Iowa Department of Transportation

Statewide Transit Intelligent Transportation Systems Deployment Plan

FINAL REPORT

DRAFT

September 10, 2002

TranSystems Corporation

MultiSystems

INTELLIGENT WIRELESS SYSTEMS®

Iowa Department of Transportation

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Iowa Department of Transportation

TRANSIT ITS

SUMMARY

In early 2002, the Iowa Department of Transportation engaged a consultant to help develop a statewide transit ITS plan. Iowa DOT intended to provide a means for transit agencies in the state's rural and small urban communities to utilize Intelligent Transportation Systems (ITS) applications to support and enhance transit operations. Although several of the state's transit agencies have implemented ITS applications, most agencies continue to rely on manual procedures for operations, management, and customer service functions.

This endeavor is a logical extension of Iowa's planning and deployment in the ITS arena. In 2001 Iowa DOT completed a project to produce a statewide ITS deployment plan[1].

While the project has been technology-oriented, it also supports the broader objectives of the State of Iowa as well as the participating communities. Foremost among these objectives is to provide efficient and effective transit services that meet the needs of rural and small urban communities. The implementation of technology is, therefore, not for technology's sake; it is to improve transit services. ITS technology is a tool, and the project has defined a way of deploying these tools to serve transit agencies and transit users throughout the state.

> *Transit Intelligent Transportation Systems (Transit ITS)* refers to electronics, communications or information processing technology that is specifically designed to provide or manage information for a function or functions within a transit system. Such functions include conducting on-street operations, providing passenger information, performing maintenance activities, and performing planning related analyses. The technologies can be used separately or as part of a bundle of technologies. Examples include hardware and software systems that schedule passenger/vehicle trips; track the location of vehicles and passengers; provide real-time or static service information; account for operating, human and financial assets; and assist in the planning of system services. Transit ITS does **not** include hardware or software that has wide application such as word processing, spreadsheets, and general data base management. While such hardware and software can be used to provide or manage information, they are not typically designed for a function or functions within a transit system.

The Transit ITS Deployment Plan is an initial step in the overall ITS deployment process. Experience from around the country has shown that initial planning is critical, and is too often an activity that is not given adequate time or resource. Thus, the project approaches the task of ITS deployment in several steps or phases.

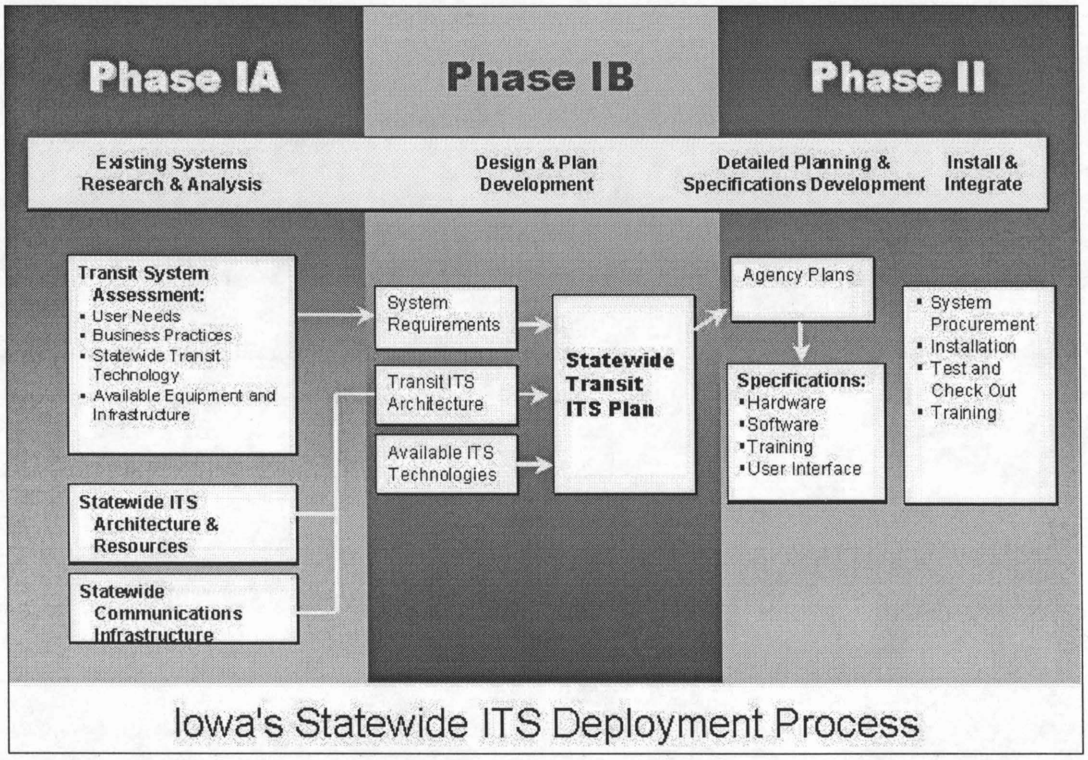
Phase IA was primarily an information gathering stage. During Phase IA an assessment was conducted to gain an understanding of how each transit agency operates, and the environment they operate in.

[1] Iowa DOT Integrated ITS and Services Deployment Plan, Draft Report, July 2001. ✓ TRANSIT ONLY PLAN

Phase IB was the general planning step. In Phase IB information was consolidated and synthesized, and the statewide Transit ITS plan was formulated.

The following graphic shows how the Phase I assessment and planning relate to implementation phase activities. Phase II will begin with the conclusion of Phase IB.

Figure 1
Iowa Transit ITS Deployment Plan Phasing



Available ITS Technologies for Transit Applications

Past research and experience with transit ITS applications have provided a "starting point" for potential applications in the state of Iowa. This project assesses ITS technologies that are most relevant to the needs of the Iowa transit agencies that were identified during the Phase IA assessments.

Generally, ITS applications for transit are categorized into five categories as shown in Figure 2 on the following page. The benefits listed in Figure 2 are those realized by other agencies that have deployed these ITS application. Additional information on these technologies is provided in the following paragraphs.

Geographic Information Systems (GIS). Most transit operations software has an underlying need for mapping. GIS uses a database that links data with a geographic location, coupled with a map to display the data based on its location. Although GIS software can be used standalone for planning purposes, it is also used as a foundation technology to support the various types of transit operations software discussed below.

Figure 2
Transit ITS Applications and Benefits

Fleet Management Systems	▪ Increased transit safety and security ▪ Improved operating efficiency ▪ Improved transit service and schedule adherence ▪ Improved transit information
Operational Software and Computer-Aided Dispatching Systems	▪ Increased efficiency in transit operations ▪ Improved transit service and customer convenience ▪ Increased compliance with transit Americans with Disabilities Act (ADA) requirements
Electronic Fare Payment Systems	▪ Improved security of transit revenues ▪ Increased customer convenience ▪ Expanded base for transit revenue ▪ Reduced fare collection and processing costs ▪ Expanded and more flexible fare structures
Advanced Traveler Information Systems	▪ Increased transit ridership and revenues ▪ Improved transit service and fixibility within the community ▪ Increased customer convenience ▪ Enhanced compliance with Americans with Disabilities Act
Transit Intelligent Vehicle Initiative	▪ Increased safety of transit passengers ▪ Reduced costs of transit vehicle maintenance and repairs ▪ Enhanced compliance with Americans with Disabilities Act

Source: Benefits Asessment of APTS Technologies Update 2000

Reservations and Scheduling. Reservations and scheduling technologies include fixed-route and paratransit applications.

Fixed Route Scheduling

Fixed route schedules are developed or updated on a periodic basis (e.g., once every six months). The process involves allocating the available fleet to the route structure and stops to develop the scheduled trips for the service period. Trips are then chained together to form runs for assignment to individual driver shifts. Fixed route scheduling software automates this time consuming runcutting process, and helps to ensure that the full range of potential scheduling alternatives is considered and that the schedules optimize the use of all possible resources.

Paratransit

Software is available that can streamline and support the call-taking and reservations process, including real-time trip scheduling during the reservations process. The software is initially used to assist in certifying rider eligibility. This includes entering information about each rider into a registration database, such as name, address, phone number, and trip subsidy funding sources. By including address information, the rider's home location is "geocoded", meaning that the location can be automatically displayed on the GIS map when "home" is used as the trip origin or destination during a reservation.

Once the origin, destination, and required pick-up (or drop-off) time are defined in the reservation, the scheduling software will propose one or more vehicle runs. On this basis, the call taker is able to select the best run option, and to confirm the scheduled pick-up and drop-off time windows with the rider during the reservation call.

Technology cannot determine what institutional relationships are best for the service coordination possibilities between paratransit agencies, funding organizations and service providers. However, the capabilities of advanced paratransit reservations and scheduling software, coupled with wide area networking technology, can enable new service coordination options. Such wide-area networking can allow all of the participants to be connected to use the reservations and scheduling software. This means that any call-taker could directly schedule the trip during the reservation process.

Transit Operations. Three transit operation's technologies are discussed below.

Data Communications and Mobile Data Terminals (MDTs)
MDTs are small special purpose computers mounted near the driver, with a small keypad and display to provide an interface with a mobile data communication system.

MDTs support text messaging between drivers and dispatch. In a paratransit operation, text messaging can help improve efficiency by transmitting the trip manifest for the run directly to the vehicle (i.e., rather than being printed off for the driver as a paper manifest), as well as any real-time manifest changes during daily operations. The driver can use the MDT to indicate the completion of each pick-up and drop-off, and this information can be transmitted back to dispatch in real-time. As discussed below, MDTs can enable further enhancements to daily operations through computer-aided dispatch (CAD) and automatic vehicle location (AVL) software.

Two additional types of text messages that MDTs can support are alarms and vehicle maintenance monitoring. The MDTs can provide a silent alarm, which is unobtrusively mounted switch near the driver. This alarm, when activated, will covertly notify dispatch of an emergency situation. Vehicle maintenance monitoring circuits can be wired into MDT relays, that can be configured to send a text message to dispatch whenever a circuit detects a beyond threshold condition (e.g., coolant temperature, oil level).

Computer Aided Dispatch (CAD)
During daily operations, the dispatcher monitors deviations from the planned schedules of vehicles. A vehicle might pull out late, arrive early or late at a timepoint or report a mechanical problem. This applies to both fixed route and paratransit operations.

Whenever these deviations are beyond a certain threshold (e.g., vehicle running more than five minutes late), the dispatcher may attempt to change the operating pattern of certain vehicles or assign a new vehicle and/or driver. CAD software helps the dispatcher identify and assess the feasible alternatives when operational problems occur, and keeps a comprehensive record of any changes that are made. Although CAD can operate using voice communications, MDT text messaging is often used to facilitate these processes.

Automatic Vehicle Location (AVL)
Even with CAD software support, the dispatcher must still be aware of vehicle locations. AVL software operating at a central dispatch location receives periodic location reports from each vehicle in the field and then updates the vehicle locations displayed on a GIS map (using symbols representing each vehicle). This time-stamped location data can also provide dispatchers with schedule adherence information by exception (this schedule adherence feedback is also often provided to the drivers on the MDT). The dispatcher can view detailed information about a particular vehicle, by clicking its map symbol or by checking a table that provides current information about the entire fleet.

The typical approach to generating the incoming vehicle location reports is to equip each vehicle with a Global Positioning System (GPS) receiver. The GPS receiver uses simultaneous signals from at least four GPS satellites to determine its current position within approximately 15 feet. The GPS equipment is integrated with an MDT, which sends the periodic location report to dispatch through a radio or modem.

Fleet Maintenance. Software programs can help automate vehicle maintenance tracking and analysis. Instead of recording maintenance activities in paper files, details can be recorded in a computer database. By building on the capabilities of commercial database management software, fleet maintenance software programs have been made easy to use with on-screen input forms. The database can also be used to periodically generate reports such as work orders, purchase orders, and reports for tracking and analyzing vehicle or staff performance indicators.

Transit User Information. Technology can enhance both the quantity and quality of the information available to the public. Applications include a variety of web-based systems that allow both static information and interactive systems for use in trip planning. Other applications include the installation of computer terminals in kiosk format at high-traffic public locations. Variable message signs can be installed at bus stop locations to provide both scheduled and real- time information to the public.

Because much of the information exchange between transit system managers and their customers is by telephone, particularly for paratransit operations, benefits can be secured through advanced telephone systems. Interactive Voice Response (IVR) systems may be useful for the larger transit systems that experience very high call volumes. At a minimum, all transit systems should have telephone voice mail or other recording systems that allow customers to communicate with the transit systems at all times of the day.

Fare Payment and Rider Identification. Electronic Fare Payment systems used in conjunction with MDT's and Transit Management software can form an integrated system to automate many of the administrative tasks involved with reporting and invoicing. These systems can be particularly beneficial to paratransit systems that typically have a higher level of reporting requirements to support funding sources. Electronic Fare Payment systems can also be used for trip verification.

Transit ITS Plan Outline for the State of Iowa

The Transit ITS Deployment Plan consists of two parts:

1. A Statewide Plan Framework that structures the approach to ITS deployment from the state's perspective.
2. General recommendations for individual transit agencies.

The following is a summary of the Statewide ITS Deployment Plan elements:

Communications Between Dispatch and Vehicles. Voice Communications is a fundamental requirement for transit operations. Data communications is a fundamental requirement for many ITS applications, especially those involving advanced operational applications.

Most Iowa transit systems have adequate voice communications using both RF and cellular, and varied frequencies. For applications requiring data communications, agencies will have to upgrade both radio hardware and radio service, in some cases requiring more capacity. Iowa DOT can assist transit agencies secure data communications, possible through a partnership with radio service providers.

Transit Operations Management. Transit Operations Software Management software which includes GIS, reservations and scheduling software, Mobile Data Terminals (MDTs), Computer-Aided Dispatch (CAD) and Automatic Vehicle Location (AVL) have application based on the assessment of each system. Generally, the need for these management related applications increase as the size and complexity of the transit operation increases. It should be noted that some of these applications are required for other ITS applications, similar to building blocks. For example, AVL is a requirement for the provision of real-time information to customers.

Paratransit systems, due to their greater complexity, will more likely require Transit Management applications, such as CAD and scheduling. At a minimum all of the state's paratransit systems should have computer-based systems to manage the client database and assist with the reservation/scheduling system.

Vehicle Maintenance Software. Software programs can help automate vehicle maintenance tracking and analysis. Instead of recording maintenance activities in paper files, details can be recorded in a computer database. The database can also be used to periodically generate reports such as work orders, purchase orders, and reports for tracking and analyzing vehicle or staff performance indicators.

Customer Service. A variety of applications exist to improve customer service functions, and make more information available to transit users. These applications range from advanced telephone systems to the provision of real-time transit schedule information.

Electronic Fare Payment systems. Machine-readable farecards are can be used to carry fare payment or rider identification information. Applications can provide fixed data such as a rider identification number or updateable data such as the end date for a period pass, the remaining number of prepaid rides or the remaining prepaid cash fares balance. Fare payment systems can be used as part of an automated invoicing system.

Service Coordination. ITS applications make service coordination easier and the degree of coordination among agencies is likely to affect the design of systems. The plan suggests opportunities for service coordination among transit systems that can either be better accomplished with the use of technology, or may become part of the justification for service technology investment. For example, paratransit service coordination between urban transit agencies and adjacent regional transit systems may provide an opportunity for ITS deployment.

Cost and Funding. ITS applications are not inexpensive, and they usually have an ongoing cost associated with supporting the hardware and software systems. Initial acquisition costs and ongoing operating and maintenance costs have been estimated for each of the recommended applications. The Plan includes a funding strategy for transit ITS improvements developed in concert with the Steering Committee. Funding includes a mix of federal, state, and local funding.

Staging and Timing. The Plan includes a staging plan to logically implement ITS applications at the state's transit systems. The staged implementation of ITS is recommended as a means to allow a transit system to integrate new technology into its operation more gradually to ensure proper operation incrementally and to spread the funding requirement over a longer period of time. The staging plan must also allow for a logical sequence of implementation so that specific components rely on others previously deployed.

Institutional Arrangements. Transit in Iowa today is a partnership between individual transit agencies and the Iowa Department of Transportation. The ITS Deployment Plan suggests roles for the transit agencies and Iowa DOT. Because of the potential for economies through centralization of certain activities, Iowa DOT's role includes areas such as procurement, technical assistance, funding and technical support.

