Iowa Department of Transportation

Intelligent Transportation Systems Deployment Plan
Large Urban Transit Systems

Final Report – Executive Summary

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Summary

The Intelligent Transportation Systems (ITS) Deployment Plan for Large Urban Transit Systems is a road map that will assist the large urban transit systems in Iowa in improving their services through the use of ITS technologies. ITS technologies are hardware and software systems that can increase the efficiency and safety of public transportation and offer users better information on system operations. The implementation of ITS has been transforming the way public transportation systems operate. One of the key benefits of ITS is providing public transportation decision-makers with more information with which they can make decisions regarding improving operations, increasing ridership and improving customer service.

In early 2006, the Iowa Department of Transportation engaged TranSystems to assist in the development of a statewide ITS deployment plan for Iowa's large urban transit systems. This project examined the needs and opportunities related to the expanded deployment of ITS applications by the state's urban transit agencies.

The purpose of this ITS Deployment Plan is to identify technologies that are recommended for implementation; describe their characteristics, costs and benefits; identify resources and training requirements; and define preliminary implementation timeframes. The Deployment Plan contains information that can be used to:

- Determine whether technology is needed, and if so, what kinds of technologies;
- Determine and/or validate the appropriate "phasing" of various technologies;
- Facilitate management understanding on technology;
- Understand the use of technology in the transit system;
- Plan the specifications development processes;
- Initially determine resource requirements (e.g., operations, maintenance, administration);
- Determine the impact on the organization(s) and employees, and plan to manage these impacts;
- Assist Iowa DOT and agencies in securing ITS funding through grants and earmarks;
- Plan for initial and full deployment of multiple technologies; and
- Plan for project evaluations.

Several important steps and processes were used to accomplish the required tasks for this project. One of these steps included a Systems Engineering Analysis, which is required as part of the Federal Transit Administration (FTA) National ITS Architecture Policy on Transit Projects. This analysis process included the TranSystems Team visiting every urban transit agency that took part in this study, and interviewing their staff and collecting essential data and information. This provided the TranSystems Team with an in-depth understanding of each agency's needs, issues and internal processes. A comprehensive review of agencies' communications systems was also conducted, as was a review of existing ITS technologies. Recent studies and agencies' future plans were also reviewed and considered as part of the analysis.

Based on the analysis, specific technologies were recommended for each agency. The costs, preliminary deployment timelines, and the impacts on agencies of each technology were defined in this project.

S-1. Participating Transit Agencies

Out of the 12 large urban transit systems that provide transit services throughout the state of Iowa, 11 participated in this project. The urban transit systems are shown in Table S-1.

Table S-1. Large Urban Transit Systems

City	Agency
Sioux City	Sioux City Transit
Waterloo	Metropolitan Transit Authority of Black Hawk County
Dubuque	Keyline Transit
Bettendorf	Bettendorf Transit
Davenport	CitiBus
Cedar Rapids	Five Seasons Transportation
Coralville	Coralville Transit
Iowa City	Iowa City Transit
Iowa City	University of Iowa, Cambus
Ames	CyRide
Des Moines	Des Moines Area Regional Transit Authority
Council Bluffs	Omaha Metro Area Transit

Council Bluffs did not participate because their transit service is provided by Omaha MAT and MAT has an ITS system in place. Bettendorf's participation was minimal because they are currently implementing transit ITS as part of the City's traffic program.

The project was led by a Steering Committee comprised of the individuals shown in Table S-2.

Table S-2. Members of the Steering Committee

Name	Agency
Bob Krause	Iowa DOT- Public Transit
Peter Hallock	Iowa DOT- Public Transit
Matthew Simaytis	City of Bettendorf
Mark Little	Black Hawk County
Vicky Robrock	Coralville Transit
Sheri Kyras	CyRide
Pete Donner	Davenport CitiBus
Brad Miller	Des Moines Area Regional Transit Authority
Jon Rodocker	City of Dubuque- Keyline Transit
Bill Hoekstra	Five Seasons Transportation & Parking
Ron Logsden	Iowa City Transit
Curt Miller	Sioux City Transit
Brian McClatchey	University of Iowa

S-2. Identified Needs

The main objective of this study is to assess and plan for transit ITS technology applications for urban transit systems, using solutions that have been shown to improve the efficiency and effectiveness of transit services in other transit agencies. Hence, an understanding of each of these agencies' needs was vital for the completion of this study. The following is a summary of the overall needs assessment.

Operations: Agencies have expressed a need to know the exact location of their vehicles at any particular moment to better manage their fleet and to better answer customer inquiries on where their vehicles are.

Further, on-time performance is currently monitored by street supervisors, or not at all. There appears to be a need to automate this process to provide more complete and reliable on-time performance data.

Scheduling: At most of the participating agencies, route schedules are developed manually using spreadsheet software. This is a very tedious and time consuming task, and may not produce the most efficient schedules. There is a need to automate that process through the use of specialized scheduling software.

