_payment_on_ transit_vehicle + tpi-request_fare_payment_ at_roadside + tpi-request_fare_payment_ on_transit_vehicle + tpi-request_payment_at_ parking_lot

DDE Name	DDE Description	DDE Definition
		+ tpi-request_payment_at_ toll_plaza.
to_rail_ operations	This data flow is sent to a railroad operated operations center (or centers) from an ITS Manage Traffic function. It contains information about scheduled and/or predicted highway events that may be relevant to rail traffic management (e.g. HRI maintenance schedules, HAZMAT incidents near railroads, etc.). This is typically informational data and is not required for timely operation of grade crossing protection and safety devices. It does however have a mechanism for notification of incidents or situations that are not normally detected and reported at HRIs and through wayside rail equipment. This data flow consists of the following data items each of which is defined in its own DDE:	Tro-event_schedules + tro-incident_notification + tro-equipment_status.
to_toll_operator	This data flow is sent from the Provide Electronic Payment function to the operator at a toll plaza and contains previously requested transaction reports. It consists of the following data items each of which is defined in its own DDE:	tto-transaction_reports.
to_toll_service_ provider	This data flow is sent from the Provide Electronic Payment Services function to the toll service provider. It contains the requests for changes in toll prices, and advanced tolls, plus new toll price data. The data flow consists of the following data items each of which is defined in its own DDE:	ttsp-credit_identity + ttsp-toll_price_changes_ request + ttsp-toll_segments + ttsp-transaction_reports + ttsp-vehicle_identity.
to_wayside_ equipment	This data flow represents information for trains or hi-rail vehicles approaching a specific highway grade crossing and their crews. It is provided by HRI traffic control elements to rail owned and operated wayside interface equipment (train signaling circuits, automatic control interfaces, local connections to centralized sites via railroad communications networks, etc.). This is a time critical flow and requires the most direct communications path available to a train approaching a grade crossing. This data flow consists of the following data items each of which is defined in its own DDE:	twe-stop_train_indication + twe-stop_highway_ indication + twe-hri_status.
toll_operational_	This data flow is sent from the Provide	Date

DDE Name	DDE Description	DDE Definition
data	Electronic Payment Services function to the Plan System Deployment function. It contains data about the cost of toll segments and the number of users of those segments during the time period since the data was last sent. The data flow consists of the following data items each of which is defined in its own DDE:	+ list_size + list_size{toll_cost toll_segment_identity toll_segment_users} + time.
toll_price_data	This data flow is used within the Provide Electronic Payment Services function. It contains the price for each road segment to which a toll applies, with the time and date for when it applies. The data flow consists of the following data items each of which is defined in its own DDE:	toll_segment_identity + toll_price + toll_price_application_time + vehicle_type_for_tolls.
toll_price_data_ request	This data flow is used within the Provide Electronic Payment Services function. It contains a request for the current toll price data to be provided from the store that is being used to calculate toll costs.	
toll_price_details	This data flow is sent from the Provide Electronic Payment Services function to the Manage Traffic function and contains the price for each road segment to which a toll applies, with the time and date for when it applies. This data will be used by the Manage Travel Demand facility in its efforts to re-distribute travel demand to the more efficient providers. The data flow consists of the following data items each of which is defined in its own DDE:	toll_segments + toll_price + toll_price_application_time + vehicle_type_for_tolls.
toll_price_ direct_details	This data flow contains the price for each road segment to which a toll applies, with the time and date for when it applies. This data will be used by the Manage Travel Demand facility in its efforts to re-distribute travel demand to the more efficient providers. The data flow consists of the following data items each of which is defined in its own DDE:	toll_segments + toll_price + toll_price_application_time + vehicle_type_for_tolls.
toll_price_ direct_request	This data flow contains a request for the current prices being charged for toll segments on the road and highway network.	
toll_price_ request	This data flow is sent from the Manage Traffic function to the Provide Electronic Payment Services function and contains a request for the current prices being charged for toll segments	

DDE Name	DDE Description	DDE Definition
	on the road and highway network.	
toll_tag_data_ input	This data flow is sent from the Provide Electronic Payment Services function to the Manage Traffic function. It contains the data from a toll tag on-board a vehicle which will be used to calculate vehicle journey times for links in the road (surface street) and freeway network served by the Manage Traffic function. The data flow consists of the following data item which is defined in its own DDE:	toll_tag_data.
toll_tag_data_ needed	This data flow is used within the Manage Traffic and Provide Electronic Payment Services functions to request the output of the data from a parking lot tag that may be on-board a vehicle. This data will be used to calculate vehicle journey times for links in the road (surface street) and freeway network served by the Manage Traffic function.	
toll_violation_ information	This data is used by the Provide Electronic Payment Services functions to send data about a violator of the toll collection processes to the Manage Emergency Services function. This data will contain a digitized video image of the vehicle trying to violate the toll collection process.	
traffic_data_ flow	This data flow is sent from the Manage Traffic function to the Provide Driver and Traveler Services function. It contains traffic data either to be provided direct to travelers or for use by the route guidance and route selection processes. The data flow consists of the following data items each of which is defined in its own DDE:	Current_roadway_network_ state + link_data_for_guidance + traffic_data_for_advisory_ output + traffic_data_for_guidance + traffic_data_for_kiosks + traffic_data_for_personal_ devices + traffic_data_for_ridesharing + prediction_data + predicted_incidents + vehicle_signage_data + vehicle_smart_probe_data_ output.
transfer_fares_ to_tolls	This data flow is used within the Provide Electronic Payment Services function. It is sent from the fare payment facility to the toll payment facility and contains the following data items each of which is define in its own DDE:	Advanced_tolls + advanced_fares_confirm.
transfer_tolls_ to_charges	This data flow is used within the Provide Electronic Payment Services function. It is sent from the toll payment facility to the parking lot	Advanced_charges + advanced_tolls_confirm.

DDE Name	DDE Description	DDE Definition
	charge payment facility an contains the following items of data each of which is defined in its own DDE:	
transfer_tolls_ to_fares	This data flow is used within the Provide Electronic Payment Services function. It is sent from the toll payment facility to the transit fare payment facility and contains the following data items each of which is defined in its own DDE:	Advanced_fare_details + advanced_tolls_confirm.
transit_data	This data flow is sent from the Manage Transit function to the Provide Driver and Traveler Services function and contains information that is being provided in response to requests from drivers or travelers. It consists of the following data items each of which is defined in its own DDE:	Paratransit_personal_schedule + transit_incident_data + transit_running_data_for_ advisory_output + transit_running_data_for_ guidance + transit_services_for_ advisory_data + transit_services_for_ guidance + transit_services_for_kiosks + transit_services_for_ personal_devices + transit_deviations_ for_kiosks + transit_deviations_for_ personal_devices.
transit_fare_data	This data flow is used within the Provide Electronic Payment Services function and contains details of the fares being currently charged for transit services. It consists of the following item which is defined in its own DDE:	List_size + list_size{transit_fares}.
transit_fare_ data_request	This data flow is used within the Provide Electronic Payment Services function. It contains a request for the current transit fare price data to be provided from the store that is being used to calculate transit fares.	
transit_fare_ details	This data flow is sent from the Provide Electronic Payment Services function to the Manage Traffic function and contains details of the fares being currently charged for transit services. It consists of the following data items each of which is defined in its own DDE:	List_size + list_size{transit_route_ number + transit_route_segment_list + transit_user_category + transit_route_use_time}.
transit_fare_ direct_details	This data flow contains details of the fares being currently charged for transit services. It consists of the following data items each of which is defined in its own DDE:	list_size + list_size{transit_route_ number + transit_route_segment_list + transit_user_category + transit_route_use_time}.
transit_fare_	This data flow contains a request for the current	

DDE Name	DDE Description	DDE Definition
direct_request	prices being charged for transit fares.	
transit_fare_ request	This data flow is sent from the Manage Traffic function to the Provide Electronic Payment Services function and contains a request for the current prices being charged for transit fares.	
transit_inputs	This data flow is sent from the Manage Transit function to the Manage Traffic function and contains information about the operation of transit vehicles, requests for preemption at signalized intersections and the response to requests for changes in transit services that have been made to help redistribute traveler demand. It consists of the following data items each of which is defined in its own DDE:	Parking_lot_transit_response +transit_roadway_overall_ priority + transit_vehicle_roadway_ preemptions + transit_ramp_overall_ priority + transit_services_for_ demand + transit_services_changes_ response + transit_running_data_for_ demand + transit_probe_data.
transit_payment_ data	This data flow is sent from the Manage Transit function to the Provide Electronic Payment Services function and contains data used in payment transactions. It consists of the following data items each of which is defined in its own DDE:	Advanced_tolls_and_charges_ roadside_request +advanced_tolls_and_ charges_vehicle_request + bad_tag_list_request + other_services_roadside_ request + other_services_vehicle_ request + request_roadside_fare_ payment + request_vehicle_fare_ payment + transit_services_for_ advanced_fares + transit_user_advanced_ payment_at_roadside + transit_user_advanced_ payment_on_vehicle + transit_user_roadside_image + transit_user_vehicle_image.
transit_payment_ results	This data flow is sent from the Provide Electronic Payment Services function to the Manage Transit function and contains the results of payment transactions. It consists of the following data items each of which is defined in its own DDE:	Advanced_tolls_and_charges_ roadside_confirm + advanced_tolls_and_ charges_vehicle_confirm + bad_tag_list_update + confirm_roadside_fare_ payment + confirm_vehicle_fare_ payment + other_services_roadside_ response + other_services_vehicle_ response

DDE Name	DDE Description	DDE Definition
		+ request_transit_user_ roadside_image + request_transit_user_ vehicle_image + transit_roadside_fare_data + transit_vehicle_fare_data + transit_user_roadside_ credit_identity + transit_user_roadside_ tag_data + transit_user_vehicle_credit_ identity + transit_user_vehicle_tag_ data.
transit_requests	This data flow is sent from the Provide Driver and Traveler Services function to the Manage Transit function and contains requests for information about transit services or a request for a paratransit service, plus vehicle location data and transit user tag data. It consists of the following data items each of which is defined in its own DDE:	Paratransit_service_confirmati on + paratransit_trip_request + transit_conditions_ advisories_request + transit_conditions_ guidance_request + transit_deviation_kiosk_ request + transit_deviations_personal_ request + transit_services_advisories_ request + transit_services_guidance_ request + transit_services_kiosk_ request + transit_services_personal_ request + traveler_transit_profile + vehicle_location_for_ transit.
transit_roadside_ fare_data	This data flow is sent by the Provide Electronic Payment Services function to the Manage Transit function and contains details of the fares being currently charged for regular transit services. It is for use in calculating fares that are to be paid by transit users at the roadside, i.e. a transit stop, and consists of the following data item which is defined in its own DDE:	Transit_fare_data.
transit_services_ for_advanced_ fares	This data flow is sent from the Manage Transit function to the Provide Electronic Payment Services function. It contains details of the transit user fares for all the transit routes operated by the transit fleet from which the request was made. This data is for use in processing advanced transit fare payments	Transit_route_fare_data.