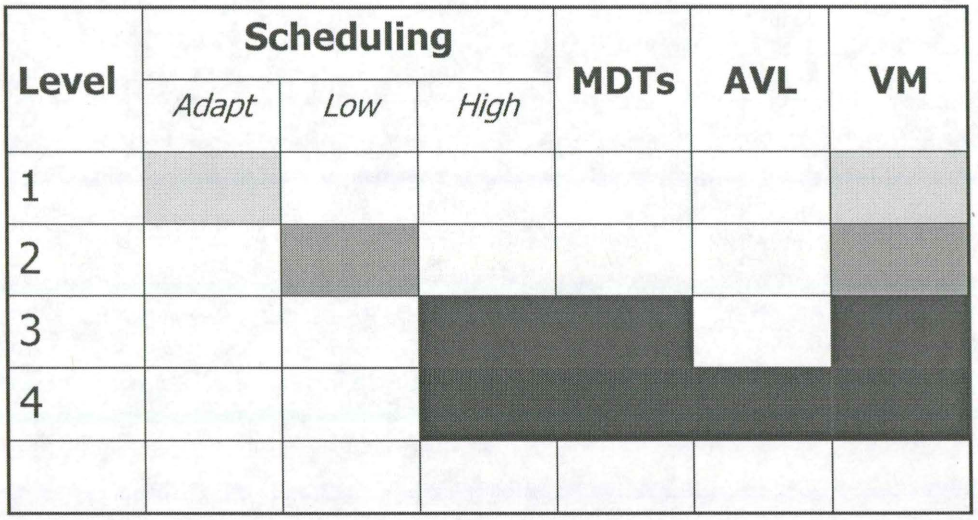
The possibility of creating a standing working group comprised of transit agency representatives should be explored. In concept, this working group can be an extension of the Steering Committee, and could have a role in recommending projects for funding to Iowa DOT. The working group could also serve as a resource as technology is deployed throughout the state. The creation of a transit ITS working group was recommended in the Iowa DOT statewide deployment plan.

Individual Transit Agency Plans:

The Statewide ITS project did not produce deployment plans for each of the state's transit agencies per se. Rather, each of the state's 23 rural and small urban transit agencies were assessed and categorized into four Transit Technology Profiles (TTP) based on needs, and factors such as size and scope of operations, complexity of service delivery and degree of service coordination.

Figure 3 below shows different profile levels along with the technology applications that may be associated with that level. The figure generalizes four levels of technology deployment. Level 1 is the simplest with Level 4 the most involved. Level 1 would use two technology groups (scheduling and vehicle maintenance). Level 4 would use all four of the technology groups.

Figure 3
Technology Levels



Based on the Phase IA assessments and available technologies, a determination was made as to the TTP for each rural and small urban transit agency. These assignments are shown in Table 1.

Table 1
System Assessment

Technology Level	System	Location
1	Mason City Transit	Mason City
	Burlington Urban System	Burlington
	Clinton	Clinton
	Marshalltown MMT	Marshalltown
	Muscatine Muscabus	Muscatine
2	Reg. 11 HIRTA	Des Moines
	Fort Dodge DART	Fort Dodge
	Reg. 2 North Iowa RTA	Mason City
	Reg. 10 East Central Iowa	Cedar Rapids
3	Reg. 1 NRTS	Decorah
	Reg. 5 MIDAS	Fort Dodge
	Reg. 6 Peoplerides	Marshalltown
	Reg. 7 Iowa Northland	Waterloo
	Reg. 8 RTA	Dubuque
	Reg. 9 River Bend Transit	Davenport
	Reg. 12 Western Iowa	Carroll
	Reg. 13 SWITA	Atlantic
	Reg. 14 Southern Iowa	Creston
	Reg. 15 Ottuma/10-15	Ottumwa
	Reg. 16 Southeast Iowa	Burlington
4	Reg. 3 RTA	Spencer
	Reg. 4 SRTS	Sioux City

6 16

• WHERE DOES J.C.'S SEATS FALL?

• ARE THERE OTHER SEATS-LIKE PROPERTIES ROLLED INTO THE 16?

Again, these assignments, and the technology applications that follow, are general. Each agency will be required to develop a more detailed and specific Agency Plan in Phase II prior to the implementation of ITS technologies.

- WILL PROJECT PROVIDE "TEMPLATE" FOR SELF-ASSESSMENT... OR WILL THAT BE CONSULTANTS SCOPE-O-SERVICE TASK AND ¢ ??
- ... WILL IMPLEMENTATION FUNDING BE PART OF SUBSEQUENT STATE EFFORT (CMAQ GRANTS) OR WILL FUNDING FALL TO FTA ~ TIPS OR EACH PROPERTY ?

1.0 *INTRODUCTION*

This report summarizes the findings and conclusions of the Statewide Transit ITS Deployment Plan study. In early 2002, the Iowa Department of Transportation engaged a consultant to help it develop a statewide transit ITS plan. Iowa DOT intended to provide a means for transit agencies in the state's rural and small urban communities to utilize Intelligent Transportation Systems (ITS) applications to support and enhance transit operations. The project was a nine-month study of the needs and opportunities related to the expanded deployment of ITS applications by the state's transit agencies.

Complete project documentation is provided in a two-volume set of working papers and technical reports that have been delivered to the Iowa DOT Office of Public Transit and other study participants.

This report also summarizes specific recommendations that are the basis of the deployment plan.

1.1. Project Organization

A Steering Committee comprised of Iowa DOT staff and transit agency managers guided the study and reviewed the consultant's work products and conclusions. The members of the Steering Committee are:

Name	Title	Agency
Peggi Knight	Director, Office of Public Transit	Iowa DOT
Kay Thede	Senior Policy Analyst	Iowa DOT
Peter Hallock	Assistant Director OPT	Iowa DOT
Craig Markley	Transportation Planner	Iowa DOT
Willy Sorenson	ITS Engineer	Iowa DOT
Steve Andrle	Executive Director	CTRE/ISU
Dennis Kroeger	Research Associate	CTRE/ISU
Rose Lee	Executive Director	Regional Transit Authority – Region 3
Walt Stephenson	General Manager	Black Hawk County Metro Transit Authority
Rich Stone	Transit Administrator	Marshalltown
Pam Ward	Transit Administrator	Ottumwa Transit
Jeff Hanson	Transit Director	Siouxland Regional Transit System

The consultant team was lead by TranSystems Corporation, a Kansas City based transportation planning and engineering firm. Multisystems, Inc., a Cambridge transit planning firm with a transit technology specialty and Intelligent Wireless Systems, a Kansas City communications and technology firm were subconsultants.

The project included eight specific tasks:

Transit System Assessment. To assess the ITS needs and capabilities of Iowa's sixteen regional, seven small urban transit agencies and twelve large urban systems.

Statewide Communications Assessment. To assess the communications resources available in Iowa currently and in the short term to identify elements of the existing communications infrastructure that can be used to support Transit ITS applications.

Inventory of Statewide ITS Resources. To assemble an inventory of the ITS resources and initiatives in Iowa that may offer resource-sharing potential for the Transit ITS plan.

Assessment of Available Technology. To assess the availability of technologies on the market that address the ITS needs of Iowa's transit agencies.

Develop Statewide Transit ITS Architecture. To develop a statewide transit ITS architecture based on the draft architecture in the Iowa ITS plan and consistent with the national ITS architecture

Develop Application Evaluation Process. To develop criteria for deployment prioritization and strategies of proposed systems. Criteria should be based on increasing operating efficiencies, improving services, improving information and integration with other technologies, and increasing safety and security for passengers and drivers.

Evaluate Deployment and Procurement Strategies. To examine opportunities for economies through standardization and interoperability in Iowa. Consider procurement strategies.

Recommend Iowa's Transit ITS Plan. To present a transit ITS deployment plan for implementation in the 2002-2004 time frame.

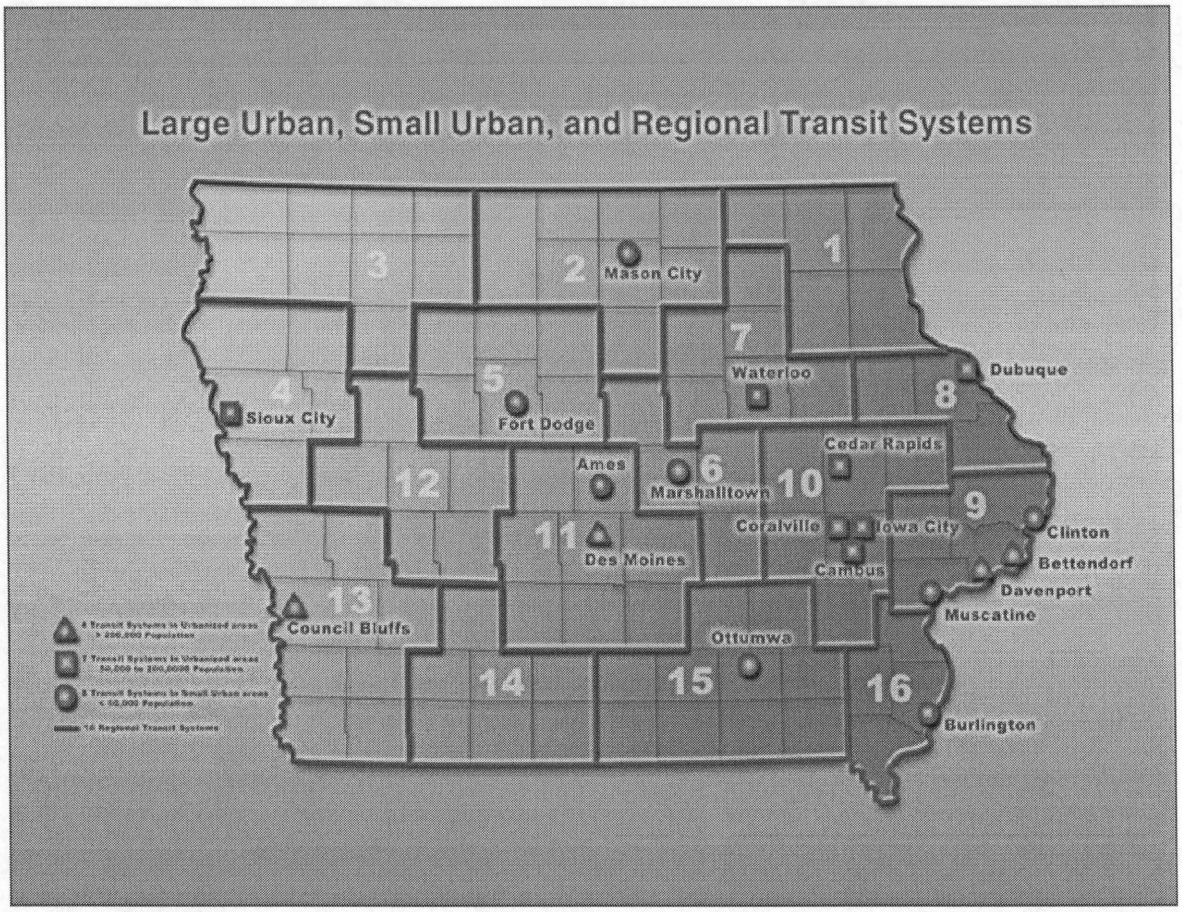
The Transit ITS Deployment Plan is divided into two parts:

1. A Statewide Plan Framework that structures the approach to ITS deployment from the state's perspective.
2. Recommendations for individual transit agencies.

1.2. Transit in the State of Iowa

At the end of 2001, thirty-five transit systems were operating in the State of Iowa. The Iowa Department of Transportation's Office of Public Transit grouped those systems as Regional (or rural), Small Urban, or Large Urban. Figure 1.1 illustrates the locations of these systems through out Iowa. Table 1.1 summarizes the characteristics of these systems. Together, Iowa's thirty-five systems had $64 million in annual operating costs and served just over 22 million annual passenger trips.

Figure 1.1
State of Iowa Public Transit Systems



Source: State Of Iowa, Department of Transportation Website.

Just over half of Iowa's transit systems are "small" or "large" urban systems. Small and large urban systems are mainly fixed route services operating out of one location and serving mainly one city or county. Regional systems, on the other hand, are all mainly paratransit operations serving multiple counties, and typically have fleets operating out of more than one location.

There are two main types of regional systems. First, are those that directly operate their service. Thirteen of the sixteen systems fall in this category. Second are those systems called "brokerages". The host broker agency does not operate service. Rather, it contracts the provision of services to operators in its service area. The number of providers ranges from six for one regional broker to seventeen for another.

Table 1.1
Summary of Iowa Transit System Characteristics (2001)

Item	System Type			
	Regional/ Rural	Small Urban*	Large Urban*	All
Number of Systems	16	8	11	35
Total Annual Operating Costs	$19.4 million	$8.3 million	$36.4 million	$64.0 million
Total Annual Riders (000's)	3,943	4,526	13,787	22,256
Average Annual Operating Costs	$1.2 Million	$1.0 million	$3.3 million	$1.8 million
Contract Revenue % Annual Costs	40%	7%	9%	18%

**In 2002, the Ames transit system was re-classified as a large urban system from a small urban system. As the statistics are from 2001, Ames is reflected here as a small urban system.*

1.3. Study Methodology

The Statewide Transit ITS Deployment Plan is based on an assessment of the needs and business practices of each small urban and regional transit agency in the state of Iowa. Site visits were conducted at each agency, which consisted of interviews with key agency staff, observations of work processes, and review of written materials to include external and internal reports. The results of these site visits were evaluated and compiled in a document entitled "Transit System Working Summaries – Regional and Small Urban Systems."

Site visits were also conducted at eight of the state's twelve large urban transit systems. Information from the site visits was augmented with a survey of each system designed to determine technology-related needs and plans for ITS deployment. This information is summarized in Working Paper 4, "Status and Potential for ITS Applications in Large Urban Areas."

Fundamentally, the purpose of the assessment was to determine the management systems and business practices in use at twenty-two of Iowa's transit systems. The goal of the assessment was to determine whether ITS applications could provide cost effective solutions. Another purpose was to determine the status and type of technology used by these transit agencies. This baseline assessment was obtained through a "hands-on" inventory of current operations.

Consultant project staff personally visited all twenty-two regional and small urban systems. Project personnel interviewed executive management as well as some of the front line operating personnel. Further, project staff obtained hard copy samples of reports and other information. System staff often demonstrated which information was collected and processed as well as how that information was used.

To facilitate these on-site interviews, the consultant team developed a concise questionnaire that was distributed to the rural and small urban transit agencies prior to the site visit. A similar survey was also sent to the large urban systems. Finally, for the systems that were "brokerages," the consultant worked with the host agencies to collect service provider data. The surveys generally covered these basic topics:

- Overview of system operations including institutional funding partners.

- Management and office procedures including internal and external reporting requirements and information flow.
- Street operations including method of driver work assignments and reporting.
- Fare collection procedures.
- Customer service.
- Vehicle maintenance.
- Perceived and actual agency barriers/opportunities for implementing advanced technology.

After site visits were completed, the transit systems were categorized by type of operation, level and type of technology currently in use, key problems and issues, and interest level in technology. "Technology Profile Levels" (TPL) were developed that grouped rural and small urban transit agencies by some common features. These TPLs will eventually set-up the task of developing a common migration strategy for developing and implementing technology statewide.

The general approach used to assess the various systems was to gauge those systems' level of business complexity. The more complex an operation from a "business information" point of view, the greater the need exists for technology. Small urban systems in Iowa are relatively straightforward operations with limited needs for advanced technology. Generally, the regional systems (all of which are rural transit providers) are complex operations that, because of limited resources, tend to improvise ways in which to provide services. Thus, they have varied needs for technology.

Rural transit systems are complex mainly because of the multitude of funding or revenue sources they use to finance their services. Rural transit systems are also complex because service areas are often dispersed among multiple counties with fleet and dispatching operations based out of more than one location. Forty percent of operating costs in rural areas are covered by contracted revenue. For the other systems in Iowa, less than ten percent of such costs are covered by such contracted relationships. Contract revenue is accrued when a system has an agreement to provide transportation services for an outside organization.

It is common for rural or regional systems in Iowa to have service contracts with a number of institutional clients. Clients included sheltered workshops and other social service agencies. Each of these clients typically has a unique process in which the transit system receives payment for services. Each invoice can be fairly detailed requiring each trip served to be individually documented as to time, location, and purpose. An example is with sheltered workshops.

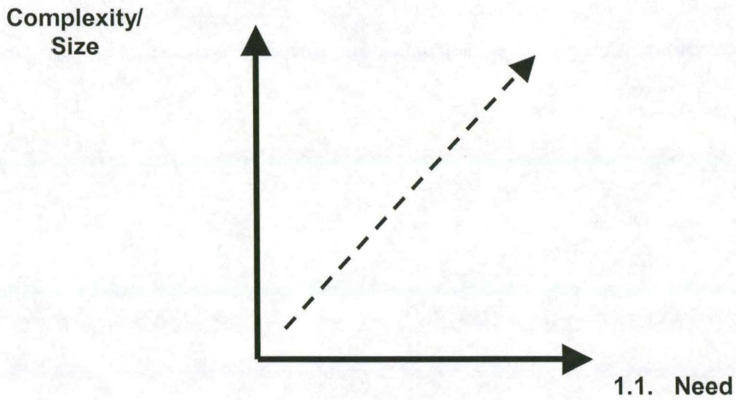
? BASED ON FUNDING SOURCE?

Determining Technology Needs

This section discusses the methodology for determining the preliminary technology needs for Iowa rural and small urban transit systems. These "needs" were embodied in "Technology Profile Levels" to be discussed below. These technology profiles classify Iowa small urban and regional transit systems according to similar technology needs.

The process of developing "Technology Profiles" involves organizing the various transit systems by key, defining characteristics. This process attempts to provide structure in relating the "business information complexity and dependency" to technology need. As shown in Figure 1.2, the more complex the system, or the greater its size, the greater the need for technology.