Planning: One of the most valuable data to a planning department is ridership data which is used in planning new services as well as modifying existing routes. Almost all of the agencies in this study are currently dependent on manual collection of ridership data. This makes the data prone to errors. Further, the process of collecting, entering and analyzing the data is usually very long. There is an obvious need, for almost all of these agencies, to collect ridership data in a timely manner, and to improve its reliability and accuracy. This data is also used in meeting federal reporting requirements such as the National Transit Database.

Customer Service: For many of the agencies taking part in this project, the volume of service information calls has increased substantially in recent years and have become somewhat of a burden to the personnel who take these calls. Hence, there is a need to provide as much of the requested information to customers in real-time on the Internet or at bus stops. The provision of real-time information would keep customers apprised of bus arrival/departure times.

Moreover, agencies are very much interested in increasing their ridership which translates into greater revenues. Deploying web based information has the potential to attract more ridership as it makes finding transit information much easier and user friendly.

Additionally, one of the critical issues for most agencies is complying with the Americans with Disabilities Act (ADA) requirement for making next-stop announcements on board buses. In order to comply with this requirement, these announcements can be automated, as not all drivers are currently making all the announcements.

Security: Some agencies have portions of their fleet equipped with onboard cameras. Onboard cameras are becoming more and more critical for transit agencies as they provide a greater sense of security to the drivers and passengers. Further, they have been playing a role in dismissing fraudulent lawsuits.

Finance: Some agencies are still using cash boxes for collecting fares while electronic fareboxes at the other agencies are outdated and do not meet the agencies' needs. Some of the existing issues include a lack of accurate fare data, fare evasion, and high collection and handling costs. There is a need to deploy the next generation fareboxes capable of tracking fares and using electronic fare media.

Maintenance: About half of the participating agencies are in need of maintenance management software that can interface with their financial system. Maintenance software will enable the agencies to better track their maintenance activities, reduce the cost of maintenance and inventory, schedule preventive maintenance, and collect required data for internal use as well as for federal reporting.

Communications: Although voice radio communication systems do not seem to be a problem for most of the agencies, there is a real deficit in data communications. In the past, a simple voice radio communications system was usually sufficient to support most agencies, but the evolution of ITS technologies and on-board mobile data terminals (MDTs) have added a need for mobile data communications. All participating agencies will require a data communication system. A cellular option may be the best technology for most agencies. Commercial cellular carriers offer rapid implementation, higher bandwidth, low cost monthly rate plans, low cost equipment, reliable service, low maintenance costs, good coverage in urban areas and along major highways, and the ability for multiple agencies to operate on a common system if desired.

S-3. Recommended Technologies

The following paragraphs provide a summary of each of the recommended ITS technology.

Scheduling Software: Fixed route scheduling and daily operations management software applications help transit agencies with route planning and restructuring, runcutting, operator scheduling, and vehicle assignments. Increasingly, scheduling software products are being integrated with other technologies (e.g., automatic vehicle location) for additional benefits.

AVL/CAD: Automatic vehicle location (AVL) systems determine the location of vehicles that are equipped with specific hardware and software. Central dispatch can view the equipped vehicles' locations on a map, in addition to displaying specific information about each vehicle. An AVL system serves as the backbone to many transit ITS applications such as automatic annunciation, vehicle component monitoring, automatic passenger counting (APC), and transit signal priority (TSP) systems.

Transit agencies use Computer-Aided Dispatch (CAD) systems for bus service and operations management. A number of transit agencies and their vendors have implemented or are developing modules that will expand the capabilities of vehicle location and dispatch systems to provide data for other agency functions.

Mobile data terminals (MDTs), which are typically located in each vehicle near the driver, are an integral aspect of a CAD/AVL system since they facilitate data transfer between the vehicle and operations/dispatch. MDTs usually have a small screen that displays text and/or graphics, along with a keypad that contains either pre-coded keys (e.g., pick-up/drop-off, request to talk, maintenance incident) or "soft" keys that can be flexibly programmed.

Maintenance Management Software: Maintenance management software is designed for supporting vehicle, infrastructure and facility maintenance. The software usually supports corrective and preventive maintenance, inspections, overhauls, and campaigns. It also identifies and tracks vehicles and serialized components; identifies, plans, schedules, and tracks work; collects maintenance histories and costs; analyzes maintenance performance and manages equipment configuration. Some systems include a warranty module that identifies warranty terms, condition notification, claims processing, and payment processing.

On-board Cameras: On-board cameras monitor and record the passenger environment on-board transit vehicles. Cameras are usually mounted to provide complete coverage of the bus interior, and can be mounted to view door wells as well as the road through the front windshield.

Advanced Traveler Information Systems: Advanced Traveler Information Systems (ATIS) provide information to help travelers make decisions regarding their trips. This information generally includes: transit service areas and routes; scheduled vehicle departure times; projected vehicle arrival/departure times (through AVL); service disruptions and delays; fares, transfers and other transportation services; as well as information on the service area. This information is used to assist riders in making pre-trip and en-route (including in-vehicle) trip and mode choice decisions. Access to this information can be made through dynamic message signs (DMS) at stops/stations, kiosks (at bus shelters, office buildings, shopping centers and other locations such as a convention center and arenas), the Internet, e-mail, and phone.