DDE Name	DDE Description	DDE Definition
	initiated by drivers at toll plazas or parking lots. The data flow consists of the following data item which is defined in its own DDE:	
transit_updates	This data flow is sent from the Manage Traffic function to the Manage Transit function and contains traffic data for use in transit operations, requests for information on transit services, or requests for changes to transit services to try and re-distribute traveler demand. It consists of the following data items each of which is defined in its own DDE:	Parking_lot_transit_request + prediction_data **+transit_conditions_ demand_ request** + transit_ramp_priority_given + transit_roadway_priority_ given + transit_services_demand_ request + transit_services_changes_ request + traffic_data_for_transit.
transit_user_ advanced_ payment_at_ roadside	This data flow is sent from the Manage Transit function to the Provide Electronic Payment Services function. It contains the cost of advanced payments that must be deducted from the credit currently stored on the payment instrument, being used by a transit user at the roadside, i.e. a transit stop. These advanced payments may cover tolls, and/or parking lot charges, and/or transit fares. The data flow consists of the following data items each of which is defined in its own DDE:	Stored_credit + parking_lot_cost + toll_cost + transit_fare.
transit_user_ advanced_ payment_on_ vehicle	This data flow is sent from the Manage Transit function to the Provide Electronic Payment Services function. It contains the cost of advanced payments that must be deducted from the credit currently stored on the payment instrument being used by a transit user on-board a transit vehicle. These advanced payments may cover tolls, and/or parking lot charges, and/or transit fares. The data flow consists of the following data items each of which is defined in its own DDE:	Stored_credit + parking_lot_cost + toll_cost + transit_fare.
transit_user_ roadside_credit_ identity	This data flow is sent from the Provide Electronic Payments Services function to the Manage Transit function and contains the credit identity of a transit user at the roadside, i.e. a transit stop. It is obtained as data input from the payment instrument terminator and consists of the following data item which is defined in its own DDE:	Credit_identity.
transit_user_ roadside_image	This data flow is sent from the Manage Transit function to the Provide Electronic Payment	

DDE Name	DDE Description	DDE Definition
	Services function. It contains an JPEG compressed image of the transit user who has violated the transit fare collection process at the roadside, i.e. at a transit stop. The data will be used in subsequent transit fare violation processing.	
transit_user_ roadside_tag_ data	This data flow is used within the Provide Electronic Payment Services function and contains the data that has been provided by the payment instrument being used by the transit user at the roadside. This may be either a credit identity, or the value of the credit currently stored by the payment instrument, to which transit fares may be charged. The data flow consists of the following items each of which is defined in its own DDE:	Credit_identity + stored_credit.
transit_user_ vehicle_credit_ identity	This data flow is sent from the Provide Electronic Payments Services function to the Manage Transit function and contains the credit identity of a transit user on-board a transit vehicle, or a stored credit value. Either data item is obtained by a process within the Provide Electronic Payment Services function as data input from the payment instrument terminator and consists of the following data items each of which is defined in its own DDE:	Credit_identity + stored_credit.
transit_user_ vehicle_image	This data flow is sent from the Manage Transit function to the Provide Electronic Payment Services function. It contains a compressed image of the transit user who has violated the transit fare collection process on-board a transit vehicle. The data will be used in subsequent transit fare violation processing.	
transit_user_ vehicle_tag_data	This data flow is used within the Provide Electronic Payment Services function and contains the data that has been provided by the payment instrument being used by the transit user on-board a transit vehicle. This may be either a credit identity, or the value of the credit currently stored by the payment instrument, to which transit fares may be charged. The data flow consists of the following items each of which is defined in its own DDE:	Credit_identity + stored_credit.
transit_vehicle_ fare_data	This data flow is sent by the Provide Electronic Payment Services function to the Manage	Transit_fares.

DDE Name	DDE Description	DDE Definition
	Transit function and contains details of the fares being currently charged for regular transit services. It is for use in calculating fares that are to be paid by transit users on-board a transit vehicle and consists of the following data item which is defined in its own DDE:	
traveler_ payment_ request	This data flow is used to send traveler payment information for a confirmed trip from the Provide Driver and Traveler Services function to the Provide Electronic Payment Services function. The payment will have been initiated by input from the traveler to a kiosk or a personal device. The data flow consists the following data items each of which is defined in its own DDE:	Credit_identity + ride_segments + parking_space_details + stored_credit + toll_route_segments + transaction_number + traveler_identity.
traveler_ payment_ response	This data flow is sent by the Provide Electronic Payment Services function to the Provide Driver and Traveler Services function to indicate the payment for a confirmed trip has been successfully completed. The payment will have been initiated by input from the traveler to a kiosk or a personal device. The data flow consists of the following data items each of which is defined in its own DDE:	Transaction_number + advanced_tolls_confirm + advanced_fares_confirm + advanced_parking_lot_ charges_confirm.
traveler_ personal_credit_ identity	This data flow is sent from the Provide Electronic Payments Services function to the Provide Driver and Traveler Services function and contains the credit identity of a traveler using a personal device, e.g. PDA. It is obtained as data input from the payment instrument terminator and consists of the following data items each of which is defined in its own DDE:	Credit_identity + stored_credit.
traveler_ personal_trip_ costs	This data flow is sent from the Provide Driver and Traveler Services function to the Provide Electronic Payment Services function. It contains the cost of a traveler's trip based on a previous trip request and confirmation input by the traveler from a personal device such as a PDA. This cost is to be deducted from the credit currently stored on the traveler's payment instrument. The data flow includes the following data items each of which is defined in its own DDE:	Stored_credit + traveler_identity + traveler_total_trip_cost.
traveler_	This data flow is sent from the Provide	Credit_identity.

DDE Name	DDE Description	DDE Definition
roadside_credit_ identity	Electronic Payments Services function to the Provide Driver and Traveler Services function and contains the credit identity of a traveler using a roadside facility such as a kiosk. It is obtained as data input from the payment instrument terminator and consists of the following data item which is defined in its own DDE:	
traveler_ roadside_trip_ costs	This data flow is sent from the Provide Driver and Traveler Services function to the Provide Electronic Payment Services function. It contains the cost of a traveler's trip based on a previous trip request and confirmation input by the traveler from a roadside unit such as a kiosk. This cost is to be deducted from the credit currently stored on the traveler's payment instrument. The data flow includes the following data items each of which is defined in its own DDE:	Kiosk_identity + stored_credit + traveler_total_trip_cost.
vehicle_ location_for_cv	This data flow is sent from the Provide Driver and Traveler Services function to the Manage Commercial Vehicles function. It contains the vehicle location data for use in reporting on-board data to the commercial fleet manager, or the driver acting in this role. The data is computed from data input to sensors controlled by the processes that determines vehicle location. The data flow consists of the following data item which is defined in its own DDE:	Location_identity.
vehicle_toll_ probe_data	This data flow is sent from the Provide Electronic Payment Services function to the Provide Driver and Traveler Services function. It contains the smoothed average vehicle journey times for the route segment between two toll collection points, and the identity of the route segment. The data is used to calculate link journey times for in-vehicle guidance purposes. The data flow consists of the following data items each of which is defined in its own DDE:	List_size +list_size{route_segment_ identity + route_segment_journey_ time_from_tolls}.
violation_ information	This data is used by the Manage Transit and Provide Electronic Payment Services functions to send data about a violator of the toll, parking lot or fare collection processes to the Manage	Fare_violation_information +parking_lot_violation_ information + toll_violation_information.

DDE Name	DDE Description	DDE Definition
	Emergency Services function. It consists of the following data items each of which is defined it its own DDE:	

Appendix D

Mapping Table – All Projects to Standards

	Standard Name	Standard Title	Mayday Support	ITS Planning
1	TS 3.PRO	NTCIP - Profiles - Framework and Classification of Profiles		
2	TS 3.RMC	NTCIP - Object Definitions for Ramp Meter Control		
3	TS 3.VCC	NTCIP - Object Definitions for Video Camera Control		
4	TS 3.CLA.C	NTCIP - Class A and Class C Profile		
5	TS 3.HAR	NTCIP - Object Definitions for Highway Advisory Radio (HAR)		
6	TS 3.FTP	NTCIP - File Transfer Protocol – Application Profile		
7	TS 3.7	NTCIP - Object Definitions for Environmental Sensor Stations		
8	TS 3.TFTP	NTCIP - Trivial File Transfer Protocol – Application Profile		
9	TS 3.CORBA, TS 3.DATEX	NTCIP - Application Profile - CORBA & Data Exchange (DATEX)		•
10	TS 3.OER	NTCIP - Octet Encoding Rules		
11	TS 3.1	NTCIP - Overview		
12	TS 3.2	NTCIP - Simple Transportation Management Framework (STMF)		
13	TS 3.3	NTCIP - Class B Profile		
14	TS 3.4	NTCIP - Global Object Definitions		
15	TS 3.5	NTCIP - Object Definitions for Actuated Traffic Signal Controller Units		
16	TS 3.6	NTCIP - Object Definitions for Dynamic Message Signs		
17	TS 3.PMP232	NTCIP - Point-to-Multipoint Protocol/RS232 Subnetwork Profile		
18	TS 3.TSS	NTCIP - Object Definitions for Transportation Sensor Systems (formerl		
19	TS 3.DCM	NTCIP - Data Collection & Monitoring Devices		
20	TS 3.STMF	NTCIP - STMF Application Profile		
21	TS 3.TUI	NTCIP - Internet (TCP/IP & UDP/IP) Transport Profiles		
22	ITE-9601-1	ATMS Data Dictionary (TMDD) - Section 1&2 (Links/Nodes/Events) (Tl		
23	ITE-9601-3	ATMS Data Dictionary (TMDD) - Section 3&4 (Traffic Control/DMS/Vid		•
24	ITE-9603-1	ATC Software Application Interface (API)		
25	ITE-9603-2	ATC Physical Cabinet Functional Design		
26	ITE-9603-3	Advanced Transportation Controller (ATC) Functionality and Interface [		
27	ITE-9604-1	Message Set for External TMC Communication (MS/ETMCC) (TM 2.01		
28	ITE-9604-2	Message Set for External TMC Communication (MS/ETMCC) - Bundle		
29	TCIP-CC	TCIP – Control Center Objects		
30	TCIP-CPT	TCIP – Common Public Transportation Objects		
31	TCIP-FC	TCIP – Fare Collection Objects		
32	TCIP-FRAME	TCIP – Framework		
33	TCIP-IM	TCIP – Incident Management Objects		
34	TCIP-OB	TCIP – Onboard Objects		
35	TCIP-PI	TCIP – Passenger Information Objects		
36	TCIP-SCH	TCIP – Scheduling/Runcutting Objects		
37	TCIP-SP	TCIP – Spatial Representation Objects		
38	TCIP-TM	TCIP – Traffic Management Objects		
39	TS284	Commercial Vehicle Safety Reports		
40	TS285	Commercial Vehicle Safety and Credentials Information Exchange		
41	TS286	Commercial Vehicle Credential		
42	ASTM1	Standard Specification for DSRC - Physical Layer 902-928 MHz (PS 11		
43	ASTM2	Standard Specification for DSRC - Data Link Layer (Draft)		
44	Nsrc-1	High Speed FM Subcarrier Waveform Standard (CEMA1)		
45	P1512	Standard for Common Incident Management Message Set (IMMS) for	•	
46	ITSPP#5	Survey of Communications Technologies		
47	ITSPP#6-A	ITS Data Dictionaries Guidelines		
48	P1404	Guide for Microwave Communications System Development		
49	P1454	Recommended Practice for Selection and Installation of Fiber Optic Ca		
50	P1455	Message Sets for DSRC ETTM & CVO		
51	P1488	Standard for Message Set Template for ITS		
52	P1489	Standard for Data Dictionaries for Intelligent Transportation Systems		
53	J1663	Truth-in-Labeling Standard for Navigation Map Databases		
54	J1708	Serial Data Comm. Between MicroComputer and Heavy Duty Vehicle /		
55	J1760	ITS Data Bus Data Security Services Recommended Practice		
56	J1761	ITS Terms and Definitions Information Report		
57	J1763	A Conceptual ITS Architecture: An ATIS Perspective – Information Rep		
58	J1764	ISP-Vehicle Location Referencing Standard		
49	J2256	In-Vehicle Navigation System Communication Device Message Set Inf		
60	J2313	On-Board Land Vehicle Mayday Reporting Interface	•	
61	J2352	Mayday Industry Survey Information Report		
62	J2353	Advanced Traveler Information System (ATIS) Data Dictionary		
63	J2354	Advanced Traveler Information System (ATIS) Message Set		
64	J2355	ITS Data Bus Reference Architecture Information Report		
65	J2364	Standard for Navigation and Route Guidance Function Accessibility W	•	
66	J2365	Standard for Navigation and Route Guidance Man-Machine Interface T	•	
67	J2366	ITS Data Bus Protocol - Link Layer Recommended Practice (J2366-2)		
68	J2366/1	ITS Data Bus Protocol – Physical Layer Recommended Practice (J236		
69	J2366/4	ITS Data Bus Protocol - Thin Transport Layer Recommended Practice		
70	J2366/7	ITS Data Bus Protocol – Application Layer Recommended Practice		
71	J2367	ITS Data Bus Gateway Recommended Practice		
72	J2368	ITS Data Bus Conformance Test Recommended Practice		
73	J2369	Standards for ATIS Message Sets Delivered Over Bandwidth Restricte		
74	J2372	Field Test Analysis Information Report		
75	J2373	Stakeholder's Workshop Information Report		
76	J2374	National Location Referencing Information Report		
77	J2395	ITS In-Vehicle Message Priority	•	
78	J2396	Measurement of Driver Visual Behavior Using Video Based Methods (I	•	
79	J2399	Adaptive Cruise Control: Operating Characteristics and User Interface	•	
80	J2400	Forward Collision Warning: Operating Characteristics and User Interfa	•	