Figure 1.2
Relationship of System Complexity/Size and Technology Need



In general, these factors were weighed in determining how technology could support the business aspects of Iowa rural and small urban systems.

FACTORS FOR TPL (TECHNOLOGY PROFILE LEVEL)

System Annual Operating Budget — Generally, the greater the budget, the greater the volume of information typically needed to support invoicing and reporting requirements.

Percent of Contract Revenue — The higher the percent of contract revenue to total operating budget was an indicator of business complexity in dealing with involved reporting requirements.

Number of Vehicles — Generally, the greater the number of vehicles, the greater the need for technology. Usually, systems with 50 or more vehicles were ranked higher for technology need than systems with less than 50 vehicles. The only exception would be systems with budgets in excess of $1.5 million that had less than 50 vehicles were ranked higher because a higher budget indicated a degree of complexity.

Driver assignments — Decentralized or centralized method of assigning work to drivers. Drivers who are dispersed over a large service area and from multiple locations were seen as more complex than those systems operating out of one location.

Service Area — Systems operating in one county were seen as less complex than systems operating in multiple counties.

Outbound reporting — These refer to reports to entities outside the transit agency. The more complex and involved these reports, the greater the need for technology.

Service Type Fixed route operations were seen as less complex from an information processing point of view than paratransit operations.

1.4. Other ITS Initiatives in Iowa

The Iowa DOT has been involved in a number of ITS projects over the past few years. The Integrated ITS and Services Deployment Plan documented recent Iowa DOT ITS initiatives. Within the Public Traveler/Public Mobility Services category, 17 initiatives across the state are in operation or under development, as documented in the Statewide Plan. These initiatives consist primarily of automatic vehicle location (AVL), computer-aided dispatch (CAD) systems, and internet-based traveler information. Table 1.2 summarizes these initiatives, which are in operation or under development.

Table 1.2
Summary of Iowa ITS Initiatives for Public Traveler/Public Mobility Services

Project		Description
1.	Des Moines Bus Schedules/Routes	Map of bus routes & schedules on internet
2.	Des Moines Vanpool/Carpool	Carpool/vanpool information and application forms on the Internet
3.	Global Positioning System (GPS) Transit Vehicle Tracking	Install GPS on transit vehicles for dispatching and tracking
4.	Other Transit Agency Schedules	Link to other bus schedules/routes on the Internet
5.	CAMBUS On-line Route Information	Transit route information available on the Internet
6.	Cedar Rapids CAD/AVL	Automatic Vehicle Location and computer-aided dispatch systems
7.	Cedar Rapids Automated Run-Cutting	Automated run-cutting
8.	Cedar Rapids On-board Surveillance	On-board surveillance of transit vehicles
9.	Des Moines CAD/AVL	Automatic Vehicle Location and computer-aided dispatch systems
10.	Iowa City Interactive Rte. Info. Kiosks	Routes available at kiosks
11.	Iowa City On-line Route Information	Route information available on the Internet
12.	Sioux City CAD/AVL	Automatic Vehicle Location and computer-aided dispatch systems
13.	Waterloo CAD	Computer-aided dispatch systems
14.	Ames On-Line Route Information	Route information available on the Internet
15.	Ottumwa/Region 15 CAD/AVL	Automatic Vehicle Location and computer-aided dispatch systems
16.	Region 8 CAD/AVL	Automatic Vehicle Location and computer-aided dispatch systems
17.	Region 10/Johnson County CAD/AVL	Automatic Vehicle Location and computer-aided dispatch systems

Source: Integrated ITS and Services Deployment Plan, Draft Report – July 2001

This project has assembled a detailed inventory of the existing technology and ITS deployments of Iowa transit systems, additional to those discussed above. The *Transit Agency Site Visits Summary Reports* and *Working Paper 6: Inventory of Statewide ITS Resources* provide additional information on existing ITS projects and initiatives in the State. Additional ITS projects and initiatives in Iowa include:

511 for Traveler Information. The U.S.' national traveler information telephone number, 511, was designated in July 2000 by the Federal Communications Commission (FCC). Almost all implementation issues and schedules were left to state and local agencies and telecommunications carriers. Iowa DOT is leading a seven-state consortium that is developing a new 511 traveler information phone service. This service will be deployed during the next few years. Public transportation could conceivably be added to the initial information that will be provided to Iowans on 511. (Initial information to be provided on 511 in Iowa includes real-time statewide road condition and weather information.) Iowa has already developed the reporting and data acquisition systems for the 511 service. Using speech recognition, travel information databases will drive automated 511 voice messages without additional manual intervention.

Potential ITS for traveler information related to the reconstruction of I-235. Traveler information ITS applications may be used to communicate about the I-235 construction and to improve travel efficiency. IDOT is reviewing applications, such as I-235 email alerts, Highway Advisory Radio (HAR), and Variable Message Signs, to assist traffic during I-235 construction. These applications, in addition to other ITS applications for traffic monitoring and traffic management and safety, may be adopted by IDOT on a permanent basis if they meet transportation system objectives.

Weatherview. Real-time transportation-related weather updates can be accessed via the Internet at http://www.dotweatherview.com/. Continuously updated travel conditions help motorists plan ahead for local and/or long distance commutes and travel safety. Weatherview combines the Iowa DOT's Road Weather Information System (RWIS) with Automated Weather Observing Stations (AWOS) at Iowa's airports to serve as a powerful resource in assisting site visitors with their safety on Iowa's transportation system.

Iowa DOT Maintenance concept vehicle. A "concept" winter maintenance vehicle was developed beginning in 1995 by IDOT, the Michigan and Minnesota DOTs, and the Center for Transportation Research and Education (CTRE). IDOT's maintenance concept vehicle is a standard-issue snowplow truck outfitted with ITS technology and other state-of-the-art safety and information components. Drivers can make decisions about plowing and spreading material with assistance from information provided on a readout in the cab of the truck. Data can also be recorded and downloaded or transmitted to provide guidance on optimizing roadway treatments and addressing trouble spots. This information can also be transmitted to traffic management centers, ITS service centers, and rest areas to help motorists make better travel decisions.

CVISN. The term commercial vehicle information systems and networks (CVISN) refers to the ITS information system elements that support commercial vehicle operations (CVO) activities. CVISN includes information systems owned and operated by governments, carriers, and other stakeholders. A national CVISN architecture has been developed to provide states with a common information system platform for CVO.

FORETELL. FORETELL is a weather forecasting system that allows transportation professionals to disseminate appropriate weather conditions to motorists prior to making travel plans. Computers assist in identifying weather changes hours before actual occurrences so transportation officials and the public can make more accurate safety and travel decisions.

Condition Acquisition and Reporting System (CARS). The Condition Acquisition and Reporting System (CARS) allows agencies at all levels to report planned and unplanned construction detours, road conditions, and weather traffic events. The data is made available on the Internet for commercial travelers and private motor vehicle operators.

The National Model and the Department of Public Safety's Traffic and Criminal Software (TraCS). Law enforcement officers can efficiently collect, transmit and process data using special laptop computers installed in their vehicles. This helps expedite transportation-related incident reports and increase safety on our state's highways. The National Model originates from the Department of Public Safety's TraCS (Traffic and Criminal Software). TraCS is a statewide, automated system for the capture of police reported traffic crashes and was developed by the Iowa DOT.

IDOT Linear Referencing System (LRS) Project. IDOT is developing a linear referencing system (LRS) to integrate databases and mapping within various transportation systems and organizations, promoting consistency. The system's primary purpose is to improve IDOT business workflows and decision-making by improving the integration of disparate data using the data's roadway network location. The LRS is composed of people, data, tools, policies and technology that together support the DOT's data integration, analysis, and decision-making.

2.0 *TRANSIT ITS ARCHITECTURE*

Iowa Department of Transportation
TRANSIT ITS

This section updates the transit aspects of the Statewide ITS Architecture effort completed in 2000 in order to develop a Statewide Transit ITS Architecture (STIA)[2]. This update ensures that the STIA addresses the more detailed set of transit-related user needs identified throughout this project. It also considers the National ITS Architecture, on which the earlier effort had been based, which has been considerably revised since that time.

The STIA was developed using a similar methodology to the earlier effort, but began with an updated set of ITS needs that were identified during Phase IA for Iowa transit agencies. First, these needs were mapped to the User Services documented in the current National ITS Architecture. Then, these User Services were mapped to the National ITS Architecture Market Packages and Equipment Packages. The National ITS Architecture Subsystems associated with these Market Packages and Equipment Packages were used to develop the Architecture.

The STIA is based on the Market Packages and Equipment Packages that support the identified ITS needs for Iowa transit agencies, and as such represents a longer-term vision and framework for statewide transit ITS deployment. The Equipment Packages still must be prioritized to establish the sequence in which they would be deployed, and programmed based on the availability of funding (i.e., the Statewide Transit ITS Deployment Plan, which will be the final product of this study).

2.1. Transit ITS Needs

Table 2.1 summarizes the ITS needs identified for Iowa transit agencies, based on the findings of Phase IA.

2.2. Mapping ITS Needs to User Services

Table 2.2 presents the mapping of ITS needs to the User Services related to transit. Based on this mapping, most of these User Services were selected for inclusion in the STIA. However, the selected User Services were customized and do not necessarily use all of the functional capabilities associated with User Services in the National ITS Architecture (selected and customized User Services are shaded).

Table 2.3 describes the customized User Services that were selected, and highlights how they have been customized by identifying which functional capabilities are required to support the identified ITS needs of transit agencies in Iowa.

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[2] Iowa Department of Transportation, "Iowa DOT Integrated ITS and Services Deployment Plan – Draft Report", July 2001

2.3. Mapping User Services to Market Packages and Equipment Packages

Table 2.4 presents the mapping of the selected User Services to the Market and Equipment Packages. Based on this mapping, all of the Market Packages were selected for inclusion in the STIA. However, the selected Packages were customized and do not necessarily use all aspects of those Packages as they appear in the National ITS Architecture (selected and customized Packages are shaded).

Table 2.5 shows which Equipment Packages are included in each customized Market Package, and highlights how the Equipment Packages have been customized by including a brief description of what types of technology would be included.

2.4. Transit Architecture

Figure 2.1 is the STIA diagram, mapping the transit ITS system elements selected for Iowa to the structured set of standard Subsystems and communications methods defined in the National ITS Architecture. This high-level architecture diagram focuses on the physical linkages between distinct entities. The Statewide Transit ITS Deployment Plan will address the prioritized implementation of individual deployment projects within this framework.

2.5. Conclusion

The following methodology was used to develop the Iowa Statewide Transit ITS Architecture (STIA):

- The identified transit ITS needs of Iowa transit agencies were used to select and customize appropriate User Services from the National ITS Architecture (Version 4.0).

- These User services were in turn used to select and customize appropriate Market Packages and Equipment Packages from the National ITS Architecture.

The high-level STIA has been developed to create a framework for future deployment. The STIA maps the transit ITS system elements selected for Iowa to the structured set of standard Subsystems and communications methods defined in the National ITS Architecture. The Statewide Transit ITS Deployment Plan will address the prioritized implementation of individual deployment projects within this framework.

Table 2.1
ITS Needs Identified for Iowa Transit Agencies

ITS Need Category	ITS Need	Needed Functionality
Transit Operations, Management And Maintenance	Paratransit reservations and eligibility	• Enhance call-taker productivity
	Fixed route and paratransit scheduling	• Identify runs that enhance productivity and customer service
	Centralized Dispatch	• Monitor fleet location and operational status • Rapid and accurate transmission of routine communications with drivers • Driver security
	Paratransit service coordination	• Consolidating invoices to funding agencies from multiple service providers • Access to scheduling capability for geographically distributed call-takers and service providers • Coordinate transfers across service area boundaries • Integrating fixed route transit into paratransit trips
	Fleet maintenance	• Enhance collection, processing, filing and analysis of maintenance information
Transit Information	Transfer connection protection	• Systematically decide when and for how long to hold outgoing buses at a transfer point if the incoming bus is delayed
	Pre-trip information and planning	• Distribution of static transit system information • Alternatives during off hours and peak times to calling customer service agents • Providing information about known service disruptions • Real-time information about estimated arrival times at major transfer locations
	In – vehicle next stop information	• Information for those with disabilities when approaching stops
Fare Payment and Rider Identification		• Reduce the use of cash • Reduce fraud with prepaid fare media • Enable agencies to accept each others fare media and equitably share revenue • Identify eligibility of paratransit riders to address funding agency requirements

Table 2.2
Mapping ITS Needs to User Services for Iowa Transit Agencies

ITS Needs	1.1 Pre-trip Travel Information	1.3 Route Guidance	1.4 Ride Matching and Reservation	1.6 Traffic Control	2.1 Public Transportation	2.2 En-Route Transit Information	2.3 Personalized Public Transit	2.4 Public Travel Security	3.1 Electronic Payment Services	5.1 Emergency Notification and	7.1 Archived Data User Service
Paratransit Reservations and Eligibility							✓				✓
Fixed Route and Paratransit Scheduling					✓		✓				✓
Centralized Dispatch					✓		✓	✓			✓
Paratransit Service Coordination							✓				✓
Fleet Maintenance					✓						✓
Transfer Connection Protection					✓						✓
Pre-trip Information and Planning	✓	✓									✓
In-vehicle Next Stop Information						✓					
Fare Payment and Rider Identification									✓		✓

Table 2.3
Customized User Services for Iowa Transit Agencies

User Service Bundle	User Service	Functional Capabilities
1. Travel and Traffic Management	1.1 Pre-trip Travel Information	• Checking service hours and fares • Checking for current route cancellations or detours • Requesting a trip itinerary for the origin, destination and desired trip start or finish time.
	1.3 Route Guidance	• Provide transit route and schedule information • Provide information on major delays or estimated stop arrival times
2. Public Transportation Management	2.1 Public Transportation Management	• Dispatch support • Fleet maintenance support • Developing route schedules • Blocking and runcutting • Workforce management • Bidding • Voice communications • Mobile data communications
	2.2 En-Route Transit Information	• Using on-board location determination to provide next stop announcements
	2.3 Personalized Public Transit	• Paratransit eligibility and reservations • Automatic email and/or dial-out notice for trip confirmation and imminent arrival • Preparation and mobile data transmission for manifests • Dispatch support • Mobile data transmission of trip completion records • Paratransit trip scheduling • Funding provider invoicing • Voice communications • Mobile data communications
	2.4 Public Travel Security	• Driver covert alarm • Dispatch monitoring for driver alarms
3. Electronic Payment	3.1 Electronic Payment Services	• On-board payment using electronic farecards • Facilities for issuing, revaluing and accounting with electronic farecards • Paratransit rider identification using electronic farecards • Clearinghouse to allocate prepaid revenue between multiple transit agencies accepting a universal electronic farecard
		• Archiving historical data • Error checking on data as it is received

Table 2.4
Mapping User Services to the Market Packages and Equipment Packages for Iowa Transit Agencies

Market and Equipment Packages

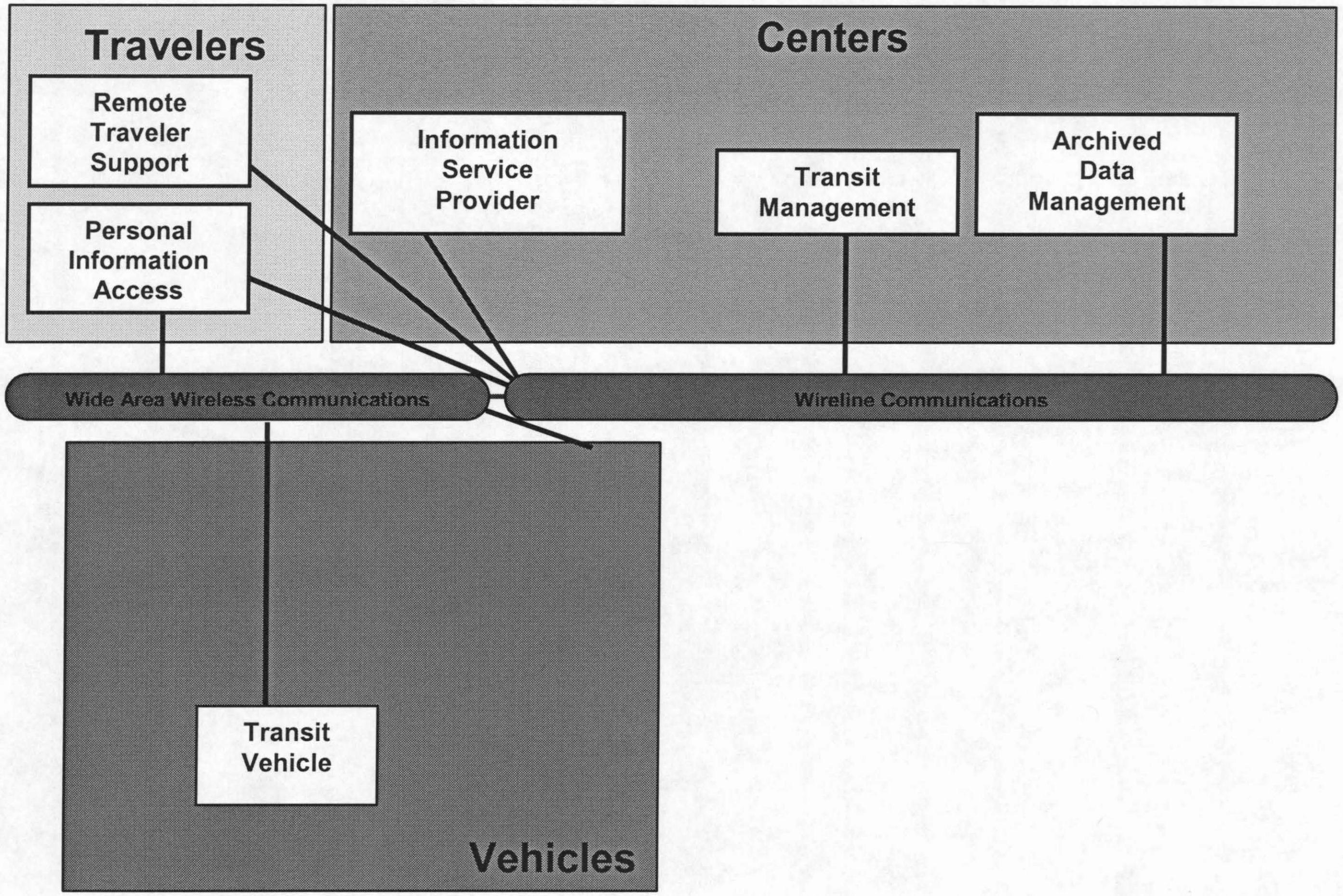
User Services	APTS1 Transit Vehicle Tracking	Transit Center Tracking and Dispatch	On-board Transit Trip Monitoring	Vehicle Location Determination	APTS2 Transit Fixed-Route Operations	Transit Center Fixed Route Operations	Transit Garage Operations	On-board Fixed Route Schedule Management	APTS3 Demand Response Transit Operations	Transit Center Paratransit Operations	Transit Garage Operations	On-board Paratransit Operations	APTS4 Transit Passenger and Fare Management	Remote Transit Fare Management	Transit Center Fare and Load Management	On-board Transit Fare and Load Management	APTS5 Transit Security	Remote Mayday Interface	Secure Area Monitoring	Transit Center Security	On-board Transit Security	APTS6 Transit Maintenance	Transit Garage Maintenance	On-board Maintenance	APTS7 Multi-modal Coordination	Roadside Signal Priority	Traffic Management Center Multimodal Coordination	Transit Center Multimodal Coordination	On-board Transit Signal Priority	APTS8 Transit Traveler Information	Interactive Infrastructure Information	Personal Interactive Information Reception	Remote Transit Information Services	Transit Center Information Services	On-board Transit Information Services
1.1 Pre-trip Travel Information																														✓		✓		✓	
1.3 Route Guidance	✓	✓		✓																										✓		✓	✓		
2.1 Public Transportation Management	✓	✓	✓	✓	✓	✓	✓		✓		✓											✓	✓		✓			✓							
2.2 En-Route Transit Information	✓		✓	✓																										✓					✓
2.3 Personalized Public Transit	✓	✓	✓	✓					✓	✓		✓																✓							
2.4 Public Travel Security	✓	✓	✓	✓													✓			✓	✓														
3.1 Electronic Payment Services			✓	✓									✓	✓	✓	✓																			
7.1 Archived Data	✓	✓			✓	✓	✓		✓	✓	✓		✓		✓		✓			✓		✓	✓		✓			✓		✓		✓	✓	✓	

Table 2.5
Customized Market and Equipment Packages for Iowa Transit Agencies

Market Packages	Equipment Packages	Technology Elements
APTS1 Transit Vehicle Tracking	Transit Center Tracking and Dispatch	• Provide vehicle locations and schedule adherence information to dispatchers • Two-way mobile voice and data communications
	On-board Transit Trip Monitoring	• Mobile Data Terminals, to integrate all on-board devices, provide on-board processing capability, provide driver schedule adherence feedback and link to the mobile data communications system
	Vehicle Location Determination	• On-board GPS receivers
APTS2 Transit Fixed-Route Operations	Transit Center Fixed Route Operations	• Scheduling, blocking and runcutting • Monitor fleet locations and schedule adherence • Daily dispatch operations • Transfer connection protection
	Transit Garage Operations	• Vehicle assignment • Workforce management • Driver bidding and assignments in daily operations
APTS3 Demand Response Transit Operations	Transit Center Paratransit Operations	• Eligibility and reservations • Trip scheduling and developing run manifests • Monitor fleet locations and schedule adherence • Daily dispatch operations • Invoicing funding providers • Paying service providers
	Transit Garage Operations	• Service provider or vehicle assignment • Workforce management (not for service providers) • Driver assignments in daily operations (not for service providers)
	On-board Paratransit Operations	• Transmit run manifest to driver • Driver completes and transmits trip records
APTS4 Transit Passenger and Fare Management	Remote Transit Fare Management	• Kiosks, agency and retailer facilities where farecards and rider identification cards can be issued and revalued
	Transit Center Fare and Load Management	• Central system support for card and account balance management • Clearinghouse for allocating revenue between multiple transit agencies accepting a universal farecard
	On-board Transit Fare and Load Management	• Accepting a farecard or rider identification card on-board • Recording locations where cards are used

Market Packages	Equipment Packages	Technology Elements
APTS7 Multi-modal Coordination	Transit Center Multimodal Coordination	• Coordinated paratransit trip scheduling with fixed route transit or across paratransit service area boundaries
APTS8 Transit Traveler Information	Personal Interactive Information Reception	• Riders receiving static transit information, next stop arrival estimates or trip itineraries using telephones, PCs and portable digital devices. Telephone access will use Interactive Voice Response (IVR) systems and automated voice/text notices, while PCs and portable device access will use websites and automatic email notices.
	Remote Transit Information Services	• Riders receiving next stop arrival estimates on variable signs at major transfer centers.
	Transit Center Information Services	• Develop real-time transit information and ready it for dissemination to riders.
	On-board Transit Information Services	• Use on-board location monitoring to trigger automated next stop announcements.

Figure 2.1
Architecture Diagram Mapping the ITS System Elements to the National Architecture Subsystems



3.0 *COMMUNICATIONS*

Effective and efficient operation of transit systems relies on a communications infrastructure and vehicle-based communications technologies. Communications systems are used to transmit voice and data (both raw and processed) between transit vehicles and operations (e.g., dispatch) centers, and to transmit commands between operators and technologies (e.g., signal priority commands to traffic signal systems). Transit communications systems are comprised mostly of wireless technologies and applications. The two-way voice radio system used for fleet management and vehicle dispatching remains at the heart of most transit operations. However, other communication technologies are becoming common; for example, short-range data links for traffic signal priority, wayside communications and signpost AVL. Mobile voice and data communication systems for bus transit include the use of analog, digital, and cellular digital packet data (CDPD).

Radio Communications systems are offered in various technologies and utilize various means to achieve the desired system functionality. There are significant differences in the basic physics and characteristics of different frequencies and why they are used for certain applications and not for others.

There are four fundamental questions that were used during the statewide communications assessment to define the research:

1. What are the communications resources available to the state's transit systems?
2. To what extent are the communication systems meeting needs and where are deficiencies?
3. What communications resources could be shared by the state's transit systems? Are there "surplus" communications resources?
4. What additional or new communications capabilities are needed to support the Statewide Transit ITS plan?

The opportunity to use existing state-owned radio communications infrastructure does not appear viable in the three to five year time frame. The design of these systems does not lend itself to the needs of most transit agencies. Moreover, Iowa DOT has neither the plans or the resources to upgrade the system to address transit needs. Transit systems do utilize existing infrastructure in many cases. For example, most small urban systems utilize the radio system

As part of the transit system assessments, information was collected on the communications systems and devices currently used by the state's transit systems. The state's transit agencies employ a variety of techniques to address the need for communications. Two-Way radio communication in the 150, 450 and 800 MHz frequency bands is most frequently used, although several systems use cellular communication. In addition, many systems use cellular as a supplement to their radio system for use when coverage is limited, or for confidential communications. For the most part, the state's transit systems are addressing their communications needs in an acceptable manner, i.e., managers rate the system adequate or better.

In nearly all the regional and small urban transit systems communications is limited to voice transmissions. The Ottumwa regional/small urban system is an exception, with both voice and data communications. Sioux City and Cedar Rapids also use data communications.

Several regional transit agencies do not have their own communications systems because they are "brokered systems." In these cases the contract operator is responsible for providing communications between vehicles in the service area and a base station.

Although the communications function is being addressed by the systems currently in use, there has been some concern expressed regarding cost. The current arrangement does not allow for the least cost solution in some cases. For example, Region 4 recently acquired radio hardware with a total cost of about $120,000. This is a substantial project for an agency with an annual budget of only $1.3 million. In addition, ongoing charges for access to tower sites and frequencies and servicing typically exceed $10,000 annually for regional systems. Transit systems in small urban areas are typically able to use the radio communications system owned and operated by the city (usually the public works department). In this manner, the transit system avoids at least ongoing access-related costs.

3.2. Existing Communications Resources Within the State

Iowa Department of Transportation

The consultant team gathered preliminary information on the radio communications assets in place throughout the state that are being used by Iowa DOT and explored their short-term viability in support of transit ITS needs.

The Iowa DOT radio communications infrastructure is comprised of two systems operated and maintained by two entities within the Department, Highway Maintenance and Motor Vehicle Enforcement.

The Iowa DOT Highway Maintenance system includes approximately 99 tower sites and repeaters centrally located in every county in the state. Approximately 80% of the tower sites are located at or near the DOT office or garage in each county. The average tower height is models operate in either voice or data modes within one radio, allowing the user to send and receive both types of information. The technology in place currently can eventually migrate to an entirely digital system. The inventory of mobile radios is approximately 3,500. The inventory of handheld radios is approximately 1,000. These radios are currently being purchased for approximately $2,400.00 each, in volume. List price for this mobile radio with the 128 channel, Digital format and Conventional Software is $3,213.00, uninstalled.

Iowa DOT Motor Vehicle Enforcement system towers are located at or near Highway Scale sites. These radio towers reach as high as 180 feet above ground level.

The in-vehicle technology being used includes a laptop PC in each vehicle.

There exists a 4 wire data (virtual) circuit that is installed from each of these Motor Vehicle Enforcement tower sites to the nearest Point-of-Presence location for the Iowa Communications Network (ICN). Some of the locations are local high schools, while others may be community colleges. The current monthly charge from ICN to Iowa DOT is around $1,000.00 per month for each of these lines.

The Iowa DOT Motor Vehicle Enforcement radio system is divided into 6 districts. Districts 5 & 6 have digital voice capability. Districts 1, 2 & 4 have digital installed, but not operational at this point. District 3 should have digital radio capability by the summer of 2002. The digital radio system can communicate at a data rate of 9,600 baud.

Based on interviews with communications staff, a typical regional transit system, if added to the state system, would not burden the DOT's Highway Maintenance radio system. It is also noted that Iowa DOT likes the idea of other entities piggybacking on their system, including some county agencies. This type of relationship brings revenue, cost-sharing and ultimately reduced expenditures to their existing system. It also provides a financial basis for upgrades.

Iowa Department of Public Safety/Iowa State Patrol

The consultant team gathered preliminary information on the radio communications assets in place throughout the state that were being used by IDPS and to ascertain the short-term viability in support of Transit ITS needs.

The IDPS is currently utilizing the same radios as Iowa DOT, Motorola. They have digital system in place currently, but are only utilizing the analog capabilities. They have approximately 28 towers with repeaters, while also utilizing a number of vehicle mounted repeaters. The IDPS/ISP has a number of entities sharing tower space at this time. An example is weather data gathering applications.

The ISP is currently working with Wireless Matrix Satellite Group out of Reston, Virginia as a

To the extent that it becomes feasible, the IDPS has expressed a willingness to share communications resources with other state entities. However, priority would always have to be given to IDPS communications.

Networking, Data and other IT Considerations

One of the most interesting issues that were researched was the Iowa Communications Network (ICN). The Iowa Communications Network is a statewide fiber backbone, designed primarily for distance education, but which more than 80 percent of the traffic is something other than distance education. The network also handles long distance telephone traffic for state government, and administrative meetings are conducted using the network's two-way full-motion video capabilities. State law prohibits use by private parties, but some private users have been able to have access by partnering with educational institutions. Those institutions can reserve use of the network without justifying the purpose or explaining the nature of the use.

The Iowa Communications Network has at least one point of presence (POP) in every one of Iowa's 99 counties. Phased construction began on the ICN in 1991 and it is estimated that there are more than 600 existing points of presence throughout Iowa currently.

The Code of Iowa authorizes specific users. These include the Iowa National Guard, Iowa Public Television, libraries, State government agencies, community colleges, Regents institutions, private colleges and universities, all local school districts, area education agencies, hospitals and physician clinics, federal agencies, Iowa judicial and corrections systems, and the United States Postal Service.

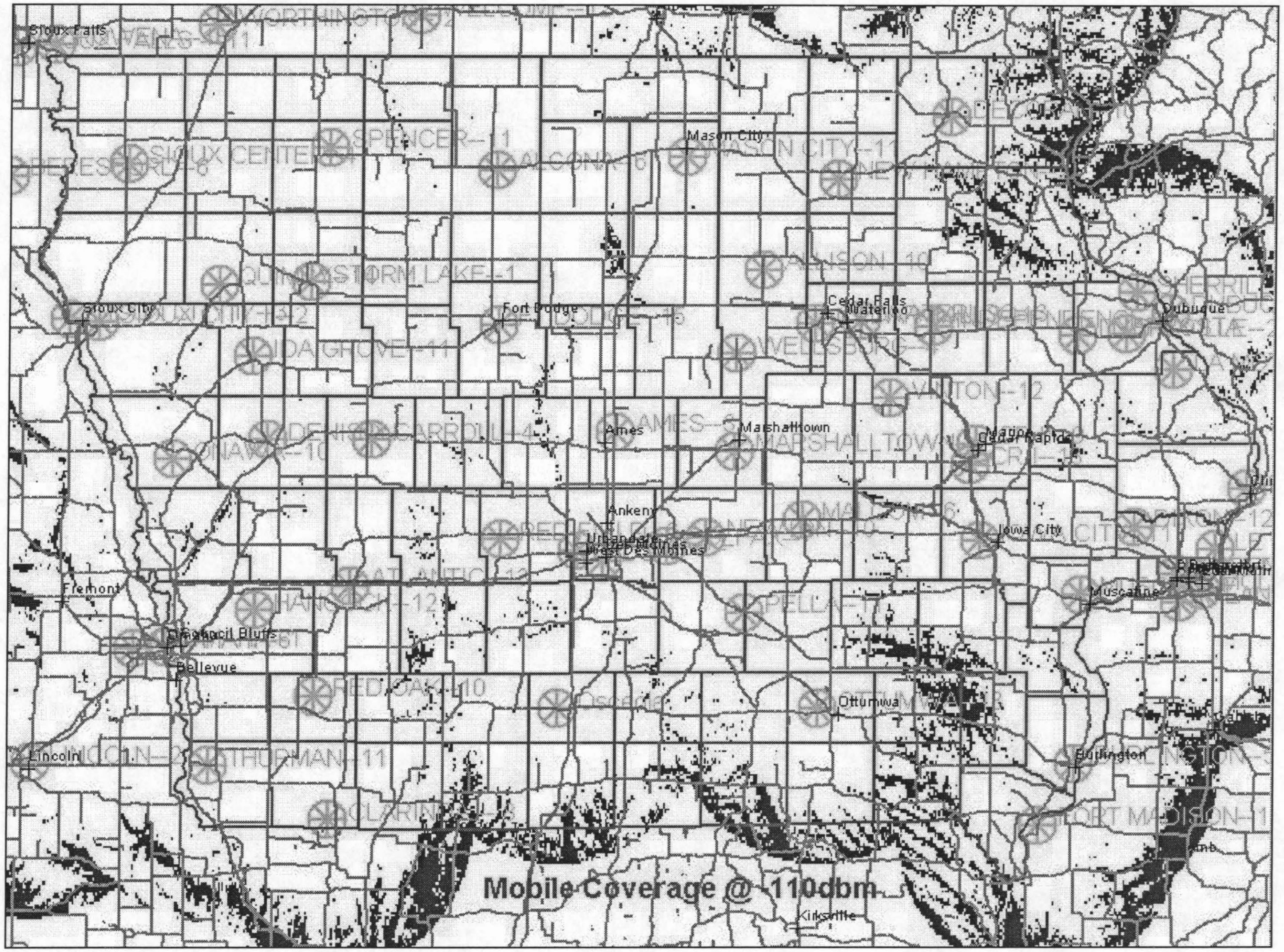
There does not appear to be any significant integration between the ICN and any of the State owned radio communications networks. Assuming available bandwidth, and, assuming an economically viable means to connect the towers and the nearest ICN point of presence, the possibilities of advanced, integrated statewide communications becomes a real potential.

Private Third-Party Providers in Iowa

RACOM, a privately held company headquartered in Marshalltown, Iowa, is one such third-party provider. The firm operates a large 800 MHz trunked digital wireless network throughout much of the State of Iowa. The company's core business consists of wireless voice and data services for public safety, utility, and industrial customers.