Appendix E

Benefit/Cost Analysis Details

Des Moines Traffic/Incident Management Program: Estimate of Benefits

The two tangible benefits of a traffic/incident management program are reduction in traffic delay and reduction in crashes.

Delay

The Des Moines Early Deployment Plan estimated that a fully deployed traffic management system/incident management program would reduce total traffic delay on the Des Moines network by 10% to 33%. Based on current traffic conditions, the expected benefit would range from $1 million to $4 million per year. The mid-range estimate of the potential benefit is **$2.5 Million per year**.

Crash Reduction

A fully deployed and integrated traffic management system/incident management program can be expected to reduce crashes by between 15% and 50%.[1] For the purposes of this analysis, the middle of the range or a 32.5% reduction in crashes is assumed.

The majority of the Des Moines metropolitan area falls within Polk County. Polk County averages 1,386 interstate and freeway crashes per year. The average annual cost of a crash along an urban interstate in Iowa is $17,875 (in 1998 dollars). Fully deployed, a Des Moines traffic management system and incident management program is expected to reduce accidents by 32% or 444 crashes per year. At an average cost of $17,875 per crash, the average annual savings is estimated to be **$7.9 Million.**

The estimated benefit of the Des Moines Traffic Management System/Incident Management Plan is **$10.4 Million.**

This benefit estimate should be considered to be on the low end of the range of expectations, considering that:

- Congestion and delay are treated as constant although the Des Moines MPO projects that traffic volume will double over the next twenty years and the I-235 reconstruction is likely to result in greater congestion over the next five to ten years. Projecting future vehicle miles traveled (VMT) and delay resulting from the increase is VMT beyond the scope of the project.
- Fuel savings attributable to reduction in congestion are not factored into the estimate.
- Air quality benefits are not factored into the estimate.

[1] *Intelligent Transportation Infrastructure Benefits: Expected and Experienced*, USDOT, FHWA, January 1996.)

Des Moines Traffic Management System/Incident Management Program: Benefit/Cost Analysis

Annual Benefit-100% Deployment = $10,400,000

	Year										
	2	3	4	5	6	7	8	9	10	11	12
Des Moines TMS	$ 2,750,000	$ 2,750,000	$ 2,750,000	$ 2,750,000	$ 2,750,000	$ 2,750,000	$ 2,750,000	$ 2,750,000	$ 2,750,000	$ 2,750,000	$ 2,750,000
Des Moines IMP	$ 90,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
25% of Portable CMS Pool Project	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ -	$ -	$ -	$ -	$ -	$ -
25% of Four Statewide ATIS Projects	$ -	$ 50,000	$ 50,000	$ 50,000	$ 50,000						
Annual Capital Costs	$ 2,900,000	$ 2,860,000	$ 2,860,000	$ 2,860,000	$ 2,860,000	$ 2,750,000	$ 2,750,000	$ 2,750,000	$ 2,750,000	$ 2,750,000	$ 2,750,000
Cumulative Capital Costs		$ 5,760,000	$ 8,620,000	$ 11,480,000	$ 14,340,000	$ 17,090,000	$ 19,840,000	$ 22,590,000	$ 25,340,000	$ 28,090,000	$ 30,840,000
O&M as percent of capital costs.	0%	5%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Total Costs	$ 2,900,000	$ 3,148,000	$ 3,722,000	$ 4,008,000	$ 4,294,000	$ 4,459,000	$ 4,734,000	$ 5,009,000	$ 5,284,000	$ 5,559,000	$ 5,834,000
Total Costs Year 2 through Year 12	$ 48,951,000										
Annual Benefit percentage	0%	10%	20%	50%	75%	80%	85%	90%	90%	90%	95%
Benefit	$ -	$ 1,040,000	$ 2,080,000	$ 5,020,000	$ 7,800,000	$ 8,320,000	$ 8,840,000	$ 9,360,000	$ 9,360,000	$ 9,360,000	$ 9,880,000
Total Benefits Year 2 through Year 12	$ 71,060,000										
Benefits and Costs Year 13 through Year 22	Annual	Total									
O&M Cost	$ 3,084,000	$ 30,840,000									
Benefit-100% Deployment	$ 10,400,000	$ 104,000,000									
Total Cost-Twenty Years	$ 79,791,000										
Total Benefit-Twenty Years	$ 175,060,000										
Twenty Year Benefit to Cost Ratio	**2.2 to 1**										

I-29 through Sioux City: Cost of Crashes 1993 - 1997 (5 years)

Type of Crash	Number of Crashes	Iowa DOT Values	Total
Fatalities	7	$ 800,000	$ 5,600,000
Major Injuries	44	$ 120,000	$ 5,280,000
Minor Injuries	184	$ 8,000	$ 1,472,000
Possible or Unknown Injury	473	$ 2,000	$ 946,000
Property Damage	-	$ 3,418,230	$ 3,418,230
		Total	**$ 16,716,230**
		Benefit	**$ 2,507,435**

I-29 through Sioux City: Benefit/Cost Analysis

	Year				
	2	**3**	**4**	**5**	**6**
I-29 Incident Warning System Capital Costs	$ 100,000	$ 300,000	$ 200,000		
Cumulative Capital Costs	$ 100,000	$ 400,000	$ 600,000		
O&M as percent of capital costs	0%	10%	10%		
Total Costs	$ 100,000	$ 340,000	$ 260,000	$ 60,000	$ 60,000
Total Cost Five Years	$ 820,000				
Total Benefit Five Years	$ 2,507,435				
Five Year Benefit to Cost Ratio	**3 to 1**				

Dubuque Crash Analysis of US 151, 61, 52: Cost of Crashes 1993 - 1997 (5 years)

Type of Crash	Number of Crashes	Iowa DOT Values	Total
Fatalities	0	$ 800,000	$ -
Major Injuries	9	$ 120,000	$ 1,080,000
Minor Injuries	18	$ 8,000	$ 144,000
Possible of Unknown Injury	35	$ 2,000	$ 70,000
Property Damage	-	$ 340,123	$ 340,123
		Total	**$ 1,634,123**
		Benefit	**$ 245,118**

Dubuque Crash Analysis of US 151, 61, 52: Benefit/Cost Analysis

	Year				
	2	**3**	**4**	**5**	**6**
Dubuque Incident Warning System Capital Costs	$ 100,000	$ 300,000	$ 200,000		
Cumulative Capital Costs	$ 100,000	$ 400,000	$ 600,000		
O&M as percent of capital costs	0%	0%	10%	10%	10%
Total Costs	$ 100,000	$ 340,000	$ 260,000	$ 60,000	$ 60,000
Total Cost Five Years	$ 820,000				
Total Benefit Five Years	$ 245,118				
Five Year Benefit to Cost Ratio	**.3 to 1**				

A benefit/cost analysis was conducted first for Iowa's signalized intersection with the highest average cost of crashes and second for the twenty five intersections with the highest average annual cost of crashes.

Red Light Running One Intersection: Benefit/Cost Analysis
Annual Benefit-100% Deployment = $41,260

	Year	
	2	**3-22**
Redlight Running	$ 50,000	$ -
O&M (assume 10% of capital costs/year)	$ -	$ 5,000
Total Costs	$ 50,000	$ 95,000
Total Costs Year 2 through Year 22	$ 145,000	
Expected Annual Benefit	$ 825,200	
Twenty Year Benefit to Cost Ratio	**6 to 1**	

Red Light Running Worst Twenty-five Intersections: Benefit/Cost Analysis		
Annual Benefit-100% Deployment = $627,912		
	Year	
	2	**3-22**
Redlight Running Top 25 Intersections	$ 1,250,000	$ -
O&M (assume 10% of capital costs/year)	$ -	$ 95,000
Total Costs	$ 1,250,000	$ 1,805,000
Total Costs Year 2 through Year 22	$ 3,055,000	
Expected Annual Benefit	$ 12,558,240	
Twenty Year Benefit to Cost Ratio	**4 to 1**	

Waterloo/Cedar Falls Transit AVL: Benefit/Cost Analysis

Annual Benefit-100% Deployment = $267,000

	Year			
	2	**3**	**4**	**5**
Waterloo/Cedar Falls Transit AVL	$ 1,000,000	$ 80,000	$ 80,000	$ 80,000
O&M as percent of capital costs.	0%	10%	10%	10%
Cumulative Capital Costs	$1,000,000	$1,080,000	$1,160,000	$1,240,000
Total Costs	$ 1,000,000	$ 188,000	$ 196,000	$ 204,000
Total Costs Year 2 through Year 5	$ 1,588,000			
Annual Benefit percentage	33%	50%	85%	100%
Benefit	$ 88,110	$ 133,500	$ 226,950	$ 267,000
Total Benefits Year 2 through Year 5	$ 715,560			
Benefits and Costs Year 6 through Year 22	Annual	Total		
O&M Cost	$ 124,000	$ 1,984,000		
Benefit-100% Deployment	$ 267,000	$ 4,272,000		
Total Cost-Twenty Years	$ 3,572,000			
Total Benefit-Twenty Years	$ 4,987,560			
Twenty Year Benefit to Cost Ratio	**1.4 to 1**			

Appendix F

ITS Stakeholder/User Needs Survey

Iowa Department of Transportation Integrated ITS and Services Deployment Plan

User Needs Survey

The Iowa Department of Transportation is preparing a plan to guide the deployment of Intelligent Transportation Systems and Services in the state. Intelligent Transportation Systems (ITS) and Services refer to a wide variety of tools and techniques that focus on addressing transportation problems by improving the efficiency of the existing transportation infrastructure through the application of communications, computing, information, and other advanced technologies. The plan will identify a long-range strategy, but will also include a detailed, immediate-term component identifying specific projects for implementation in the first year. The following survey is an important tool in identifying transportation problems and issues in Iowa.

1. Respondent Identification

Please provide the following information about yourself:

Name ____________________

Agency ____________________

Title ____________________

Address ____________________

City ____________________ State __________ ZIP __________

Phone ____________________ Fax ____________________

E-mail ____________________

Please Indicate Your Affiliation:

State Government ______
Regional Agency ______
Local Government ______
Commercial Operation ______
Private Citizen ______
Trade Organization ______
Other ____________

Please Indicate Transportation Areas You Represent: ***(if applicable):***

Traveler Safety/Security ______
Emergency Services/Incident Management ______
Commercial Vehicles ______
Tourism/Traveler Information ______
Public Mobility ______
Infrastructure Operations/Maintenance ______
Fleet Operations/Maintenance ______

2. Problem Areas

Please rank the severity of each problem area listed based on the scale below. Leave the ranking blank if you do not have an opinion about the problem.

1-Not a Problem **2**-Occasional Problem **3**-General Problem **4**-Significant Problem **5**-Very Significant Problem

Problem Area		Ranking				
Travel Conditions (For Highways)	Congestion *(Recurring – rush hour traffic)*	1	2	3	4	5
	Congestion *(Non-recurring – stalled vehicles)*	1	2	3	4	5
	Safety	1	2	3	4	5
	Travel Time *(Unexpected Delays)*	1	2	3	4	5
	Unfamiliar Users/Tourists	1	2	3	4	5
	Emergency Response Time	1	2	3	4	5
	Personal Security	1	2	3	4	5
	Finding Help When Needed	1	2	3	4	5
	Construction and Maintenance Projects	1	2	3	4	5
	Seasonal Congestion	1	2	3	4	5
	Weather	1	2	3	4	5
	Access to Interstates/Freeways	1	2	3	4	5
	Air Pollution	1	2	3	4	5
	Other________________________	1	2	3	4	5
Travel Conditions (For Major City Streets)	Congestion *(Recurring – rush hour traffic)*	1	2	3	4	5
	Congestion *(Non-recurring – stalled vehicles)*	1	2	3	4	5
	Safety	1	2	3	4	5
	Travel Time *(Unexpected Delays)*	1	2	3	4	5
	Unfamiliar Users/Tourists	1	2	3	4	5
	Emergency Response Time	1	2	3	4	5
	Personal Security	1	2	3	4	5
	Finding Help When Needed	1	2	3	4	5
	Construction and Maintenance Projects	1	2	3	4	5
	Seasonal Congestion	1	2	3	4	5
	Weather	1	2	3	4	5
	Access to Freeways	1	2	3	4	5
	Air Pollution	1	2	3	4	5
	Other________________________	1	2	3	4	5
Information for Travelers	Lack of Travel Time Information	1	2	3	4	5
	Lack of Road Condition Information	1	2	3	4	5
	Lack of Weather Condition Information	1	2	3	4	5
	Lack of Adequate Alternate Routes	1	2	3	4	5
	Notification of Major Accidents	1	2	3	4	5
	Updates for Travelers	1	2	3	4	5
	Other________________________	1	2	3	4	5

1-Not a Problem	2-Occasional Problem	3-General Problem	4-Significant Problem	5-Very Significant Problem

Problem Area		Ranking				
Public Transit Service	Travel Time	1	2	3	4	5
	Safety/Security	1	2	3	4	5
	Schedule and Route Information	1	2	3	4	5
	Bus Shelter Conditions	1	2	3	4	5
	Appropriate Stop Locations	1	2	3	4	5
	Other________________________	1	2	3	4	5
Commercial Vehicle Operations	Time Associated with Vehicle Inspections	1	2	3	4	5
	Time Spent on Regulatory Matters	1	2	3	4	5
	Hazardous Materials Response Procedures	1	2	3	4	5
	Available HAZMAT Routing Information	1	2	3	4	5
	Oversize/Overweight Permitting	1	2	3	4	5
	Time Spent at Weigh Stations	1	2	3	4	5
	Lack of Roadway Conditions Information	1	2	3	4	5
	Other________________________	1	2	3	4	5

Please identify the top 3 transportation problems in your area and provide a short description of the problem, (please specify the location using the nearest roads, section lines, etc.). Also provide any concerns or issues you may have related to these problems.

Problem #1: ____

Description: ____

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Problem #2: ____

Description: ____

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Problem #3: ____

Description: ____

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3. User Needs

ITS user services are designed to help reduce transportation problems, listed in Section 2 of this survey, with the application of advanced technology systems and innovative institutional arrangements. The ITS National Program Plan identifies 30 user services grouped in 7 general categories. Please read the brief descriptions of these user services and then rate them based on the following scale. Consider the needs of all Iowa transportation users when rating the services.

1-Not a Problem	**2**-Occasional Problem	**3**-General Problem	**4**-Significant Problem	**5**-Very Significant Problem

TRAVEL AND TRANSPORTATION MANAGEMENT SERVICES

_____ **En-Route Driver Information -** Driver advisories, in-vehicle signing and route alternatives for convenience and safety.

_____ **Route Guidance -** Provides travelers with route alternatives and simple instructions on how to reach their destinations.

_____ **Traveler Services Information -** Provides a business directory, or "yellow pages" of service information.

_____ **Traffic Control -** Manages the movement of traffic on streets and highways.

_____ **Incident Management -** Helps public and private organizations quickly identify incidents/crashes and implement a response to minimize their effects on traffic.

_____ **Emissions Testing and Mitigation -** Provides information for monitoring air quality and developing air quality improvement strategies.

_____ **Highway-Rail Intersection -** Automated systems that allow deployment of safety systems to adequately warn drivers of crossing hazards.

TRAVEL DEMAND MANAGEMENT SERVICES

_____ **Demand Management and Operations -** Supports policies and regulations designed to reduce the environmental and social impacts of traffic congestion.

_____ **Pre-Trip Travel Information -** Provides information for selecting the best departure time, transportation modes and routes based on real-time status reports.

_____ **Ride Matching and Reservation -** Makes ride sharing more convenient.

EMERGENCY MANAGEMENT SERVICES

_____ **Emergency Notification and Personal Security -** Provides immediate notification of an incident/crash and an immediate request for assistance.

_____ **Emergency Vehicle Management -** Reduces the time it takes emergency vehicles to respond to an incident/crash.

PUBLIC TRANSIT OPERATIONS SERVICES

_____ **Public Transit Management -** Enhances management of public transit services by automating operations, planning, and management functions. This service includes systems that extend green lights for buses *(bus priority systems)*.

_____ **En-Route Transit Information -** Provides information to travelers using public transit after they begin their trip.

_____ **Personalized Public Transit -** Flexibly routed transit vehicles offer more convenient service to customers.

_____ **Public Travel Security -** Creates a secure environment for public transit patrons and operators.

COMMERCIAL VEHICLE OPERATIONS SERVICES, *(e.g. Motor Carriers, Trucking Services)*

_____ **Commercial Vehicle Electronic Clearance -** Facilitates domestic and international border clearance, minimizing stops.

_____ **Automated Roadside Safety Inspections -** Facilitates roadside inspections.

_____ **On-Board Safety Monitoring -** Senses the status of commercial vehicle, cargo and driver.

_____ **Commercial Vehicle Administrative Processes -** Provides electronic purchasing of credentials and automated mileage and fuel reporting and auditing.

_____ **Hazardous Material Incident Response -** Provides immediate description of hazardous materials to emergency responders.

_____ **Freight Mobility -** Provides communications between drivers, dispatchers and intermodal transportation providers.

ADVANCED VEHICLE CONTROL AND SAFETY SYSTEMS

_____ **Front-to-Back Collision Avoidance -** Helps prevent head-on and rear-end collisions between vehicles, or between vehicles and other objects or pedestrians.

_____ **Side-to-Side Collision Avoidance -** Helps prevent collisions when vehicles leave their travel lane.

_____ **Intersection Collision Avoidance -** Helps prevent collisions at intersections.

_____ **Vision Enhancement for Crash Avoidance -** Improves the driver's ability to see the roadway and objects that are on or along the roadway.

_____ **Pre-Crash Restraint Deployment -** Anticipates an imminent collision and activates passenger safety systems before the collision occurs.

_____ **Safety Readiness -** Provides warnings about the condition of the driver, the vehicle and the roadway.

_____ **Automated Vehicle Operations -** Provides a fully automated, "hands-off" operating environment.

ELECTRONIC PAYMENT SERVICES

_____ **Electronic Payment Services -** Allows travelers to pay for transportation services electronically.

4. Top Five Ideas

On the basis of your knowledge of transportation problems and possible applications of advanced technology in Iowa, please suggest some ideas that can address area-wide problems. Please attach any additional material you feel necessary to describe your ideas.

Idea #1:

Idea #2

Idea #3

Idea #4

5. Additional Comments

If you have any concerns or comments about any of the problem areas, user services, examples of ITS concepts or would like to suggest other priorities for user services, please provide them in the space below.

Appendix G

Summary of Iowa DOT Divisional Meetings and Regional Stakeholder Interviews

Statewide ITS Plan

NEEDS ASSESSMENT ACTIVITIES:

SUMMARY OF DOT DIVISIONAL MEETINGS AND REGIONAL STAKEHOLDER INTERVIEWS

This document summarizes meetings that were held with each DOT Division and interviews with groups of local transportation agency staff, or "regional stakeholders". The purpose of the meetings and interviews was to brief them on the Statewide ITS Plan development effort, and to garner their input on transportation problems and potential ITS solutions.

The DOT Division meetings were held March 23-24, 1999 at DOT Headquarters in Ames, and at the Motor Vehicle Division office in Des Moines. Four rounds of regional stakeholder interviews were held April 27-29, 1999:

- Iowa City (April 27)
- Waterloo (April 28)
- Storm Lake (April 29)

Each round of regional stakeholder interviews consisted of three separate sessions, although attendance sometimes overlapped: traffic management, incident management, and transit. Typically, between 3 and 10 local agency staff members participated in each session.