The Racom backbone network consists of M/A Comm Wireless EDACS system. Racom has more than 70 different tower locations throughout Iowa and neighboring states. Figure 3.1 shows the Raycom tower sites as well as the EDACS coverage area.

Figure 3.1
Raycom Tower Sites and EDACS Coverage Area



3.3. Conclusions on Communications

What are the communications resources available to the state's transit systems?

The State of Iowa has a multitude of communications resources available including the ICN's fiber optic network, non-networked radio communications resources from Iowa DOT and Iowa DPS, as well as a number of private communications providers including local telephone providers, cellular telephone providers, Nextel's Communications network and Racom's statewide EDACS radio network.

To what extent are the communication systems meeting needs and where are deficiencies?

For the most part communications systems employed by the state's regional and small urban systems are meeting their own needs. Some of the large regional systems experience limitations in coverage. The fragmentation of technology limits direct coordination through the communications system. It also limits the type of ITS technologies that can be deployed, such as AVL. Although communications are being addressed by the systems currently in use, there has been some concern expressed about cost. The current arrangement does not allow for the least cost solution in some cases.

What communications resources could be shared by the state's transit systems? Are there "surplus" communications resources?

The existing communications systems are designed for their individual intended uses and are not suitable for transit applications in most cases, as presently configured and deployed, with the exception of voice only capability in each county. This is especially true for the regional systems that have extensive service areas.

Surplus capacity does exist, but availability and transit needs would have to be determined on a case-by-case basis.

In order to utilize any surplus communications capacity transit systems will face financial, legal and administrative issues. These issues represent obstacles that can be overcome through cooperation among transit systems and the communication systems owners and managers.

Iowa DOT staff representatives have expressed willingness to work with statewide transit interests on a shared use demonstration project.

What additional or new communications capabilities are needed to support the Statewide Transit ITS plan?

The ability to transmit and receive data is a requirement for some transit operations applications. Generally, the need to provide for data communications to support ITS applications such as Mobile Data Terminals (MDT's) and AVL is expected to be the greatest challenge. While voice and data can use the same channel in conventional radio systems, most transit agencies provide a separate channel for data to avoid complications arising from the joint use of a channel. Most regional and small urban systems have only one channel currently available.

Another consideration is cost. Experience with commercial communication providers has shown access charges increase significantly (e.g., double) when data communications is included. In addition, there is a cost associated with enabling radio equipment for data transmission.

There are significant communications resources currently being used and available throughout the State of Iowa. For all practical purposes, they are standalone applications. Based upon the needs of statewide ITS, IDOT, IDPS and other county governmental entities, there appears to be a long range opportunity to combine and integrate a number of user bodies' needs into a truly interoperable statewide system. However, much further study and evaluation of specific needs would be required.

Iowa Department of Transportation

TRANSIT ITS

4.0 *ITS PROJECT EVALUATION*

This section presents the evaluation criteria and process that were used for determining the priorities for transit ITS deployment throughout Iowa. This section also summarizes the assessment of the estimated costs and potential benefits associated with 22 transit ITS projects covering the rural, small urban and regional transit systems. Evaluating the costs and benefits provides additional information for determining which projects best meet the Iowa DOT's goals.

4.1. Goals and Objectives

Based on the results of the tasks performed in Phase 1A of the project, the Steering Committee and consultant team developed goals and objectives for deploying transit ITS throughout Iowa. These goals are shown in Table 4.1.

Table 4.1
Goals and Objectives for Deploying Transit ITS

Goals	Objectives/Evaluation Criteria
Improve operational and administrative efficiencies, system performance and information for operations	· Increase automation of administrative functions (e.g., third-party billing) · Increase automation of operations and management functions · Reduce travel time variability (including reducing service delays and average travel time, and increasing average vehicle speed · Increase employee satisfaction · Provide data management capabilities · Provide data communication system · Increase productivity (passengers per vehicle hour) · Increase number of trips provided · Increase ridership · Increase number of passenger trips per vehicle mile
Improve transit and paratransit services/enhance mobility	· Increase inter-regional service coordination · Increase intra-regional service coordination · Better monitor vehicle location · Increase operating hours
Reduce operational and administrative costs	· Reduce cost per passenger-trip or passenger-mile · Reduce cost per vehicle-hour · Shift trips from paratransit to fixed-route service · More accurate and timely billing · Reduce administrative costs

Goals	Objectives/Evaluation Criteria
Improve safety and security of passengers and drivers	· Better monitor vehicle location · Provide silent alarm feature in vehicles · Provide data communication system · Decreased response time to incidents
Improve customer service	· Improve reliability of service · Reduce travel time and service delays · Increase customer satisfaction · Reduce time required to schedule a trip · Reduce customer wait time prior to a trip · Reduce number of customer complaints
Improve integration with other technologies	· Provide information to Iowa 511 system · Exchange information with traffic management centers · Use Weatherview information

Because evaluation criteria should represent what is expected to result from the deployment of transit ITS, it was determined that the objectives are effectively evaluation criteria. The evaluation criteria that are being used to prioritize transit ITS projects for deployment were adopted the Technical Committee and the Committee "voted" to rank the goals. The results of the ranking are shown in Table 4.2.

Table 4.2
Final Evaluation Criteria

Ranking	Goals	No. Votes
1	Improve operational and administrative efficiencies, system performance, and information for operations	121
2	Reduce operational and administrative costs	49
3	Improve customer service	48
4	Improve safety and security of passengers and drivers	35
5	Improve transit and paratransit services/enhance mobility	34
6	Improve integration with other technologies	24

These goals are used evaluation criteria in the utility-costs analysis.

4.2. Utility-Cost Analysis

Because the benefits of deploying transit ITS in rural and small urban systems in Iowa are difficult to accurately estimate, and evaluation criteria have been developed to reflect ITS benefits, a utility-cost analysis approach was used to determine the order in which transit ITS projects should be deployed in Iowa.

Utility-cost analysis requires, in the absence of monetary values of benefits, that weighted indices of effectiveness be created. These indices, registering the utility of ITS actions to meet objective goals, objectives, and/or evaluation criteria, are created using subjective reasoning, often based on consensus input from informed and interested parties. Utility criteria can account for how well ITS technologies address the needs of the provider, customers and/or positive externalities. In the case of this project, the evaluation criteria/goals that were developed for Task 7 were be used as the weighted indices of effectiveness.

The objective of the utility-cost analysis is to determine and evaluate available information for transit ITS projects for rural, small urban and regional transit systems in Iowa. The project team used this data to facilitate rough comparisons among the projects. Comparisons, however, must take into account a variety of factors. That fact that cost information was determined generally (based on the costs presented in Task 5) means that variables such as the detailed costs associated with a particular agency, and variations in potential benefits could lead to inconsistencies in the information. For example, in all cases, the project team determined generalized capital, and operating and maintenance costs, which did not include detailed, line item budgets for each transit agency's planning, development, design, and start-up costs. Benefits data was even less detailed, not quantifiable, and more variable than the cost data.

Nevertheless, the utility-cost analysis gives Iowa DOT stakeholders a general illustration of expected project costs and anticipated project benefits.

The project team's calculated a single cost figure for each of the 22 projects. Three types of costs were included for each project:

- Capital and other one-time costs;
- Annual operating costs (estimated at 10% of capital costs); and
- Annual maintenance costs (estimated at 8% of capital costs).

Capital costs include one-time expenditures for hardware, software, and services to implement and deploy a project. Where available, non-recurring expenditures for planning, design and engineering, system integration and other one-time start-up costs were also included as capital costs.

All projects were assumed to have a five-year life cycle. The capital and other one-time costs were also assumed to be in present value dollars. This assumption eliminated the difficult, time-consuming, and often infeasible task of determining the present value of funds that had been expended at different times and/or would be spent in the future. The assumption of the five-year project life cycle was also needed for consistency with the net present value (NPV) calculations described below.

Annual operating costs include recurring expenditures for items such as staff salaries and benefits, rent and facility maintenance, communications charges, and other overhead expenses. Maintenance costs include annual repair, upgrade, and support costs for hardware, software, and operational facilities. The project team estimated the operating and maintenance costs as a percentage of the capital costs, using 10% and 8% respectively.

An NPV was calculated for both operating and maintenance costs to transform them into numbers that could be added to the total capital costs. The discounting period for the NPV calculations was set at the same five-years as the project life cycle. The NPV calculations were made using a discount rate of 6%, consistent with federal standards for life cycle costing of federally-funded projects.[3] Total base and present value costs are provided in Table 6 for each of the 22 projects assessed.

3 "Guidelines and Discount Rates for Benefit-Cost Analyses of Federal Programs." Office of Management and Budget: Circular No. A-94 (revised January 2000), Transmittal Memorandum No. 64; October, 1992.

4.3. Utility-Cost Analysis

The six evaluation criteria (see Table 1) for the transit ITS systems that are being considered for deployment in Iowa represent the needed goals for the utility-cost analysis. In this step, each of these goals is assigned a weight from 1 through 10, with 10 being the most important. The goals are independent of the technologies are being considered.

The weights were determined as follows. Since the voting process yielded a significant difference among the goals, weights were assigned to these goals that were representative of the importance of each goal. The importance was reflected in the number of votes that each goal received. Table 4.3 shows the weighting for each goal.

Table 4.3
Weights of Goals

Goal	No. Votes	% Total Votes	Final Weight
Improve operational and administrative efficiencies, system performance, and information for operations	121	39	10
Reduce operational and administrative costs	49	16	4
Improve customer service	48	15	4
Improve safety and security of passengers and drivers	35	11	3
Improve transit and paratransit services/enhance mobility	34	11	3
Improve integration with other technologies	24	8	2
TOTAL	311	100	

The next step in the utility-cost analysis is to assess each transit ITS project in terms of its effectiveness in meeting each goal. In this case, a 1-5 scale was used, with 5 being most effective. These ratings (and the scale) were defined based upon the consultant team's extensive experience in transit ITS. The effectiveness rations are shown in Table 4.4.

Table 4.4
Effectiveness of Technology in Achieving Goals

Goal	Vehicle maintenance software	Computer-assisted scheduling software	Data communication/ MDTs	Fully automated scheduling software	AVL
Improve operational and administrative efficiencies, system performance, and information for operations	3	6	9	9	8
Reduce operational and administrative costs	3	5	8	8	6
Improve customer service	2	4	8	8	7

Goal	Vehicle maintenance software	Computer-assisted scheduling software	Data communication/ MDTs	Fully automated scheduling software	AVL
Improve safety and security of passengers and drivers	2	1	9	1	10
Improve transit and paratransit services/enhance mobility	2	6	5	8	4
Improve integration with other technologies	2	5	10	8	9

Next, the total utility was calculated (see Table 4.5). This part of the analysis is pure arithmetic: multiply the effectiveness factor from Table 4.4 (showing how well an ITS technology addresses a goal) by the weight of that goal from Table 4.3. Then, for each technology, sum all the utilities to determine the overall utility for that technology.

Table 4.5 shows that data communication, both computer-assisted and fully automated scheduling/dispatching software, MDTs and AVL have the highest overall utility in Iowa, meaning that they will yield the most significant benefits. Their overall utilities are very similar. Vehicle maintenance software ranks much lower in terms of the effectives in meeting the aforementioned goals.

Table 4.5
Total Utility

Goal	Vehicle maintenance software	Computer-assisted scheduling software	Data communication/ MDTs	Fully automated scheduling software	AVL
Improve operational and administrative efficiencies, system performance, and information for operations	30	60	90	90	80
Reduce operational and administrative costs	12	20	32	32	24
Improve customer service	8	16	32	32	28
Improve safety and security of passengers and drivers	6	3	27	3	30

Goal	Vehicle maintenance software	Computer-assisted scheduling software	Data communication/ MDTs	Fully automated scheduling software	AVL
Improve transit and paratransit services/enhance mobility	6	18	15	24	12
Improve integration with other technologies	4	10	20	16	18
TOTAL UTILITY	66	127	216	197	192

This section includes the general costs for each of the technologies. Table 4.6 shows the total costs for each technology being recommended for deployment and the average cost per agency.

Table 4.6
Technology Costs

System	Vehicle maintenance software	Computer-assisted scheduling software	Data communication & MDTs	Fully automated scheduling software	AVL
Mason City Transit	$4,220	$121,428			
Burlington Urban System	$4,220	$121,428			
Clinton	$4,220	$121,428			
Marshalltown MMT	$4,220	$121,428			
Muscatine Muscabus	$4,220	$121,428			
Region 11 HIRTA	$9,143	$180,174	$1,062,042		
Fort Dodge DART	$6,330	$121,428	$268,562		
Region 2 North Iowa RTA	$9,143	$180,174	$1,013,212		
Region 10 East Central Iowa	$6,330	$160,592	$817,894		
Region 1 NRTS	$6,330		$537,124	$158,592	
Region 5 MIDAS	$6,330		$512,710	$158,592	
Region 6 Peoplerides	$4,220		$219,733	$139,010	
Region 7 Iowa Northland	$4,220		$292,977	$139,010	
Region 8 RTA	$4,220		$390,636	$158,592	
Region 9 River Bend Transit	$6,330		$708,028	$178,174	
Region 12 Western Iowa	$6,330		$805,687	$178,174	
Region 13 SWITA	$6,330		$683,613	$178,174	
Region 14 Southern Iowa	$6,330		$476,088	$158,592	
Region 15 Ottumwa/10-15	$6,330		$610,369	$158,592	
Region 16 Southeast Iowa	$4,220		$280,770	$139,010	
Region 3 RTA	$9,143		$891,138	$197,757	$282,580
Region 4 SRTS	$6,330		$561,539	$158,592	$216,936
TOTAL	**$128,702**	**$1,249,508**	**$10,132,121**	**$2,100,864**	**$499,516**
Average per Agency	**$5,850**	**$138,834**	**$596,007**	**$161,605**	**$249,758**

In the final step in the utility-cost analysis, the total utility for each technology is divided by the total cost of that technology (and then multiplied by 10,000 for sake of viewing the results). The resulting utility-cost ratios for the recommended technologies are shown in Table 4.7.

Table 4.7
Utility-Cost Ratios

	Vehicle maintenance software	Computer-assisted scheduling software	Data communication & MDTs	Fully automated scheduling software	AVL
Utility-Cost Ratio – Total Cost	5.13	1.02	0.21	0.94	3.84
Utility-Cost Ratio – Average Cost	11.28	0.91	0.36	1.22	0.77

These results suggest that the recommended technologies be deployed throughout the state with the following priority:

- Vehicle maintenance software (highest priority)
- AVL
- Computer-assisted scheduling software
- Fully automated scheduling software
- Data communication and MDTs (lowest priority)

The utility-cost ratio that utilized the average cost of each technology per agency yielded only slightly different technology priorities, as follows:

- Vehicle maintenance software (highest priority)
- Fully automated scheduling software
- Computer-assisted scheduling software
- AVL
- Data communication and MDTs (lowest priority)

4.4. Conclusions and Recommendations

The utility-cost analysis clearly shows that the top (and least-cost) priority should be for Iowa DOT to invest in vehicle maintenance software for all 22 agencies included in the analysis. It is a low-cost technology that can facilitate the collection, processing, filing, and analysis of maintenance information in a paperless environment.

The utility-cost analysis also shows that data communication and MDTs should be considered as a low priority item. While this differs from the TranSystems' Team's initial recommendation on this technology's relative priority, the analysis makes it clear that the other technologies should be considered as higher priorities, since they have the potential to better meet the goals identified for deploying technology throughout the state.

Computer-assisted scheduling is recommended to be deployed as a second priority throughout the state. The reason for this recommendation is that most of the agencies that were identified as having a need for some automation (but not full automation) have little right now in the way of scheduling tools. Much of their scheduling is accomplished using paper and pencil. Thus, they would benefit more than those agencies that already some type of scheduling tool.

Our recommendation for the next priority is to deploy fully automated scheduling. The reason for this is that (1) it is should be in-place before AVL is considered for deployment; and (2) it will improve the scheduling and dispatching process, and operations for those agencies that already have some computer-assisted tools. AVL can be added at any point after fully automated scheduling is in-place for the two agencies identified (Regions 3 and 4).

5.0 IMPLEMENTATION STRATEGIES FOR ITS

Iowa Department of Transportation

TRANSIT ITS

5.1. Procurement Strategy

The purpose of Task 8 (in Phase IB) was to examine the opportunities for economies of intelligent transportation systems (ITS) software and hardware through standardization and interoperability, and to consider various procurement strategies. One of the most critical questions related to funding and procurement is whether economies of scale can be achieved if multiple transit agencies purchase the same ITS software and hardware. For example, there is a significant difference in the cost of purchasing 250 mobile data terminals (MDTs) vs. purchasing 20 MDTs. The underlying issue is whether or not the same ITS hardware and software is appropriate for multiple agencies.

Based the work that was accomplished in Phase IA, and Tasks 5, 6, and 7 of Phase IB of this project, and experience from elsewhere, there is strong evidence that economies of scale can be gained by procuring transit ITS components for multiple Iowa transit agencies at the same time, or using a statewide contract/purchase order for these components.