The following 45 agencies were represented in the regional stakeholder interviews (many other agencies were invited):

- Bi-State Planning Commission
- Black Hawk County
- City of Bettendorf
- City of Cedar Rapids
- City of Cedar Rapids 5 Season Transportation and Parking
- City of Coralville
- City of Council Bluffs
- City of Davenport
- City of Iowa City
- City of Waterloo
- Coralville Police Department
- Coralville Transit
- Des Moines Chamber of Commerce
- Des Moines Area Metropolitan Planning Organization
- Des Moines Transit Authority

- ECIA (Dubuque area)
- Federal Highway Administration
- Five Oaks Charters (private transit operator)
- INRCOG (Waterloo-Cedar Falls area)
- Iowa City Fire Department
- Iowa Department of Public Health EMS
- Iowa Department of Transportation (Center staff)
- Johnson County Council of Governments
- Linn County
- Linn County LIFTS
- Linn County Regional Planning Commission
- MIDAS Council of Governments
- NEICA Transit (Region 1)
- NIACOG (Mason City area)
- NWIPDC
- Omaha Metropolitan Planning Organization (MAPA)
- Ottumwa Transit
- Polk County
- Region XII Council of Governments (Sioux City area)
- RIDES Regional Transit Authority
- RTC
- Sioux City Transit
- SIMPCO
- Southeast Iowa Regional Transit Authority
- Southwest Iowa Transit Agency
- Tama County EMA/911
- University of Iowa
- Waterloo Fire Rescue
- Waterloo Police Department
- West Des Moines Police Department

This document contains the following three sections:

I. High level summary of ***Problems, Solutions and Challenges*** identified at the meetings and interviews

II. Brief summaries of individual ***DOT Division meetings***

III. Brief summaries of individual ***regional stakeholder interviews***

I. Summary of Problems, Solutions and Challenges from DOT Divisional Meetings and Regional Stakeholder Interviews

Transportation System Problems

- Safety concerns for rural/regional transit drivers and passengers
- Inefficiencies in rural/regional transit service (e.g. lack of connectivity, redundancies)
- Congestion and delay on signalized urban arterials (not widespread)
- Emergency vehicle safety and delay at signalized intersections
- Slippery pavement conditions
- Maintenance of traffic and safety along I-235 during construction
- Lack of formal, multi-jurisdictional, multi-agency incident management plans and procedures
- Inadequate work zone safety
- Snow and ice control
- Commercial vehicle administration and processing inefficiencies
- Driver awareness of traffic signals on high speed roadways, especially in rural areas
- Inadequate dissemination of traveler information by the media
- Conflicts between motorized vehicles, bicycles and pedestrians
- Inadequate coordination of construction/maintenance information sharing among agencies, including to EMS
- Inadequate construction/maintenance information to travelers
- Increasing need for railroad overpasses and impacts to EMS response
- Inefficient EMS response and long times due to inefficiently defined jurisdictional boudaries
- Incidents and major delays on high volume bridge crossings
- Narrow shoulders on urban interstates (hinders incident response and clearance)
- Accidents at low overpasses
- Inadequate weather information for travelers
- Aging population and greater safety concerns
- Travelers don't know where they are when they report an accident or congestion
- Need for real-time transit arrival time information
- Transit delays at signalized intersections (and impact on on-time performance)

Suggested Solutions

- A standardized implementation model, and set of technologies, for regional/rural transit operators, including automatic vehicle location, mobile data terminals, computer-aided scheduling and dispatch, consolidated dispatching, electronic fared payment, automated passenger counters, vehicle monitoring and coordinated transfers.
- Traffic signal coordination, within and across jurisdictions
- Emergency vehicle traffic signal preemption
- Pavement sensors and warning signs
- Traffic management and incident management strategies for I-235 during reconstruction, including surveillance cameras, vehicle detectors, changeable message signs, highway advisory radio, coordinated route detours supported by arterial street improvements, service patrols and coordinated incident management
- Formalized, multi-disciplinary and multi-agency incident management plans in major urban areas
- Use of changeable message signs, highway advisory radio and other information dissemination techniques in conjunction with work zones
- Expansion of the maintenance concept vehicle demonstration
- Continuation of Motor Vehicle Divisions projects to streamline commercial and private vehicle administrative processes and accident reporting
- Advance, "active" (e.g., linked to signal controller) warning signs for signals with high speed approaches
- More formalized arrangements with the media to communicate traveler information, including incidents and construction/maintenance
- Consolidation of planning and programming data
- Consolidation of traveler information
- Railroad sensors tied to adjacent traffic signals
- Railroad detector information provided to EMS dispatchers
- Revision of EMS response boundaries and dispatch methods
- Surveillance, vehicle sensors and warning signs at high-volume bridge crossings (e.g., I-74)
- Warning devices for low overpasses
- Supplemental roadway markers to support vehicle location (e.g., 1/10-mile markers with route and direction)
- Transit arrival time information on the Internet, by phone, and/or with station signs
- Highway advisory radio and/or kiosks for tourist information

Challenges

- Lack of ITS "champions" at the local level and at the DOT
- Lack of a clearly articulated DOT ITS role (especially in information dissemination and traffic management centers), policy and program
- Need to integrate the various ITS activities of the DOT
- Lack of ITS expertise, among local implementers and at the DOT
- Lack of adequate funding for implementation
- Uncertainty and lack of funding for operations and maintenance
- ITS is often a tough sell without significant congestion and delay
- Insuring data security and controlling access to electronic information
- Need for marketing of ITS, emphasizing real benefits, to decision makers and to end users
- Providing information to travelers without access to "high tech" (e.g., Internet)
- Need to integrate ITS activities into traditional activities (i.e., "mainstream")
- Need to attract public sector interest and leverage resources
- Ownership of traveler information and rights to sell it
- Need a justifiable approach to balancing investment across modes and throughout the state, especially rural/urban

II. DOT Divisional Meeting Summaries

Director's Staff Division
(Ames, March 23, 1999)

In attendance:
- Jim Doeden, DOT
- Mary Christy, DOT
- Dena Gray-Fisher, DOT
- Dale Vander Schaaf, DOT
- Craig Markley, DOT (Systems Planning)
- John Cunningham, DOT (Field Services)
- Jerry Dickinson, DOT
- Matt Burt, BRW
- David Plazak, CTRE
- Jeff Benson, BRW

Funding is a major concern; for implementation, for on-going maintenance and operations, and for marketing services to consumers. Funding for marketing/education should be set aside in advance, and the emphasis should be on real world benefits (e.g., lives saved, fewer delays, etc.).

Safety is the highest priority for ITS investments, followed by communications, both internal and external. Investment should be balanced between urban and rural environments and across modes. Generally, it is harder to justify expenditures in rural areas due to a lack of congestion.

ITS provides an opportunity to bridge various levels of governments, for example through centralized data bases. Partnerships and interjurisdictional projects, including with other states, should be sought. In prioritizing investments, "early winners" should be sought out, such as ITS investments to support the reconstruction of I-235 through Des Moines. Commercial vehicle operators can see big cost savings, and can help build support for ITS through early winners.

How to assimilate and disseminate information is a major issue. Should this be done completely within the DOT or should outside vendors be utilized? The fact that some users, especially in rural areas, don't have access to high technologies needs to be take into consideration.

Engineering Division
(Ames, March 24, 1999)

In attendance:
- Ian MacGillivray, DOT
- Dave Little, DOT
- Steve Gent, DOT
- Tim Simodynes, DOT
- Tim Crouch, DOT
- Chad Smith, DOT
- Tom Welch, DOT
- Matt Burt, BRW
- Jeff Benson, BRW
- Tom Maze, CTRE

Overall, the DOT's ITS program should focus on safety—in work zones, in conjunction with incidents, providing motorists information during winter driving conditions. Traffic management is also a focus, with traveler information less certain.

A number of institutional issues were identified as critical to the DOT's ITS program. These issues center on the establishment of an overall role and policy for the DOT. Several specific institutional issues were identified. First, the ITS Plan should reinforce integration and cooperation within agencies. The ITS Plan needs to bring together the various "pet" projects, to achieve a more global goal. Second, who is going to be the interface with the public, the DOT or a service provider? Third, there needs to be an increase in the level competency within the DOT, in regards to ITS. Finally, it was felt that there is not a need for a single ITS lead Division or Department. The Engineering Division would like to have the ITS expertise scattered throughout the DOT, but with a central repository of knowledge and resources.

The division is interested in ways ITS can be applied to: assist elderly drivers; assist with conflicts between highway and rail modes; warn drivers of traffic signals on rural high speed, highly traveled routes; enhance the detection of crashes and then respond in a timely manner; improve winter time roadway safety; automate enforcement (legal support lacking) and ways to improve all aspects of work zone safety.

In general, ITS cannot substitute for added roadway capacity. Integration of ITS into the I-235 reconstruction through Des Moines is seen as an important opportunity. The DOT needs to understand, and participate in the development of the National Transportation Communications and Information Protocol (NTCIP).

Maintenance Division
(Ames, March 24, 1999)

In attendance:
- Neil Volmer, DOT
- Marlee Walton, DOT
- Dennis Burkheimer, DOT
- Lee Smithson, DOT
- Matt Burt, BRW
- Howard Preston, BRW
- Jeff Benson, BRW
- Bill McCall, CTRE

The highest priority for the division is work zone safety—alerting drivers to work zone conditions and reducing speeds through the work zone to protect workers and motorists. Current information dissemination techniques are inadequate.

Winter road conditions—both snow and ice control, and the dissemination of information to motorists—is another high priority. Relative to snow and ice control, the division is currently pursuing a demonstration project that features a number of on-board technologies, including automatic vehicle location. They would like to expand this system statewide. Regarding traveler information, current information and sources are lacking; there is no information on icing/traction or visibility. The FORETELL system is seen as the foundation for statewide traveler information dissemination, but there are major unresolved issues relative to ownership of the information and the "selling" of the information. A major issue relative to information dissemination is access rights and data security, i.e., "firewalls".

The division noted the need to talk to DOT customers to determine needs and priorities, and to market ITS aggressively to non-technical decision makers, which is a real challenge. In "selling" ITS, the benefits should be emphasized, not the technologies. Overall, the division needs to avoid being too "visionary" and focus resources on operational projects.

Planning and Programming Division
(Ames, March 23, 1999)

In attendance:

- Matt Burt, BRW
- Darid Plazak, CTRE
- Dennis Tice, DOT
- Pat Cain
- Don Ward, DOT
- Lee Benfield, DOT (Cedar Rapids Center)
- Jon Ranney
- Mike Slyby, DOT (Council Bluffs Center)
- Fred Dean, DOT (Quad Cities Center)
- Harry Miller
- Peter Hallock, DOT (Transit)
- Craig Markley, DOT (Systems Planning)
- Brad Hofer

The transportation issues of specific DOT Transportation Centers (e.g., Cedar Rapids, Council Bluffs, etc.) were discussed, along with general issues relative to the statewide plan.

The major ITS related transportation issue in the Omaha-Council Bluffs area is the lack of resources to implement projects identified in the Omaha ITS Early Deployment Plan. In the Quad Cities, the need for a regional ITS plan has been identified, along with some immediate problems that may be addressed with ITS. These include serious, incident-related delays on the I-74 river bridge, need for additional traffic signal coordination, frequent truck accidents at overpasses with low clearance; and the need for tourist information. Deteriorating level of service and lack of funding for long-term physical improvements in the US 20 corridor in Dubuque is a concern. In Sioux City, interchange safety and downtown access are a concern. Iowa City, Ames and the Quad Cities have traffic concerns associated with major events.