There are several ITS procurement strategies available to Iowa DOT. Before a discussion of each method, it is important to briefly explore issues that should be considered before the procurement process. First, ITS procurements need to be flexible and adaptable. Purchasing ITS systems is not like purchasing a bus or tires for a bus. Procurement processes need to be flexible and adaptable to the facts and circumstances surrounding each procurement. It is important to provide an environment that offers the maximum range of procurement options and strategies.

Second, being prepared to overcome contracting barriers at various institutional levels and during project phases is important. The following tools can overcome typical contracting barriers:

- Partnering with other public and private sector entities;
- Enacting new or revised legislation;
- Selecting funding sources that allow flexibility;
- Leveraging intellectual property rights;
- Utilizing private sector cost sharing with reasonable compliance requirements;
- Carefully segregating, bundling and drafting contract scopes of work;
- Promoting competition among pre-qualified offerors;
- Utilizing evaluation and award criteria which are fair and flexible; and
- Incorporating expedited dispute resolution procedures.

Third, involving procurement personnel early in the planning process enhances the project's chance of success. Since it has been difficult for transit agencies or State DOT transit personnel to develop procurement expertise when dealing with ITS, they may want to consider outside help from a consultant with innovative procurement expertise.

At this point, two major questions need to be answered: (1) is the legal/procurement department/person or procurement ready and willing to handle a non-traditional procurement? and (2) can the agency be flexible in the type of procurement used?

Often, legal and procurement personnel are less likely to explore alternatives that they have not directly experienced than the primary stakeholders that are directly involved in the technology. This lack of flexibility can result in a less than ideal procurement. Also, is the agency able to choose the appropriate procurement method, or are they bound to use only a specific method due to agency or local rules? For example, Westchester County Department of Transportation (in Westchester County, NY), which operates fixed route and paratransit service, is not an authority and is thereby bound by County procurement rules. These rules dictate that all equipment procurements must be use a bid process, rather than a request for proposal (RFP) process.

Basic Procurement Methods

There are four basic methods of procuring transit ITS systems and services, as follows:

- Invitation for Bid (IFB) (a.k.a. formally-advertised competitive bid);
- Two-step competitive bid (a variation on an IFB);
- Request for Proposal (RFP) (a.k.a. competitive negotiated procurement); and
- Sole source.

One additional method that is not typically used for transit ITS procurements is an unsolicited proposal. The last item, sole source, is usually not appropriate for procurements of this type because of their size and complexity. However, if the agency is exploring public/private partnerships, this may be possible.

An IFB is used when the specifications represent a final design, and when price is the only deciding factor. If the agency knows exactly what it wants to procure, the IFB is an appropriate method. The system or services being procured must be defined in detail by specifications; the selection of a vendor/contractor must be based on low price alone, once the bid is deemed responsive and responsible; and the specifications must reflect a final design and bidders cannot take any exceptions to the specifications. If a bidder is more qualified than other bidders and comes in at a higher price, they cannot be selected. Also, no negotiations can be held with bidders regarding technical or cost issues.

Most transit agencies do not have exact specifications because they are not quite sure of what they need. Also, agencies are typically procuring more than just hardware/equipment. A technology purchase involves hardware, software, installation, and other services. This type of purchase does not lend itself easily to an IFB process.

The two-step IFB process is more flexible than the basic IFB since there is an opportunity to modify the specifications before completing the process. In this type of procurement, the agency "pre-qualifies" bidders. During the first step, potential bidders can take exception to the specifications and contract terms, and make suggestions about modifications while responding to the IFB. This is not allowed in the one-step IFB process. Once the agency reviews the responses, they can modify the specifications if they desire. Then, an addendum to the specifications would be issued to those who responded in the first step. Those bidders can then submit an amendment to their bid that responds to the addendum.

So, a two-step IFB is the same as an IFB except that prospective bidders are "tested" before being invited to submit a bid. They can take exception to contract terms and specifications in the initial "test" step. Then, an addendum is issued to the initial specifications that reflects exceptions and modifications. Bidders can then submit an amendment that responds to the modifications.

The RFP process works well for projects of the complexity and scope of advanced technology for transit. It allows much more flexibility than an IFB process, particularly since the specifications do not have to reflect a final design. Functional or performance specifications, or requirements checklists are often used in an RFP. The basis of an RFP is a Statement of Work (SOW). Proposals contain technical and cost sections that are reviewed separately. Proposal evaluation criteria go beyond just cost - they may include cost, but cost is usually a minor criteria. Technical, management and cost criteria are often used. In addition, the proposers may be asked to conduct demonstrations of their systems, and the agency personnel may conduct on-site visits at agencies that have successfully deployed the proposers' systems. The scope of services and the price can be negotiated when using an RFP process. Thus, an RFP process allows the greatest amount of flexibility.

All processes should incorporate a pre-bid/proposal meeting during which potential vendors/contractors can ask questions and get a better sense of the environment.

The selection of the most appropriate method is based on several factors. One factor is the agency's procurement requirements. Another is the soundness of the specifications that describe the transit ITS systems and/or services. Most often, IFBs contain technical rather than functional specifications. Responses to IFBs are considered equal except for price - this process can only be done with technical specifications.

Selection of the Right Procurement Method

There are three bases for making procurement decisions: qualifications, cost and qualifications combined, and cost alone.

If an agency is seeking alternative approaches to a transit ITS system, the RFP approach is the appropriate procurement method.

Qualifications based procurements uses the RFP method (it does not have cost as a proposal evaluation criteria) or the sole source method, as well as the two-step qualifications, Letter of Interest (LOI) or Request for Qualifications (RFQ), then RFP and/or interview) process. Two-step qualifications is just an extension of an RFP process – it includes more steps before the RFP is released.

Cost and qualifications combined use the two-step IFB described earlier, sole source or an RFP process that includes cost as an evaluation criteria. Here, best and final offers (BAFOs) are often solicited from the top-ranked vendor(s)/contractor(s). This is also known as competitive negotiations.

Competitive negotiations involve the following process. Selection of a vendor is made of two or more offerors deemed to be fully qualified and best suited among those submitting proposals, on the basis of the factors stated in the RFP, including price. Negotiations are then conducted with each of the offerors selected. Price is considered, but need not be the sole determining factor. After negotiations have been conducted with each offeror, the agency makes a contract award to the offeror who, in the agency's opinion, has made the best proposal. The idea behind a cost and qualifications combined approach is to ensure that the agency is receiving the best value.

Cost alone, or low-bid, should be used only for fixed outcome projects. Fixed cost works best for fixed outcome projects. Cost alone is often inappropriate for ITS.

The factors that should be used to determine when to use qualifications alone or a qualifications and cost combined approach are as follows:

- Consider what you are buying. Is it intellectual property or real property or both?
- How difficult will it be to achieve the desired outcome? Will it be technically more difficult, or institutionally more difficult?

Once you have considered these factors, you can match the selection method to the outcome, as follows:

- Qualifications and cost combined works well if the product is a combination of services and products; and
- Qualifications alone work well for software alone, or services.

One cautionary note about a low-bid for software - this should be used only when bidding for items with very little or no software development/integration.

Procurement Recommendations

This section is divided into two subsections. The first describes recommendations regarding purchasing the same hardware/software for multiple agencies, and the second discusses the recommended procurement strategies that should be used by either each transit agency or the state to procure transit ITS hardware, software and services.

Multiple Agency Procurement Recommendations

Given the information presented earlier in this report about integration and interoperability, and the information about the technology profile associated with each regional and small urban/rural transit system in Iowa, we recommend that multiple agencies purchase the same hardware and software where possible.

There is an opportunity for economies of scale when scheduling software and MDTs are being considered for deployment. A total of 560 vehicles are covered in Technology Levels 3 and 4. Given that the majority of MDT procurement involves in-vehicle hardware and software, procurement of 560 units versus as many as 73 at a time will potentially yield lower cost units.

Further, we recommend that all agencies, with the exception of Technology Level 1 agencies, deploy a data communication system. The alternatives regarding data communications were described in Working Paper 5 – Inventory of Statewide Communications Resources.

Because vehicle maintenance software is being recommended for every agency included in this study, Iowa DOT should purchase this software on a statewide basis for all of these agencies. South Carolina DOT (SCDOT) made OmniFleet® Equipment Maintenance Management Software from Resolute Solutions Corporation available to all transit agencies throughout the state, rather than having each agency develop specifications and go through a whole procurement process.

Recommended Procurement Strategies

Given the information presented earlier in this report about various procurement and selection methods, we strongly recommend that an RFP process is used for the majority of procurements of transit ITS for Iowa. The only time that an IFB should be used is when only equipment is being purchased, and that type of equipment is well defined. IFBs can probably be used for some data communications equipment, as well as MDTs. However, if MDTs are being purchased and must be interfaced with scheduling and dispatching software, they should be part of procurement for the software. This is due to the fact that interfaces between the scheduling software and the MDT will be required to be developed (if they do not already exist).

Use of an RFP process for procuring the majority of the transit ITS hardware, software, and services requires the following decisions:

- Iowa DOT must decide if it becomes the "procuring agency" for the transit ITS;
- Whether or not Iowa DOT becomes the procuring agency, a decision must be made about whether to develop specifications internally or externally (using a consultant); and
- Iowa DOT must determine if it is possible to set-up a contractual vehicle that agencies can use to purchase their transit ITS systems.

There are several pros and cons to having Iowa DOT be the focal point for all transit ITS procurement for the rural, small urban and regional transit agencies in Iowa. On the positive side, each transit agency would not have to conduct the whole procurement process themselves. This not only eliminates duplication of effort, but also allows each agency to focus their efforts on the deployment, rather than the procurement activities. Further, once Iowa DOT sets up a procurement process for transit ITS and becomes familiar with the process, no additional effort will be required to assist agencies that wish to procure transit ITS.

On the negative side, having Iowa DOT as the focal point may require that additional external help be retained to develop the procurement process and to provide the necessary technical assistance to each agency as transit ITS is being procured. Further, having Iowa DOT as the Procuring agency may be perceived as taking some control away from each agency.

The issue regarding specifications development is important since most of the agencies included in this study do not have the internal personnel with the appropriate expertise to develop the necessary specifications for transit ITS systems. Further, Iowa DOT may not have the in-house personnel to develop these specifications.

The final issue – setting up a statewide contractual vehicle to facilitate the procurement of transit ITS by agencies – will require that either Iowa DOT or an external party develop this vehicle and make it available to the agencies that are interested in procuring transit ITS using this vehicle.

For example, in Massachusetts, there is a State Purchase Program[4] that allows certain agencies to utilize Statewide Contracts for selected commodities and services. There are two primary benefits to this approach: (1) goods and services can be purchased directly by agencies from Statewide contractors at a low price negotiated by the Commonwealth of Massachusetts; and (2) agencies do not have to conduct a competitive procurement on their own.

This type of vehicle has been used for procuring transit ITS in the past. However, there is not a vast amount of experience with this type of procurement vehicle.

Thus, our recommendations regarding the three decisions are as follows:

- Iowa DOT should become the procuring agency;
- Specifications should be developed by an external party; and
- A statewide procurement vehicle should be developed for agencies to procure transit ITS.

5.2. Standardization and Interoperability

Early on in this project, the need for standardization and interoperability among the rural and small urban transit systems in Iowa was identified. This need requires that the appropriate transit ITS standards be identified and the issues associated with interoperability among systems be described. The following subsections present information about existing standards and their use and about interoperability among transit systems in Iowa.

Standardization

There are a limited number of standards for transit ITS software and hardware. However, these should be strongly considered for use to ensure that ITS products purchased in the future for various agencies all adhere to existing and proven standards.

Appropriate ITS standards must be identified for each information flow in an ITS architecture (see Task 6 report). Establishing regional and/or statewide standards for exchanging information among ITS systems is important not only from an interoperability point of view; it also reduces risk and cost since a region and/or state can select among multiple vendors for deployment products[5].

ITS standards address interfaces between ITS systems, so typically, the ITS stakeholders in a region and/or state should have reached consensus on the information flowing between each pair of ITS systems in a region and/or state prior to identifying applicable standards. If interfaces defined in the Regional and/or Statewide ITS Architecture are not mature, stakeholders should agree on an interim standards approach.

In general, each information flow has up to three types of standards that are relevant: a message set standard, a data element standard, and one or more communications protocol standards. Especially in the area of communications protocols, there are various technology choices that a region and/or state can make. For this project, we will recommend specific

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4 "OSD [Massachusetts Operational Services Division] POS [Purchase of Service] State Purchase Program," http://www.state.ma.us/osd/pos/info/psppdesc.pdf and http://www.state.ma.us/osd/pos/dps.htm

5 A report identifying ITS standards supporting regional and national interoperability is a required component of a Regional ITS Architecture according to the FTA Policy on ITS Architecture Consistency.

standards that the state of Iowa should consider to ensure standardization of transit ITS hardware and software purchased by the rural and small urban transit systems, and to ensure interoperability among systems.

Before describing the applicable standards for transit ITS in Iowa, it is important to discuss the consideration of standards, particularly standards maturity. The maturity of ITS standards was reviewed prior to selection in terms of the following:

- Has the standard been approved or published one or more of the standards development organizations (SDOs)?
- Has the standard been adopted by multiple vendors?
- Has the standard been tested?
- Is there an amendment to the standard in process, and if so, how much will it change as a result?

In addition to the interface standards that are being defined for ITS, a range of other regional and/or statewide standards may be considered that would facilitate interoperability and implementation of a Regional and/or Statewide ITS Architecture. For example, standard base maps, naming conventions, measurement and location standards, and organizational structure identifiers can all facilitate the meaningful exchange of information between systems in a region/state. These types of regional/statewide standards should also be considered and can be included in the standards documentation at the discretion of the region/state.

The leading applicable transit ITS standards include the Society of Automotive Engineers (SAE) J-1708 vehicle area network (VAN) standard and the Transit Communications Interface Profiles (TCIP) standards. The VAN standard provides a common backbone by which ITS systems and data can be linked on a vehicle. SAE J-1708 is a slow, low bandwidth multiplex bus standard. Currently, there is an effort to migrate to SAE J-1939, which has higher speed and greater bandwidth than J-1708. SAE J-1939 is not supported currently by all transit ITS vendors.

TCIP is a suite of data definition/interface standards for the transit industry. The TCIP standards define all the information used by transit agency systems in a standard way, with standard names and formats. They are like many other standards that have been used for commerce for decades, such as standards for electronic purchase orders and invoices. For new systems, they may be used directly for structuring databases and programs. But even if they are not, program interfaces can be built around the standards. In the future, when standards use reaches a critical mass, these standards should make it easier to interface between agency systems and vendor software, or between two vendors' software products.

There are three levels of conformance with TCIP, as follows:

Level 1	Data (data elements). Level 1 requires that legacy systems/applications be able to translate between proprietary system and TCIP data elements;
Level 2	Message (Level 1 and Message Sets). Level 2 requires support of Level 1 **AND** the ability to map proprietary objects/entities (message structures) to TCIP data elements and messages; and
Level 3	Dialog (Level 2, dialog patterns and implementation specification). Level 3 requires Level 2 **AND** support of the library of TCIP Application Programming Interfaces (APIs).

Interoperability

Interoperability is defined as the ability of ITS systems:

- To provide information and services to other systems;
- To accept information and services from other systems; and
- To use the information and services that are exchanged to operate together effectively.

There are three types of interoperability. Systems must be able to communicate and operate effectively together at the following levels:

Technical	Ability of equipment (hardware and software) to communicate (i.e., send and receive information);
Procedural	Common procedures to exchange meaningful information (i.e., interpret and understand the information); and
Institutional	Administrative and/or contractual agreements between operators and users of the information (e.g., financial transactions among accounts).

As initially presented in Task 3, the difference between ITS integration and interoperability is as follows:

Integration is sharing infrastructure, exchanging information, and using data for control; and **Interoperability** is using standardized protocols to accomplish the same goals.

In Working Paper 7, there was a discussion of the considerations and challenges associated with integration and interoperability of transit ITS in Iowa. It is recommended that Iowa DOT consider the integration of transit ITS among those operators whose service is coordinated, as well as interoperability of transit ITS systems throughout Iowa. The reason for this recommendation for interoperability can be summarized in the following bullets. Implementing and deploying the same transit ITS systems in rural and small urban agencies across the state will:

- Lower the risk associated with each deployment;
- Lower the costs associated with each deployment[6] from;
  - Elimination of duplicate testing environments (labs, platforms, testing personnel);
  - Standardization of information technology (IT) specifications;
  - Leveraging of software license purchasing power;
  - Standardization of system configuration and user guides; and
  - Common system support;
- Increase the body of knowledge about specific systems throughout the state;
- Provide a supportive environment among agencies that have the same systems;
- Encourage more vendors to compete in order to have a statewide market for their products; and
- Increase the efficiency and effectiveness of the services provided by the agencies that deploy these systems.

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6 Adapted from "Benefits of a "Virtual Enterprise," http://www.isg-scra.org/transit/srts/srts-VTEProject.html

5.3. Strategies for Technology Support

ITS applications require a level and type of ongoing support that Iowa's transit agencies do not have access to. This support is a fundamental requirement for successful Transit ITS deployment. There are several ways to secure this support, each with advantages and disadvantages.