Cedar Rapids is experiencing increasing congestion on I-380 and the tight curves and icing on the facility through downtown contribute to accidents. Congestion on Collins Road and Mount Vernon Road is also a concern in Cedar Rapids. Transit operators throughout the state are implementing, and requesting funding for, several ITS technologies, including automatic vehicle location, computer-aided scheduling and dispatch, and mobile data terminals. An effort is underway to launch a statewide effort that would encompass 11 of 16 regional transit operations. There is a concern that this effort is premature, since a successful model has not yet emerged from the pilot deployments in Cedar Rapids and Ottumwa.

General issues relative to the statewide ITS plan include: the need to improve and consolidate data for internal use (planning, programming, etc.); the need to improve and consolidate information for travelers; the need to involve the private sector; the need to use ITS to embrace and integrate the various ITS and related activities now under way in the various DOT divisions; the need for ITS activities to build upon the work done to date on the ISTEA management systems; the need to "mainstream" ITS and to include it as part of overall project costs; and the need to balance urban and rural ITS expenditures. In regard to traveler information, the objective should ultimately be to provide accurate real-time information and forecasts. The FORETELL project well form the foundation for traveler information efforts. Data consolidation activities underway with CTRE will form the foundation for internal (DOT) data efforts.

Operations and Finance Division
(Ames, March 24, 1999)

In attendance:

- Darrel Rensink, DOT (Director)
- Gary Teague, DOT (Communications)
- Trey Carlson, DOT (Communications)
- Kevon Jones, DOT (Equipment Support)
- Nancy Richardson, DOT
- Don Toms, DOT (Data Services)
- Bar Espeland, DOT (Data Services)
- Bill George, DOT (Maintenance Support)
- Merlin Allie, DOT (Maintenance Support)
- Matt Burt, BRW
- Jeff Benson, BRW

The primary interest of this division is that the full costs of ITS projects, including the communications and on-going operations and support costs, are fully identified and communicated during project development, and are taken into account in project programming decisions. In the past, these costs have not been adequately addressed early in the process. There is also a concern that data collection is not always justified—resources are expended but the data is not utilized. Overall, the division is excited about ITS but are concerned about the cost of supporting these projects.

Director Rensink emphasized the following: the need to "sell" projects to the Commission based on solid benefit-cost analysis; the need to maintain compatibility with, and take advantage of opportunities associated with national ITS efforts; the fact that "one size does not fit all" in regard to ITS deployment; and the need to fully consider all costs, including staffing resources and communications.

It was pointed out that private communications providers have approached the DOT, for example in regard to deploying a statewide fiber optic cable system. The division would like the statewide ITS plan to talk to private providers as part of the plan development.

The ITS plan should take advantage of the existing communications infrastructure throughout the state. Specifically, the plan should take into account the Iowa Access Data Project, a project just underway to establish a single point of electronic access to all state information.

Project Development Division
(Ames, March 24, 1999)

In attendance:

- Tom Cackler, DOT
- J.P. Golinvaux, DOT (Local Systems)
- Marty Sankey, DOT (I-235)
- Daniel Sprengeler, DOT (Design)
- Craig Markley, DOT (Systems Planning)
- Jeff Benson, BRW
- Howard Preston, BRW
- Tom Maze, CTRE
- Matt Burt, BRW

The six-year reconstruction of I-235 through Des Moines and work zone safety statewide were identified as the highest ITS priorities. In regard to I-235, a range of ITS technologies are being considered but major issues are unresolved at time to make decisions is running out. Concerns include not only the specification of which specific technologies are appropriate, but also: the assignment of implementation and operational responsibilities, in both the short and long terms; whether to build a single new traffic management center or to build on existing facilities; whether to have a single or multiple traffic management centers; whether systems should be temporary or permanent; and how to integrate I-235 ITS efforts into the greater Des Moines ITS program.

In regard to work zone safety, the need is to alert drivers and to reduce vehicle speeds through the work zone. A test of several technologies, including temporary rumble strips, solar powered flashers and queue monitors, will be conducted and evaluated this summer.

General issues associated with the statewide ITS program include: the difficulty in prioritizing investments among cities and across the state; the DOT role in disseminating traveler information (who does it and how?); the use of multiple traffic management centers versus a single statewide center (the division thinks that a single center may be workable); and the absence of a clear "leader" for ITS within the DOT.

Efforts to organize deployment of ITS technologies within regional transit providers statewide were noted, along with the need to develop a "cookie cutter" approach to reduce costs.

Under-utilization of the existing variable message signs in Des Moines was noted. Part of the problem is that the Highway Patrol has to contact the DOT to get a message posted, and this communication does not always occur.

Motor Vehicle Division
(Des Moines, March 24, 1999)

In attendance:

- Craig Markley, DOT (Systems Planning)
- Mike Winfrey, DOT
- Shirley Andre, DOT
- Jan Hardy, DOT
- Bill McCall, CTRE
- Matt Burt, BRW
- Jeff Benson, BRW

The Motor Vehicle Division is aggressively pursuing a range of ITS activities, and is supportive of the statewide planning effort to the extent that it does not impede the projects that they have worked hard to develop and fund. Some of the projects that they are involved in include: electronic credentialing; bar coding information on driver licenses and cab cards; over-dimension permitting; automating accident investigations; electronic citation reporting; mainline weigh-in-motion at all in-bound scales; and an automated vehicle registration fee system that will use VIN numbers.

Areas that the division would like to pursue include automation of the "desk side" of commercial vehicle operations; securement of funding for software development for the "National Model" project and expansion of the system into the "top 23 crash counties"; getting GIS/ALAS up and running; and Internet-based programs in general. In order to move ahead with several of their efforts, the division needs more programming/data processing support.

The division has good benefit/cost documentation of their projects. Also, they are currently preparing a "Mainstreaming Business Plan" that will document their projects and plans.

III. Regional Stakeholder Interview Summaries

Northeast Region
(Waterloo, April 28, 1999)

Traffic Management

In attendance:
- Richard King, Black Hawk County
- Lynn Kloberdanz, Black Hawk County
- Alan Burr, ECIA
- Krista Billhorn, NIACOG
- Kevin Blanshan, INRCOG
- Rod Larsen, DOT
- Gil Janes, Howard R. Green Co.
- Tim Mrozek, City of Waterloo
- Eric Thorson, City of Waterloo
- Craig Markley, DOT
- Jeff Benson, BRW
- Matt Burt, BRW
- Jeff Stratton, DOT

The Waterloo-Cedar Falls metro area has relatively few problems with traffic management. Daily rush hours are not severe. Congestion and delay is limited to isolated locations, and the areas surrounding retail centers, especially at holidays. The NIACOG area does not experience significant traffic congestion and most traffic issues are rural in nature, e.g., the weight of agricultural vehicles and their impact on roadways. Dubuque does not experience significant traffic congestion.

Traffic Signals

A signal optimization study is beginning in the Waterloo-Cedar Falls metro area. Currently 90% of signals in Waterloo are interconnected, but Cedar Falls has little interconnection. University Avenue in Cedar Falls is probably the main area where interconnection is needed. For a couple of high speed approaches through Waterloo on I-380/Hwy 218, signs warning motorists to "be prepared to stop" placed well ahead of traffic signals have been very effective. In Dubuque a new traffic signal system is not being used effectively; it's currently being used to do what the old system did with timed, rather than computerized, signals.

Road Capacity

In Waterloo San Marnan Drive has significant capacity and safety problems and is the greatest traffic concern in the area. Traffic becomes backed up when motorists are trying to turn left to access the shopping malls. Parking is not the issue. Reconstruction of the roadway has been proposed but the request for ICAAP funding has been turned down twice.

Access

A significant problem for emergency vehicles is lack of convenient access in Waterloo to the hospital at Hwy 21 and San Marnan. Providing a one-way entrance for emergency vehicles only from Hwy 21 has been discussed. Emergency service access to trails in the metro area is another concern.

In Dubuque access to the riverboat casinos has been a problem. Better signing and route guidance would help alleviate it.

Trails

Emergency communication along trails in the Waterloo-Cedar Falls area is limited to personal users' cell phones. Kevin Blanshan of INRCOG wondered if there were any ITS technologies for issues of trail use.

Miscellaneous Problems and Ideas

More local weather information from DTN stations and traveler information kiosks were suggested. In Dubuque, a cable channel announces construction delays. Other ideas concerned ITS uses for wildlife detection and railroad crossings. In Waterloo/Cedar Falls, kiosks to guide travelers to special event venues and other attractions was suggested.

NIACOG is interested in GPS on snow removal/maintenance vehicles and pavement data collection (i.e. the concept maintenance vehicle operated by the Iowa DOT). They are also interested in lowering sign heights to reduce knock-downs by agricultural equipment and lowering maintenance standards on extremely low volume rural roads.

Incident Management

In attendance:

- Eric Gunderson, Waterloo Police
- Dave Boesen, Waterloo Fire Rescue
- Scott Bruns, Tama County EMA/911
- Alan Burr, ECIA
- Craig Markley, DOT
- Jeff Benson, BRW
- Kevin Blanshan, INRCOG
- Jeff Stratton, DOT
- Matt Burt, BRW
- Jeff Benson, BRW

Incident Management Plans

Dubuque County has an incident management plan and a multi-disciplinary task force that meets every six weeks to discuss facets of the plan. The plan focuses on a variety of problems. Signage was stressed. Incident management detours are being put on a computer and maps are being digitized.

Officials from the Waterloo-Cedar Falls metro area do not utilize a formal incident management plan, although they do have one for major emergencies. The are very satisfied with the effectiveness of their informal procedures, which rely heavily on the consolidated emergency communications system, which includes central dispatch for law enforcement, fire, and emergency management. The arguments against formal planning are: there are not enough incidents to warrant a formal plan; it becomes a burden to keep a formal plan current; the high-turnover in staff means that new people will continually have to be taught to use the plan; and it is impossible to devise a plan that is better than what trained staff can come up with in the field.

Signal Preemption

Waterloo fire and rescue is phasing in preemptive signal equipment, but law enforcement cannot afford it (would have to equip 25 vehicles). For downtown Waterloo signals, fire still has to call dispatch to have signals manually preempted. The fire department would like to speed the implementation of the preemption equipment but lacks the funding.

Emergency Response

There's a problem with locating incidents after they have been reported by cell phone. Cell phone users have a hard time describing their location. Supplemental milepost markers would be useful.

Difficult access to Covenant Hospital at Hwy 21 and San Marnan was mentioned again in this meeting (see traffic management session summary).

Tama County emergency management suggested streamlining communications with the DOT and counties for problems such as downed stop signs. He suggested an 800 number for the DOT so the appropriate person could be paged.

Miscellaneous Ideas

A Waterloo police officer suggested building an exit ramp directly to San Marnan (see similar suggestion in traffic management summary). He also wondered about jurisdictional responsibilities for cleaning up meth lab chemicals dumped in ditches by the clean-up contractors. Will it be Waterloo or Iowa DOT?

Tama County would like better weather information for motorists, in order to reduce the volume of calls of this type to police and emergency management.

Transit

In attendance:

- Craig Markley, DOT
- Matt Burt, BRW
- Jeff Benson, BRW
- Jeff Stratton, DOT
- Alan Burr, ECIA
- Earl Henry, NEICA Transit
- Ken Swanson, RTC
- Krista Billhorn, NIACOG *(provided written input but was not in attendance)*

There was unanimous agreement about the need for coordination of regional/rural transportation services and the immediate need for advanced technologies, e.g., computer-aided scheduling and dispatch software, mobile data terminals and automatic vehicle location. Earl Henry suggested that the ultimate objective would be an integrated, seamless system where a rider could call a single number to book a trip that could entail coordinated transfers between multiple transit services. There are many inefficiencies that could be corrected with improved coordination. Dubuque is currently conducting a study regarding multi-agency ride reservation and dispatch that will be completed by November 1999.

Desired Technologies

Henry and Swanson both are interested in implementing the same basic set of technologies as being deployed by Pam Ward in Ottumwa. They want GPS with a standard interface with other systems. They'd like to use it for dispatch, automatic vehicle location, coordinating connections with other operators, and communicating with emergency vehicles. Swanson believes ITS implementation should be standardized so growth can be accommodated. He'd also like automatic fare collection to cut accounting costs, and the ability to map out routes with GPS/GIS. Tracking of vehicles would allow operators to identify service redundancies, which are thought to be extensive.

A statewide model for rural/regional transit ITS should be developed. The DOT's involvement should focus first on the communications requirements. A statewide approach or solution should be sought. The DOT should also be involved in the Transit Communications Interface Profile, an ongoing effort.

Scheduling and billing are currently all manual (Swanson uses a computerized spreadsheet but still has to input data manually). Bookkeeping is a major concern. All of the "intelligence" of the system is resident in specific individuals, creating major problems when people are out, or leave the job.

Henry is familiar with the Minnesota DOT ARTIC project which coordinates dispatching between multiple transit agencies, law enforcement and DOT maintenance, and thinks the concept should be applied in Iowa.

Communication

Henry experiences communication problems (dead spots) in Cresco. He runs 40 vehicles in five counties. Swanson has little problem with radio communication, but he'd like to be tied into the emergency management system in Black Hawk County.

Safety

Driver and passenger safety is a major concern. Automatic vehicle location would be very important as a way to quickly pinpoint vehicles during accidents or bad weather.

Miscellaneous Issues

In the NIACOG/Mason City area, transit issues include the need to make the system easily understood and navigated, demand for services outside of normal operating hours, and the failure of publicly supported transit providers to make their vehicles available to other transit operators.

Northwest Region
(Storm Lake, April 29, 1999)

Traffic Management

In attendance:

- Craig Markley, DOT
- Matt Burt, BRW
- Jeff Stratton, DOT
- Dan Jensen, Sioux City Transit
- Steve Hoesel, MIDAS
- Mike Gorman, HWS Consulting Grp
- Scott Carlson, City of Sioux City
- Steve Beningo, FHWA
- Chris Whitaker, Region XII COG
- Jim Burns, Region XII COG
- Chad Lingenfelter, SIMPCO

Interstate Roadways (I-29)

I-29 is a high accident location and officials wondered if that would give it a higher priority in ITS project selection. One-tenth mile markers are being installed. Weather-related problems, especially ice, need to be addressed.

A significant problem related to I-29 is the number of trains passing through downtown Sioux City. The trains block intersections and cause traffic backups up the off-ramps onto I-29. This is also a problem for emergency vehicles. Emergency vehicles and school buses have been caught between trains. Changeable message signs tied to a sensor could be used to divert traffic to other exits and avoid the trains. There is also potential for ramp metering in downtown Sioux City.

Traffic Signals

Sioux City is looking to fund the perpetuation of a prior coordinated signal system demonstration. They are interested in a signal systems that would support special timing plans, even an "adaptable" system, that could respond to detoured traffic, such as during incidents. They also are looking for emergency vehicle preemption (none currently), transit priority capability, coordination across jurisdictions, and the ability to monitor for malfunctions. The signal system should be adaptable to the planned light rail system that's been funded in TEA-21. Advance warning signs that would tell drivers when an upcoming light is red would be appropriate for some high speed approaches.

Traveler Information

The Sioux City area would like better information regarding construction and detours. Currently, notices go to the newspaper but they are not well-communicated. . The city would also like more tourism information, such as for the Lewis and Clark Trail celebration coming up in a few years, perhaps in the form of fixed and CMS signage. DOT tourist information efforts should be coordinated with the Department of Economic Development to avoid redundancy. Portable VMS signs for special events would be useful. A web site that has the same information as the current rest stop kiosks would be an early winner. Systems, such as VMS and HAR, are needed to attract visitors off of I-29.

Miscellaneous Issues

Sioux City wants automatic vehicle location for all vehicles. They would also like better coordination with South Dakota and Nebraska in general. There's also a lack of coordination among agenices such as HAZMAT, sheriff, and emergency response. Technologies to streamline CVO credentialing and inspections would also be desirable.

The question was asked whether an ITS plan must be in place for an area in order to receive funding for ITS projects. Overall, the highest priority for ITS deployment should be safety. In general, the DOT has the responsibility to lead an effort to insure adequate communications statewide to support ITS.

Increasing railroad traffic is an issue that needs to be addressed. Ultimately, overpasses are needed, but in the interim sensors and information to EMS dispatchers would be effective.

Incident Management

In attendance:

- Craig Markley, DOT
- Matt Burt, BRW
- Jeff Stratton, DOT
- Scott Carlson, City of Sioux City
- Steve Beningo, FHWA
- Chris Whitaker, Region XII COG
- Anita Bailey, IDPH/EMS
- Chad Lingenfelter, SIMPCO

Incident Management Plans

Sioux City does not have an incident management plan, but it needs one. There was an effort to identify HAZMAT procedures and alternate routes but it was dropped due to a lack of resources. They would like to revive that effort.

Rural EMS Problems

Jurisdictional boundaries are based on old fire service districts that don't make sense for modern EMS purposes and can contribute to long response times. A centralized dispatch system could alleviate problems with response times, but "turf" will be a tough issue. This issue applies across county lines, and between Iowa and neighboring states. Inefficiently defined jurisdictional boundaries is the "biggest problem" for rural EMS. Lack of uniformity in road naming contributes to confusion and delayed responses.

Rural EMS vehicles don't have preemption of traffic signals. Driver awareness of emergency response vehicles in rural areas is poor, compromising everyone's safety.

E911 signs disappear. A sign inventory and regular maintenance are needed. More mile markers would also help. If additional signage is implemented, however, there needs to be a commitment to maintain it.

Lack of driver (public, not the EMS drivers) in accident areas is a concern. Would be good to give them advance notice.

Communication

There's a problem with different communication systems between jurisdictions and different entities such as fire, police, and EMS.

Cell phone companies need to be able to locate a call within 100 meters by 2001, a possible solution for transit.

Need better, more consistent signage on road construction so motorists don't start to disbelieve signs and make work zones more hazardous for themselves and workers.

Miscellaneous Issues

Sioux City area is interested in doing motorist assistance patrols on the interstates. Such patrols are especially useful since there shoulders are narrow.

Transit

In attendance:

- Steve Beningo, FHWA
- Chris Whitaker, Region XII COG
- Jim Burns, Region XII COG
- Dan Jensen, Sioux City Transit
- Chad Lingenfelter, SIMPCO
- Rose Le,, RIDES Regional Transit Authority
- Aaron Steele, NWIPDC
- Craig Markely, DOT
- Jeff Stratton, DOT
- Matt Burt, BRW
- Jeff Benson, BRW

Need for State Leadership

There was tremendous enthusiasm, and agreement, among the regional stakeholders that ITS applications for transit are needed and that the state should lead the way in addressing issues at the statewide level, especially communications, and by establishing a "model", or "template" approach for local implementers. Local operators do not want to repeat others' mistakes and don't have the resources to learn it all themselves. Tremendous efficiencies could be realized if the state developed a common specification that could be used by local agencies. Local agencies are also looking for support from the state in training staff and on-going technical support.

Desired Technologies

ITS is needed to improve efficiency, and to support a higher level of service that is being demanded. For example, longer trips, trips across county lines and across regions, and trips to major destinations like airports. Billing is also getting more complicated as agencies want to be billed separately, on a day-by-day basis.

In terms of specific technologies, the transit systems want automatic vehicle location, electronic payment, computer-aided scheduling and dispatch, improved information on maintenance and construction, computer-aided billing and reporting, and improved coordination of reservations, dispatching and transfers between operators.

Miscellaneous Issues

It was recognized that the state cannot be expected to provide all of the required funding, and that a grass-roots effort to "sell" ITS must be pursued.

Coordinating with the DOT to use its communications towers seems to the operators to be an obvious solution to the need for statewide transit communications and they do not understand why the DOT denied Pam Ward's request for the Ottumwa project.

Dan Jensen has written a letter to Dennis Tice with ITS funding suggestions, one of which is automatic vehicle location for regional transit systems throughout the state.

First Steps

A study to layout needs and an implementation road map for all transit agencies to start an AVL project is a possible first project. This may make it easier for transit agencies to garner financial support from their boards and possibly federal funding.

Southeast Region
(Iowa City, April 27, 1999)

Traffic Management

In attendance:

- Wally Mook, City of Bettendorf
- Lalit Patel, Bi-State
- Denise Bulat, Bi-State
- Sam Granato, Linn County RPC
- Mark Nahra, Linn County
- Doug Ripley, Johnson County COG, City of Iowa City
- George Hollins, University of Iowa
- Gary Petersen, City of Cedar Rapids
- Jon Krieg, City of Davenport
- Fred Dean, DOT
- Dan Holderness, City of Coralville
- Rick Fosse, City of Iowa City
- Craig Markley, DOT
- Matt Burt, BRW
- Jeff Benson, BRW
- Jeff Stratton, DOT

Major concerns during this session included traffic on interstate roadways, traffic signal systems, and integrated weather, traveler, and road construction information. The Bi-State area stakeholders expressed a strong interest in developing an ITS Plan for the region, although they noted that there are ITS projects that should be pursued even before the plan is completed. The Bi-State representatives also noted the lack of local expertise in ITS and the need for support in developing and implementing an ITS program. They also noted that funding the on-going operation and maintenance of ITS systems is a concern.

Interstate Roadways

Specific problems on interstate roadways through the Quad Cities are related to traffic congestion, especially on bridges. Changeable message signs (CMS) are on the periphery of the I-80/I-280/I-74 loop, but there is an immediate need for CMS on I-74 before the last exit to alert traffic of problems ahead. Bi-State expressed concern about who controls CMS.

In Cedar Rapids there are geometrics problems with I-380, specifically curves and narrow shoulders. With 80,000 vehicles per day, safety is a significant problem along this roadway. A tri-level interchange has an historic accident problem; better directional signage has not had much effect. Cedar Rapids would like some ideas about ITS enhancements for Collins Road, a commercially developed, five-lane road with a raised median.

Traffic Signal Systems

Iowa City is trying to balance the conflicting public desires of pedestrians, drivers, and bicyclists. Interconnection of traffic signal systems has been effective and they would like to do more. Davenport has similar concerns about the walkable communities concept in the downtown business district. Traffic is a concern during special events; interconnecting signals for special events is a possibility.