1. The agency can contract with the vendor to provide support for a period of time through warranties and maintenance/service agreements. The advantage is that the costs can be included as part of the initial procurement, and the vendor has familiarity with the products. Disadvantages are that access and response time can be limited, and the service agreements usually have a term that makes the agreements "temporary."

2. The agency can hire a staff person to provide the needed support. This will provide the highest level of support in terms of response time. The disadvantages involve cost. It is unlikely that any of the applications contemplated in the five-year time frame will require the services of a full time system administrator. Furthermore, the cost of the additional staff person is not a reasonable expense for the transit agencies to cover. However, it is important for agency staff to be trained in the basics of system support (e.g., simple diagnostics) to provide a level of in-house support. If possible, a staff person with an interest or aptitude for technology can be provided additional training to offer a higher level of in house support.

3. The agency can "borrow" support from another organization, such as a city or county, that may have the resources (and the need) for IT support. The advantages include lower cost and accessibility. The disadvantages may be that the transit system is a lower priority, and the individual may not be familiar with the intricacies of the transit applications. This type of borrowed support may be best suited for standard office hardware and software systems, but may need to be augmented for the transit specialty systems.

4. Transit agencies can pool resources to secure technical support. This can be through a contract provider, or hired staff. Another possibility is to secure these services collectively through an arrangement with one of the state's universities. Iowa DOT may be able to assist with such an arrangement.

Information Technology Support Recommendation

The recommended approach to the important task of ongoing support for ITS systems is actually a combination of the approaches summarized previously.

- The agency should procure at least two years of IT support from the vendor that provides system integration services. This will allow the agency to "capitalize" much of the IT support, and will carry the project through the initial period when problems and issues are more likely to surface. In addition, the vendor's service personnel can help familiarize and train agency staff on the system.

- The agency should identify and train an individual to have lead agency responsibility for the system. This individual need not be an ITS "expert", but should be familiar with the system and the diagnostics that can be used to troubleshoot problems that occur. In addition, this individual should be familiar with services that can be provided by others, including the vendor and contract service providers. In this case, the agency's system administration can direct the activities of external service personnel.

- The agency should also be prepared to secure the services of contract service personnel at a minimum after the term of the vendor provided support. This support can be most efficiently secured through a contract with a firm experienced in general IT systems and transportation related ITS applications. These services should be secured through a pooled arrangement with other agencies, possibly using the state as a means to secure the services. Work can be assigned on a task order basis on an as-needed basis.

The provision of ongoing support is so important to the success of ITS deployment that this should be a required component of projects for state financial assistance.

5.4. Funding Strategy

Transit ITS applications are not inexpensive. Most transit ITS projects in the U.S. have been funded through a combination of federal, state, and local funding. Funding from the state and local levels allows local transit agencies to offset the initial capital cost of ITS projects. This is especially important for small urban and rural agencies that do not typically have large capital budgets.

Federal funding for transit ITS projects can come from the Federal Transit Administration's (FTA) grant programs such as 5307 formula funding, 5309 discretionary capital funding and 5310 and 5311 programs for rural areas. However, funding from these programs is usually used for other purposes, such as bus replacement, making it difficult to use FTA funding for "special" projects. 5309 capital funding can be secured specifically for ITS projects therefore representing "net new funding" for the state's transit agencies.

Overall, ITS funding at the Federal level is provided through a few vehicles. Deployment funding is given through the ITS Integration component of the ITS Deployment Program. Funds are capped at not more than $35 million for projects in any one State. Projects are selected through competitive solicitation and must meet certain detailed criteria.

The Federal Highway Administration (FHWA) also makes funding available for transit ITS projects. Thus far, Iowa DOT has received two FHWA grants for transit ITS, the initial for $1.9 million and the second for about $400,000 for a total of approximately $2.3 million. These funds can be used for 50% of the total project costs, although other federal funds can be used for funding as well up to a total of 30%. Thus, the total federal portion of the project cost cannot exceed 80%. State or local funding must provide the remaining 20%.

The US Department of Transportation is committed to the deployment of technology to make existing transportation systems more efficient, thus funding from federal sources is likely to be available in the future. Funding for ITS projects is expected to transition from being considered a special application to being included a part of any transportation improvement. This concept, referred to as "mainstreaming," will result in funds for ITS projects being allocated from traditional grant programs and projects.

Iowa DOT has addressed the issue of funding for ITS projects for transit and other transportation applications. The Iowa DOT Transportation Commission has dedicated "surplus" federal funding for ITS projects. This "surplus" is defined as the difference between what the state receives from Congestion Mitigation and Air quality (CMAQ) funding from the federal government from the period 1998 to 2003 versus the CMAQ funding received during1991 to 1997.

The Statewide ITS Deployment Plan provided an estimate that dedicated ITS funding for Fiscal Year 2002 totaled $8.68 million for the state. This estimate consists of Federal ITS funds, State matching funds, and a reduction for funding used for the state's nine early winner ITS projects. The Plan estimates that cumulative ITS funding for Fiscal Year 2003 is $11.12 million[7]. These estimates are subject to change based upon federal apportionments.

The Plan further recommends that the ITS project programming process will, on an annual basis, select projects for funding assistance. The evaluation and prioritization of project proposals in order to create an annual ITS work program will be administered by the Statewide ITS Coordinator, with participation by the ITS Deployment Committee. This annual programming process consists of three basic steps:

1. Identification of candidate projects for funding
2. Apportionment of current year funding into Program Areas based on Table 8-5
3. Select projects for funding assistance"

The Plan also addressed the relative priority and corresponding resource allocation to the various program areas for the ten-year planning period. Table 5.1 shows how these dedicated ITS funds would be allocated to six general program areas, including public transportation.

Table 5.1
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	40	40	40	20	20	20	20	20	15	15
Travel and 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 Vehicle Operations				10	10	10	10	10	15	15
Public Transportation Management	10	10	10	20	20	20	20	20	20	20
Emergency Management	10	10	10	10	10	10	10	10	10	10
Total	100	100	100	100	100	100	100	100	100	100

Source: Iowa DOT Integrated ITS and Services Deployment Plan

Table 5.1 shows that Public Transportation Management would receive an average of 17 percent of the ITS program resources over the ten-year planning period, based upon the State's ITS Plan. It should be noted that the Transportation Commission has not adopted the Plan at this time.

[7] Ibid., State ITS Deployment Plan.

Currently, Iowa DOT has approximately $2 million available to fund transit ITS projects statewide from the FHWA grant. This funding is restricted to projects in rural areas, or those involving coordination between rural and urban areas.

Transit projects could receive about $1.1 million in reserve CMAQ if the resource allocation guidelines were adopted, and if the projects were justified. In addition, other federal funds can be used to match a portion of the FHWA grant.

Finally, local or non-federal state funds need to make up at least 20% of the total project cost.

Figure 5.1 is a summary of current fund availability for transit ITS projects in the state of Iowa.

Figure 5.1
Iowa Transit ITS Funding Summary

Funding Source	Maximum Percentage of Total Cost	Total Funding
FHWA Grant	50%	$2.0 million *
Other Federal Programs	0% - 30%	0 to $1.2 million
Local	20% - 50%	$0.8 to $2.0 million
Total	100%	$4.0 million

*$2.3 million total, less $300,000 for Statewide Transit ITS Deployment Plan.

Figure 5.1 shows that the total funding could reach $4.0 million if sufficient state and local funding was available to take full advantage of the 50% FHWA grant.

Information of the cost of deployment of ITS at Iowa transit agencies is presented in subsequent sections. The $4 million would be adequate to fund deployment of all of the first two phases of the deployment plan, and possibly one or two "demonstration" projects of advanced communications. Thus, the level of funding potentially available is sufficient to fund significant short-term transit ITS projects statewide in Iowa.

Recommendations

Iowa DOT should adopt a funding strategy or policy to guide how state and federal funds will be used to deploy technology for transit agencies throughout the state. At a minimum, projects should be consistent with the Transit ITS Deployment Plan and the statewide architecture formulated in the Statewide ITS Deployment Plan in July 2001.

Transit agencies should be required to provide a minimum of 20% local funding. Local funding in excess of 20% may be required if funding from other sources is unavailable. Local funding in excess of 20% (i.e., overmatch) will be viewed as a positive in the evaluation of project applications.

It was noted that CMAQ funding Iowa DOT is "reserving" for ITS deployment might not be available for transit projects. Competition for CMAQ funds is great, and use of CMAQ funds for transit projects is not guaranteed, and will be contingent upon a careful review of the project's costs and benefits. Transit interests should establish their position with respect to state ITS funding and petition Iowa DOT management for a share of state funding consistent with the Iowa Statewide ITS Deployment Plan.

Larger more costly deployments will quickly exhaust available funding. For example, implementation of data communications and MDTs can be expected to cost $200,000 to over $1 million at a regional transit system, depending upon the system's size. Other funding should be pursued for these projects, such as a FTA 5309 earmark. This will reduce the impact of these large projects on the statewide program, and will place more responsibility for project funding on the local agency.

As federal funding programs change (for example with the next federal transportation bill), Iowa DO should become familiar with potential funding sources. The Iowa Public Transit Association, and the Associations lobbyist, can assist with this.

5.5. Staging and Timing

The implementation of the types of ITS applications being considered for Iowa transit systems requires a period of two to three years at the very minimum. It is suggested that the deployment plan adopt an implementation schedule of five years. A five-year implementation schedule allows for the necessary systems planning, specification development, procurement and implementation steps. Although different applications vary in the amount of time required, the project's schedule and staging plan should reflect this time frame.

Figures 5.2 through 5.6 show general schedules for ITS applications implementation. In each case, approximate elapsed time is shown for phases or primary task categories:

Agency plan development will require one or two months, even after completion of the statewide plan. This phase could take longer if local decision making dictates.

Specification development will require one or two months. Joint or centralized procurement could reduce this phase because the same specification (with minor modifications) can be used by other agencies.

Procurement will require at least three to four months from the time the specifications are completed to the time a notice to proceed is issued to a vendor.

Installation of ITS applications varies with the complexity of the project, with large project requiring six months or more.

Testing is critical to the success of the application and should not be compromised. After installation is complete, a period of at least a month even for straightforward projects is needed, with complex projects requiring more time.

Figure 5.2
Vehicle Maintenance Software
Timing and Staging Plan (7 months)

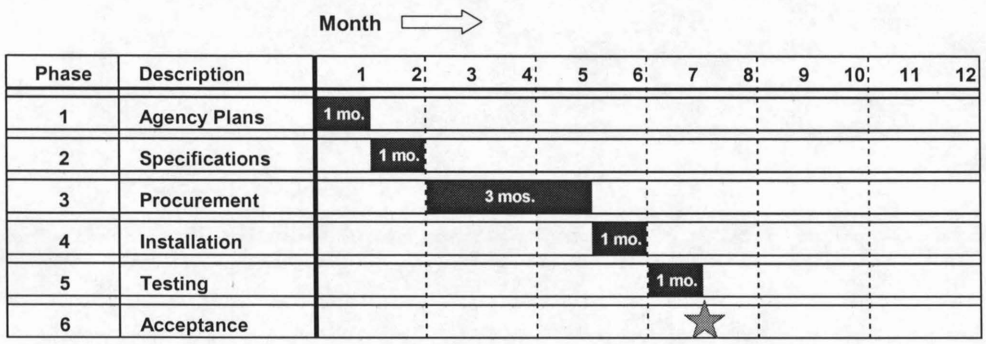


Figure 5.3
Computer-Assisted Scheduling Software
Timing and Staging Plan (9 months)

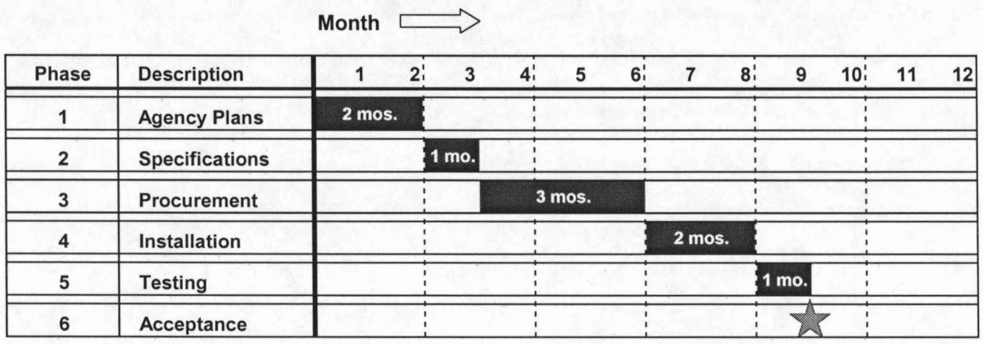


Figure 5.4
Fully-Automatic Scheduling Software
Timing and Staging Plan (12 months)

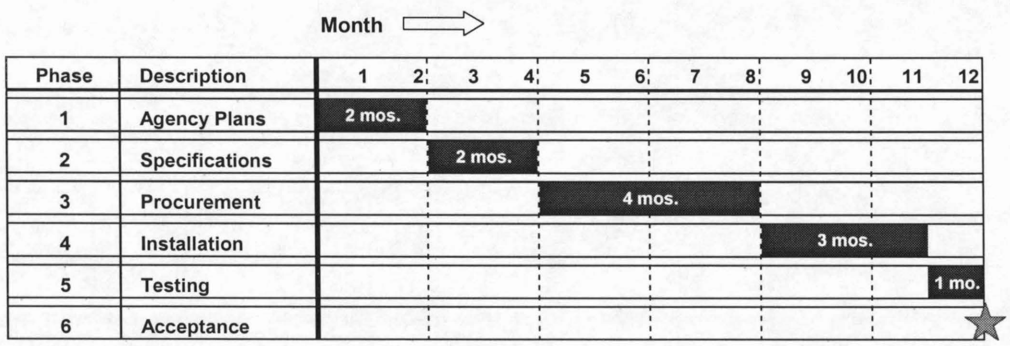


Figure 5.5
Data Communications & MDTs
Timing and Staging Plan (16 months)

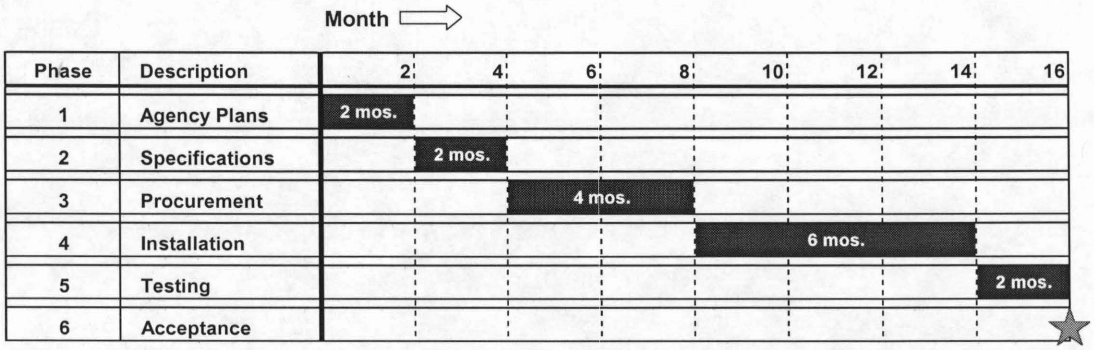
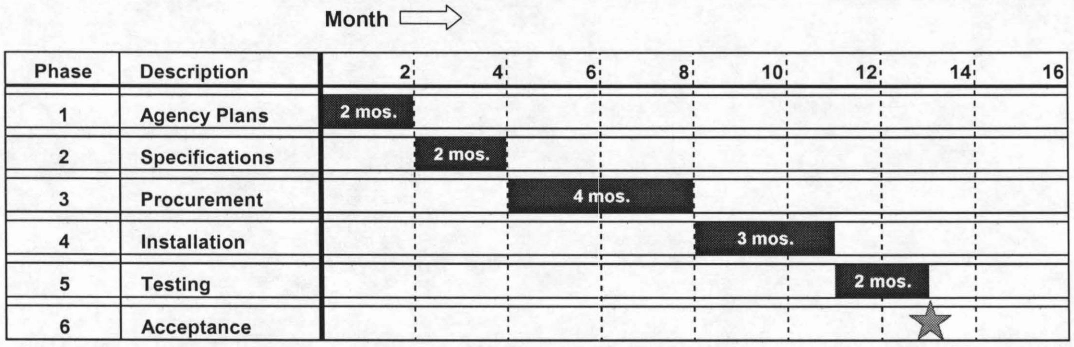


Figure 5.6
Automatic Vehicle Location (AVL)
Timing and Staging Plan (13 months) [1]



1 - Assumes Data Communications have already been installed

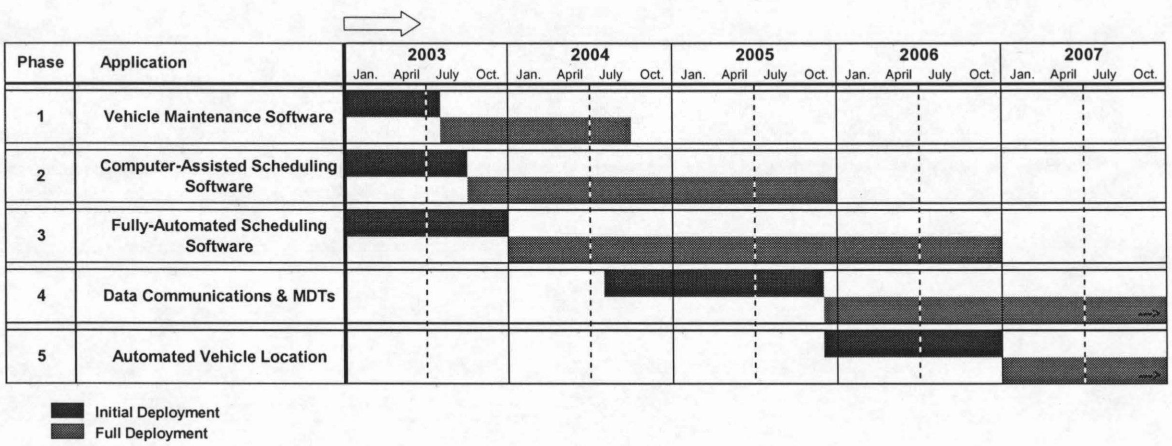
Experience has shown that a staged implementation of technology applications on a statewide basis is prudent. That is, instead of attempting to implement technology in all or most transit agencies at once, a smaller number of "demonstration" agencies should be selected for the initial stage. After successful implementation at the demonstration agencies, implementation can be completed at other agencies. In this manner, agencies can learn from the experience of their peers, and statewide resources can be better focused.