Davenport would like to coordinate traffic signals within and between jurisdictions in the Quad Cities. Cities would like to see a traffic signal system that runs more efficiently and that generates data which can be analyzed to help make recommendations. Cities are concerned about the capital costs (Cedar Rapids has funding in place for a new system) as well as maintenance and periodic updates.

Integrated Information

Providing more information to motorists was a popular topic. The University of Iowa has found that using the Web to show phasing diagrams of large construction projects has significantly decreased the number of complaints about construction. Easily accessible traffic information, weather, road construction information, and way-finding is vital for motorists, either from within their cars or at information kiosks like those at rest areas.

Miscellaneous Ideas

Davenport and Iowa City have low bridges that are sometimes struck by high profile vehicles. A temporary fix would be CMS to detour drivers around the bridges.

One suggestion was to coordinate road construction information for an area and update just one site rather than calling all affected organizations such as schools, sheriff's office, emergency management, etc.

Incident Management

In attendance:

- Wally Mook, City of Bettendorf
- Lalit Patel, Bi-State
- Denise Bulat, Bi-State
- Sam Granato, Linn County RPC
- Andy Rocca, Iowa City Fire Dept.
- Doug Ripley, Johnson County COG, City of Iowa City
- Terry Koehn, Coralville Police Dept.
- Craig Markley, DOT
- Matt Burt, BRW
- Jeff Benson, BRW
- Jeff Stratton, DOT

There was interest in formalizing incident management planning in all of the areas represented (Cedar Rapids, Iowa City/Coralville, and the Bi-State area). Cedar Rapids and Coralville do not have formal plans but are interested in doing them. The Bi-State area has a formal program and plan.

Incident Management Plans

Scott County has an incident management plan that includes the Quad Cities area and involves people from many disciplines including transportation, law enforcement, fire, and emergency management. A multi-disciplinary task force meets regularly, and the Governor's Traffic Safety Bureau is involved. The plan focuses on major emergencies and special events rather than day-to-day accident situations.

Neither Cedar Rapids nor Iowa City have incident management plans that participants in this session were aware of. Cedar Rapids started developing a plan with the DOT in the past, but the effort fell apart when all of the responsibility for developing alternate routes was placed with local law enforcement. Cedar Rapids would like to develop a new plan using a multi-agency approach.

Iowa City questioned the usefulness of an incident management plan for a city with few bridges and no short detour around I-80. However, an Iowa City law enforcement officer was concerned about incidents on I-80, particularly ones that take an hour or more to clear up. The officer estimated that two dozen such incidents occur on I-80 each year. The biggest bottleneck is the Iowa River bridge. An upcoming major contstruction project at the bridge would be a good opportunity for ITS. The cost-effectiveness of incident management (i.e. spreading accidents through town versus letting drivers stay put) is a concern.

Communication

Communicating with motorists about incidents was a major concern. Ideas included CMS with a notice to tune to a specific radio station for more information and using weather radio technology in car radios to alert motorists of emergencies even if their radios are off. One suggestion was to implement a universal emergency communication system across the country.

The media were not perceived as a useful or effective means of warning motorists about weather emergencies.

Miscellaneous Ideas

An Iowa City fire chief would like to see agencies bridge their resources and communicate more effectively about incidents. He'd also like emergency response vehicles to be able to preempt traffic signals.

Transit

In attendance:

- Wally Mook, City of Bettendorf
- Pam Ward, Ottumwa Transit
- Roger Fisher, Coralville Transit
- Brian McClatchey, University of Iowa P&T
- Bill Hoekstra, 5 Season Transportation and Parking
- Al Baker, Linn County LIFTS Dept.
- Bob Arbige, SE Iowa Regional Transit Authority
- Kevin Doyle, Johnson County COG
- Craig Markley, DOT
- Matt Burt, BRW
- Jeff Benson, BRW
- Jeff Stratton, DOT

Cedar Rapids and Linn County are in the later stages of deployment of a number of advanced technologies. Ottumwa Transit is still in the early stages of their deployment, but have been working on it for several years. Cambus, the University of Iowa transit system, is not using, and has no plans for advanced technologies. Bettendorf is not using advanced technologies and has no plans to at this pointl. Cedar Rapids, Linn County, and Ottumwa are strong proponents of advanced technologies but see the need for the state to provide support and consistency.

Technologies

Cedar Rapids and Linn County have GPS, computer-aided dispatch, maintenance monitoring, and location monitoring for their 60 vehicles. The deployment is a "beta test" partnership with Rockwell International, and as a reslult, has been slow at times. They are still trying to resolve some technical problems, although the system is operating. Cedar Rapids is working with a web service to provide GPS information online within 8–10 months.

Ottumwa Transit has for several years been attempting to implement a statewide "model" for ITS transit applications, but has experienced a number of delays and challenges, most notably communications. Ottumwa Transit covers a 5,000-square-mile area and has over 550,000 rides per year (9,000 paratransit) with growth escalating in labor-intensive areas. Only digital communications solutions, which cannot be supported with current resources, were offered in response to the first RFP that was issued. The RFP will be reissued, specifically asking for analog solutions. Ultimately Pam Ward would like to have GPS for vehicle location, vehicle monitoring, and computer-aided dispatch, but she believes she won't be able to afford computer-aided dispatch..

Bettendorf has four fixed routes with 500–550 rides per day and one-hour headways. Bettendorf would like GPS to tell dispatch and users when the bus will arrive.

Miscellaneous Ideas

Iowa City has three separate transit systems that work well separately. These transit systems support six million rides per year. Any ITS technology must be "meat and potato technology" with a real use. Iowa City would like automatic passenger counters and reliable, accessible data to plan service levels. Traffic signal preemption would also be nice. Iowa City sees a need for more convenient commuter-related service, such as park and ride lots on the outskirts of town and frequent buses to the city center. User information available in real time at prime locations would be useful. User expectations are high for bus frequency, timeliness, and capacity.

The main problem for the Southeast Iowa Regional Transit Authority is a labor shortage. They can't find and retain drivers.

Transit-unfriendly land use policy and underfunding at the federal level were also cited as overall transit problems. Relative to implementation of ITS, the cost of training operators on the use of the new technology, and the per vehicle cost of the technologies were identified as challenges.

Southwest Region
(Des Moines, March 23, 1999)

Traffic Management

In attendance:

- Mark Wandro, Polk County
- Kent Sovern, Des Moines Chamber of Commerce
- Tom Kane, Des Moines Area MPO
- Paul Mullen, MAPA (Omaha MPO)
- Blake Redfield, City of Council Bluffs
- Craig Markley, DOT (Systems Planning)
- Jeff Benson, BRW
- Matt Burt, BRW

The Omaha area has developed an ITS Early Deployment Plan and is pursuing some projects, such as freeway service patrols and some signal coordination. However, lack of funds is an impediment to further deployment. Their first attempt to fund the design of the regional traffic management center, a cornerstone of the regional ITS, was unsuccessful. The lack of a clear ITS "champion", the failure to effectively market and attract private sector partners, and the absence of severe congestion have also hampered efforts. In a survey of Omaha area travelers, safety and construction were identified as the highest priorities. No expansion of I-80 is planned, so improvements will have to come through ITS. Signal upgrades are a high priority in the Omaha area.

The Des Moines area has also prepared an ITS Early Deployment Plan, however meetings of the plan committee have lapsed and deployment has not begun in earnest. This committee will be revived in the near future. There is an I-235 Steering Committee that includes a traffic management sub-comittee that is starting to put together plans for the six-year reconstruction of I-235, which could include ITS. A proposal has been submitted to FHWA, but it contains mostly CVO related ITS projects. A high priority in the Des Moines area is to implement surveillance cameras, which can also be used to collect data, such as vehicle classification.

General comments relative to the development of the statewide ITS plan included: that ITS is a "tough sell" in rural areas, and other areas where there is no congestion; there is a need to coordinate the many kinds of data that are being collected by various agencies; that the DOT has not appeared to move strongly toward long term ITS involvement; that the DOT needs to be involved in the development of communications protocols and standards; that it would be best to take advantage of existing communications infrastructure before building more (e.g., the ICN); and that it would be good for the DOT to develop some "early winner" ITS projects, such as signal coordination.

Incident Management

In attendance:

- Captain Bob Rushing, W.D.M. Police Dept.
- Tom Kane, Des Moines Area MPO
- Paul Mullen, MAPA (Omaha MPO)
- Blake Redfield, City of Council Bluffs
- Craig Markley, DOT (Systems Planning)
- Jeff Benson, BRW
- Matt Burt, BRW

The highest priorities are to insure safety and to minimize impacts to traffic.

The Des Moines area prepared an incident management plan in the 1980's, in conjunction with construction in West Des Moines. There are detailed alternate route plans, but they may not be viable. There is currently the Metro Traffic Management Team which deals with incident management and a special traffic management subcommittee of the I-235 Steering Committee, which will dissolve after I-235 construction is completed. Incident management efforts focus on the metro area interstates, where most transportation problems are. Highway advisory radio is the preferred primary information dissemination tool. Changeable messages are not sufficient since they generally do not identify alternate routes. There are privately operated service patrols on I-80/I-35 and on I-235. West Des Moines Police Department had participated in the MARS (OIM) project, but dropped it. Changes have been made and they will participate again. The highest priority identified in the Des Moines EDP is surveillance cameras. In Des Moines, implementation is not primarily "a money issue".

Omaha has developed a set of alternate route plans. Red-tagging of vehicles for removal has been successful, but has been discontinued in Council Bluffs due to a lack of funding from the IADOT. In general, regional incident management is seen as a major challenge, one that no one has stepped up to address; no one has taken ownership of the issue. The DOT needs to stimulate and coordinate activities, perhaps through a circuit rider program. Failure to organize incident management in Omaha/Council Bluffs is partly due to the fact that there is no major congestion. Better coordination with the media is needed. Consolidation of EMS communication was identified as a high priority in the Omaha Early Deployment Plan. Council Bluffs is implementing an 800 MHz system.

Transit

In attendance:

- James Breining, Five Oaks Charters
- Tom Kane, Des Moines Area MPO
- Donna Grange, DSM Transit Authority
- Deborah Archibald, Southwest Iowa Transit Agency
- Jeanette Scoles, Heart of Iowa RTA
- Craig Markley, DOT (Systems Planning)
- Matt Burt, BRW
- Jeff Benson, BRW

Regional transit operators need ITS to improve safety and efficiency. There is a history of inadequate cooperation among providers and between counties. Improved communications and automatic vehicle location will allow transfers between systems and across counties. Most dispatchers would embrace computer-aided dispatching and consolidated dispatching. Automatic vehicle location is the highest priority. ITS technologies will support transit's efforts to serve new markets, such as commuters and will allow operators to better match available vehicles with demand. There is concern that the proposed project to implement automatic vehicle location in 11 of the 16 regional transit agencies statewide will not get funded.

Responsibility for funding and maintaining transit ITS deployments has not been assigned and is a concern. The "jobs access/reverse commute" issue will encourage transit operators to coordinate services.

There is currently a transit coordination study underway in Story County. The DOT should look at other states for applicable models, such as Missouri. The DOT denied Ottumwa's request to use DOT radio towers and this has been a major set-back for the project.