This staged implementation can be used even with joint or statewide procurement. The procurement documentation (e.g. RFP) should specify a staged development plan and should identify the agencies and time intervals required for deployment.

The staged implementation concept also applies within an agency. For example, agencies should not attempt to implement several different technologies at one time. Rather, the successful implementation of one technology should be followed by the next project. This staging approach can even be applied to components in an integrated system. For example, AVL can be added after a computerized scheduling system is in place, and after data communications are established. Again, this need not require separate procurements, rather a timing and staging plan within a single procurement.

Figure 5.7 depicts a staging plan that incorporates the concept of using an initial deployment for a smaller number of agencies, then full deployment over a longer period of time. The schedule also stages the implementation of separate technologies.

Figure 5.7
5-Year Transit ITS Staging Plan



Thus, the Statewide Transit ITS Deployment Plan should be regarded as a five-year plan, with an implementation horizon from 2003 to 2007. This staging plan not only makes implementation more manageable, but also makes better use of available funding.

6.0
BENEFITS AND COSTS

Iowa Department of Transportation
TRANSIT ITS

Information on costs and benefits appear elsewhere in this draft report. This section will be completed with a summary of costs and benefits for the meeting on September 18.

7.0 THE IOWA STATEWIDE TRANSIT ITS DEPLOYMENT PLAN

7.1. Plan Element 1 - Statewide Plan Framework

This section summarizes the recommended Statewide Transit ITS Plan in terms of key findings and recommendations.

Institutional

Definition of State Role. Iowa DOT has already taken a leadership role in ITS planning among the state's transit systems by securing funding and coordinating the deployment study project. This involvement is positive and Iowa DOT can provide important resources, expertise and direction for ITS deployment.

Recommendation:
Iowa DOT, through the Office of Public Transit, should provide technical assistance to the state's transit agencies through Iowa DOT staff and consultants contracted to perform specific tasks.

Recommendation:
It is further recommended that Iowa DOT take the lead in developing a statewide program to provide ongoing technical support to the state's transit agencies. This program should consist of DOT staff and contracted services.

Recommendation:
Iowa DOT should require that transit agency coordination and service coordination be considered as part of any transit ITS project submitted for state financial assistance. Projects should also consider opportunities for integration with other (non-transit) ITS applications. In this manner the state can help assure that resources directed toward ITS deployment are expended in the most effective manner. Projects do not necessarily need to include these coordination elements, but should at least consider them during the systems planning process.

Recommendation:
A standing working group comprised of transit agency representatives should be created. This working group can be an extension of the Steering Committee, and could have a role in recommending projects for funding to Iowa DOT. The working group could also serve as a resource as technology is deployed throughout the state.

ITS Applications

Recommendations:

Vehicle Maintenance Software should be used for all of the states transit systems. The state's investment in vehicle fleets justifies this requirement. Iowa DOT should arrange to procure the same software for all agencies as a means of reducing initial and ongoing costs. Transit agencies that already use some form of automated vehicle maintenance need not use the standard application.

Reservations and Scheduling Software should be used for all of the state's transit systems. This application can lead to operational and administrative efficiencies, and provide flexibility to allow transit agencies to serve more customers. The features included in the software depend upon the size and scope of the individual transit agency. Some agencies warrant "high end" fully automated systems, while other smaller systems require only computer-assisted software. A preliminary determination in this regard was made by the Deployment study, however the determination should be revisited during the Agency Plan development process.

The state should also investigate the practicability of developing a spreadsheet/database-based program for use by the state's smallest agencies. This approach may provide many of the benefits of commercial software at significantly lower cost.

Data Communications and Mobile Data Terminals (MDTs) are recommended for the state's larger regional systems to improve communications between dispatch and vehicles in service. In a paratransit operation, text messaging can help improve efficiency by transmitting the trip manifest for the run directly to the vehicle, as well as any real-time manifest changes during daily operations. The driver can use the MDT to indicate the completion of each pick-up and drop-off, and this information can be transmitted back to dispatch in real-time. This information can be used for trip verification and billing purposes. MDTs can enable further enhancements to daily operations through computer-aided dispatch (CAD) and automatic vehicle location (AVL) software.

The state should also investigate the possibility of data communications using phone lines or the Internet to provide some of the benefits, without the real-time communications. Some transit agencies may find this an acceptable lower-cost alternative to real-time communication.

Automatic Vehicle Location (AVL) is a possible application for several of the state's largest regional systems. AVL software operating at a central dispatch location receives periodic location reports from each vehicle in the field and then updates the vehicle locations displayed on a GIS map. Time-stamped location data can also provide dispatchers with schedule adherence information by exception (this schedule adherence feedback is also often provided to the drivers on the MDT). The dispatcher can view detailed information about a particular vehicle, by clicking its map symbol or by checking a table that provides current information about the entire fleet.

The benefits of AVL should be evaluated in a more detailed manner in the Transit Agency plans.

*Transit User Information***.** A need for advanced systems to support the customer service function was not found during the deployment study. Transit agencies should be encouraged to use available technology to provide better information to the public. All agencies should use voice mail systems (or at least recording devices) for their call centers to allow the public comprehensive access to reservations, etc. The use of cable TV, and static web-based displays along with email for reservations are other examples of inexpensive applications of current technology.

Fare Payment and Rider Identification. A need for Electronic Fare Payment systems used in conjunction with MDT's and Transit Management was not found in the time period of the Deployment Study (five years).

Communications Strategy

Recommendation:
The opportunity to use existing state-owned radio communications infrastructure does not appear viable in the three to five year time frame. The design of these systems does not lend itself to the needs of most transit agencies. This is especially true for the regional systems that have extensive service areas. However, the Office of Public Transit should be alert for opportunities to partner with DOT's communications unit where unexpected opportunities present themselves.

Recommendation:
The Office of Public Transit should make clear the communication needs of transit agencies and the expectation that transit will be included in any future state initiative to upgrade radio communications. This should be communicated in writing along with a functional requirement for communications in both urban and regional transit agencies.

Recommendation:
The Office of Public Transit should assume a lead role in pursuing and managing a cooperative relationship with private communications firms with statewide infrastructure where such a relationship is beneficial to transit agencies. The ability to transmit and receive data is a requirement for some transit operations applications. Generally, the need to provide for data communications to support ITS applications such as Mobile Data Terminals (MDT's) and AVL is expected to be the greatest challenge that may be met through a partnership with the private sector.

Funding

Recommendations:
Iowa DOT should adopt a funding strategy or policy to guide how state and federal funds will be used to deploy technology for transit agencies throughout the state. At a minimum, projects should be consistent with the Transit ITS Deployment Plan and the statewide architecture formulated in the Statewide ITS Deployment Plan in July 2001.

Transit agencies should be required to provide a minimum of 20 percent local funding. Local funding in excess of 20 percent may be required if funding from other sources is unavailable. Local funding in excess of 20 percent (i.e., overmatch) will be viewed as a positive in the evaluation of project applications.

It was noted that the CMAQ funding that the Iowa DOT is "reserving" for ITS deployment might not be available for transit projects. Competition for CMAQ funds is great, and use of CMAQ funds for transit projects is not guaranteed, and will be contingent upon a careful review of the project's costs and benefits. Transit interests should establish their position with respect to state ITS funding and petition Iowa DOT management for a share of state funding consistent with the Iowa Statewide ITS Deployment Plan.

Larger more costly deployments will quickly exhaust available funding. For example, implementation of data communications and MDTs can be expected to cost $200,000 to over $1 million at a regional transit system, depending upon the system's size. Other funding should be pursued for these projects, such as a FTA 5309 earmark. This will reduce the impact of these large projects on the statewide program, and will place more responsibility for project funding on the local agency.

03 CMAQ MATCH WILL BE AVAILABLE UP TO ~800K

As federal funding programs change (for example with the next federal transportation bill), Iowa DOT should become familiar with potential funding sources. The Iowa Public Transit Association, and the Associations lobbyist, can assist with this.

Timing and Staging

Recommendation:
The Statewide Deployment Plan should be regarded as a five-year plan, with a horizon from 2003 to 2007.

Recommendation:
Instead of attempting to implement technology in all or most transit agencies, a smaller number of "demonstration" agencies should be selected for the initial stage. Experience has shown that a staged implementation of technology applications on a statewide basis is prudent. After successful implementation at the demonstration agencies, implementation can be completed at other agencies. In this manner, agencies can learn from the experience of their peers, and statewide resources can be better focused.

The staged implementation concept also applies within an agency. For example, agencies should not attempt to implement several different technologies at one time. Rather, the successful implementation of one technology should be followed by the next project. This staging can even be applied to components in an integrated system. For example, AVL can be added after a computerized scheduling system is in place, and after data communications are established.

Procurement Strategies

Recommendation:
An RFP process should be used for the majority of procurements of transit ITS for Iowa. The only time that an Invitation for Bid should be used is when only equipment is being purchased, and that type of equipment is well defined.

Recommendation:
Iowa DOT should become the procuring agency for transit ITS projects, in partnership with transit agencies. Each transit agency would not have to conduct the whole procurement process themselves. This not only eliminates duplication of effort, but also allows each agency to focus their efforts on the deployment, rather than the procurement activities. Further, once Iowa DOT sets up a procurement process for transit ITS and becomes familiar with the process, no additional effort will be required to assist other agencies that wish to procure transit ITS.

Recommendation:
An external party familiar with transit technologies should develop specifications. The issue regarding specifications development is important since most of the agencies do not have the internal personnel with the appropriate expertise to develop the necessary specifications for transit ITS systems. Further, Iowa DOT may not have the in-house personnel to develop these specifications.

Recommendation:
A statewide procurement vehicle should be developed for agencies to procure transit ITS. This would allow certain agencies to utilize Statewide Contracts for selected commodities and services. There are two primary benefits to this approach: (1) goods and services can be purchased directly by agencies from Statewide contractors at a low negotiated price, and (2) agencies do not have to conduct a competitive procurement on their own.

7.2. Plan Element 2 – Individual Agency Plans

The Statewide Transit ITS plan provides general plans for the deployment of ITS applications in the state's transit agencies. The Statewide plan provides a very good starting point for transit agencies, but does not provide sufficient detail to immediately implement these technologies.

Each of the state's 23 rural and small urban transit agencies were assessed and categorized into four Transit Technology Profiles (TTP) based on needs, and factors such as size and scope of operations, complexity of service delivery and degree of service coordination.

The four levels are summarized as follows: Level 1 is the simplest with Level 4 the most involved.

Level 1 includes small agencies with primarily fixed route services and small service areas. Many of the small urban areas are in this category. Two technology applications are recommended, scheduling and vehicle maintenance software. The scheduling system would either be a "low end" commercial package, or a system adapted from office spreadsheet and database software.

Level 2 includes mid-sized regional agencies, and decentralized brokered systems.
Two technology applications are recommended, scheduling and vehicle maintenance software.

Level 3 includes most of the regional transit agencies. Three technology applications are recommended, scheduling, vehicle maintenance software and data communications.

Level 4 includes the largest regional systems. This level would add AVL to the Level 3 applications.

Based on the Phase IA assessments and available technologies, a determination was made as to the TTP for each rural and small urban transit agency. These assignments are shown in Table 8.1.

Table 8.1
System Assessment

Technology Level	System	Location
1	Mason City Transit Burlington Urban System Clinton Marshalltown MMT Muscatine Muscabus	Mason City Burlington Clinton Marshalltown Muscatine
2	Reg. 11 HIRTA Fort Dodge DART Reg. 2 North Iowa RTA Reg. 10 East Central Iowa	Des Moines Fort Dodge Mason City Cedar Rapids
3	Reg. 1 NRTS Reg. 5 MIDAS Reg. 6 Peoplerides Reg. 7 Iowa Northland Reg. 8 RTA Reg. 9 River Bend Transit Reg. 12 Western Iowa Reg. 13 SWITA Reg. 14 Southern Iowa Reg. 15 Ottuma/10-15 Reg. 16 Southeast Iowa	Decorah Fort Dodge Marshalltown Waterloo Dubuque Davenport Carroll Atlantic Creston Ottumwa Burlington
4	Reg. 3 RTA Reg. 4 SRTS	Spencer Sioux City

Individual Agency Plan Preparation and Project Development

These general conclusions and recommendations for each transit agency can be revisited during the preparation of the individual Agency Plans.

The Initial Transit System Assessment should be reviewed to document in detail workflows, current systems and infrastructure, and define system reporting and invoicing requirements.

There is also an opportunity to determine each transit agency's needs and expectations specifically. The process should identify specific technologies for at least five years into the future to address the findings of the assessment.

The Agency-Specific ITS Plan will include specific ITS applications, interfaces, costs and funding, staging and schedule. The plan should also include provisions for ongoing technical support and documentation that it is in compliance with regional and statewide ITS architecture. A key product is a functional requirements document that will be used as the basis for the specification used to procure the ITS system or product. The Agency Plan can be used as part of the application for funding at the state and federal level.

8.0 NEXT STEPS

Iowa Department of Transportation

TRANSIT ITS

The Statewide Transit ITS plan provides general plans for the deployment of ITS applications in the state's transit agencies. The Statewide plan provides a very good starting point for transit agencies, but does not provide sufficient detail to immediately implement these technologies.

The following outline identifies the tasks and activities required to implement specific ITS projects in a transit agency.

Individual Agency Plan Preparation and Project Development

- Review Initial Transit System Assessment: This short task will refine the conclusions of the initial site assessment performed in early 2002 and document in detail workflows, current systems and infrastructure, and define system reporting and invoicing requirements.

- Determine Transit Agency's Needs and Expectations: Identify specific technologies for at least five years into the future to address the findings of the assessment. Conduct interviews with staff and observe staff functions. Create a list of functional requirements for the ITS applications.

- Prepare Agency Specific ITS Plan: The plan will include specific ITS applications, interfaces, costs and funding, staging and schedule. The plan should also include provisions for ongoing technical support and documentation that it is in compliance with regional and statewide ITS architecture. A key product is a functional requirements document that will be used as the basis for the specification used to procure the ITS system or product. The Agency Plan can be used as part of the application for funding at the state and federal level.

As part of project development the ITS plan is submitted for approval at the local level, and submitted for funding at the state, and possibly, federal level.

- The Agency Plan is submitted to the governing body of the transit agency for review and approval. Plan approval should include authorization to pursue state and federal funding for the plan.

- The Agency Plan is submitted to Iowa DOT for consideration for state ITS funding, and federal funding. The plan should be evaluated based on consistency with the Statewide Transit ITS Deployment Plan, particularly the project evaluation criteria developed during the project.

- If applicable, Iowa can include the project in any joint procurement program.

Specifications Development

Prepare a functional or performance specification based on the Agency Plan and the functional requirements previously developed suitable to solicit proposals from qualified vendors.

Procurement

- Preparation of RFP: The functional specification will be "packaged" in an RPF suitable for distribution to vendors. The RFP will include agency requirements, procurement process information, schedules and selection criteria.

- Solicitation: Identification of qualified vendors, advertisement, pre-proposal conference, response to proposer's questions, specification clarifications and addendums.

- Award: Review and evaluation of proposals, and recommendation of the most responsive vendor, leading to the issuance of a notice to proceed.

Installation and Project Management

- Vendor Oversight: Contracting and vendor initialization, and management of the vendor's activities throughout the course of the project, including review/acceptance of invoices, acceptance of work products.

- Operating Procedure Revisions: Assistance with revising work processes with the introduction of technology, including documentation of procedures.

- Installation: Oversight of the installation of system hardware and software.

- Training: Coordination of training provided by the vendor.

System Testing

- Testing: Management of the system testing process.

- Acceptance: Recommendation of system acceptance.