Electronic Payment Systems: Electronic payment systems (EPS) make fare payment more convenient for the transit rider and financial management of fare revenues more secure and efficient for the transit agency. Electronic fare payment technologies include magnetic strip and contactless smart cards, which can be used as stored value cards or timed passes. EPS reduces cash handling, which is a labor-intensive activity, and improves the security of transit fare revenue EPS also facilitates the development of more innovative and equitable fare structures, and provides increased convenience to transit riders in the purchase and payment of transit fares.

Vehicle Component Monitoring Systems: A vehicle component monitoring system uses sensors to monitor the “health” of vital bus components, such as the engine, and reports when their performance is not within a specific tolerance. By keeping track of these components, supervisors and maintenance personnel can use this information to intervene before a minor problem becomes more substantial.

Table S-3 on the following page provides a summary of the recommended technologies by agency.

Table S-3. Summary of Recommended (✔) and Existing (E) Technologies

Agency	Recommended Technology											
	CAD/AVL	APC	ATIS (web)	ATIS (itinerary planning)	ATIS (at stop)	Automatic Annunciation	Electronic Payment System (EPS)	Maintenance Management System	On-Board Cameras	Scheduling Software	Vehicle Component Monitoring System	Driving Simulator
Sioux City Transit	✔	✔			✔	✔	✔	✔	E	✔		
MET Waterloo	✔	✔				✔	✔	E				
Keyline Dubuque	✔	✔				✔	✔	✔	✔			
Bettendorf Transit	***								***			
CitiBus Davenport	✔		✔			✔	✔	E	✔			✔
FST-Cedar Rapids		✔	✔	✔		✔	E	E	E	✔	✔	
Coralville Transit	✔		✔		✔		✔	✔	E			
Iowa City Transit	✔	✔		✔	✔	E	✔	✔	✔			
Cambus–U of Iowa	✔	✔	***		✔				E	✔		✔
CyRide - Ames	✔	✔	✔		✔	✔	✔	E	E			
DART–Des Moines	✔	✔		✔	✔	✔	✔	✔	✔	E		

*** Agency is planning on deploying that system in the near future.

S-4. Anticipated Cost Estimates and Deployment Timeframe

Most of the recommended ITS technologies cannot be deployed without having an operational CAD/AVL system. Although the deployment of the rest of the recommended ITS technologies are independent from one another, deploying two or more technologies at the same time can be more cost-effective and can shorten the overall deployment schedule. However, it is recommended that only a few systems be deployed at the same time, as it increases the risk of completing the project on-time and within budget. Hence, we recommend that the technologies be grouped into phases to better manage their deployments. Deployments are grouped into three (3) phases: Phase 1, which is one to three years; Phase 2, which is three to five years; and Phase 3, which is over five years.

The following tables provide a summary of the recommended ITS technologies and expected capital costs of the leased wireless mobile data option. Table S-4 summarizes the costs by phase of deployment and agency, while Table S-5 summarizes the costs by technology.

Table S-4. Summary of Total Cost of ITS Technologies and Leased Wireless Mobile Data

Phase/Agency	Recommended Technology		
	Cost of ITS Technologies	Cost of Communications System	Total Cost
Phase 1 (1-3 years)			
Sioux City Transit	$1,718,000	$34,760	$1,752,760
MET Waterloo	$340,000	$23,700	$363,700
Keyline - Dubuque	$763,000	$18,960	$781,960
Bettendorf Transit	$0	$64,780	$64,780
CitiBus - Davenport	$778,000	$31,600	$809,600
FST-Cedar Rapids	$0	0	$0
Coralville Transit	$564,000	$17,380	$581,380
Iowa City Transit	$654,000	$36,340	$690,340
Cambus – Univ. of Iowa	$810,000	$36,340	$846,340
CyRide - Ames	$1,533,000	$99,540	$1,632,540
DART – Des Moines	$2,295,000	$186,440	$2,481,440
Subtotal—Phase 1	***$9,455,000***	***$549,840***	***$10,004,840***
Phase 2 (3-5 years)			
Sioux City Transit	$125,000	$0	$125,000
MET Waterloo	$547,000	$0	$547,000
Keyline - Dubuque	$507,000	$0	$507,000
Bettendorf Transit	$0	$0	$0
CitiBus - Davenport	$1,021,000	$0	$1,021,000
FST-Cedar Rapids	$355,000	$0	$355,000
Coralville Transit	$410,000	$0	$410,000
Iowa City Transit	$578,000	$0	$578,000
Cambus – Univ. of Iowa	$125,000	$0	$125,000
CyRide - Ames	$1,371,000	$0	$1,371,000
DART – Des Moines	$266,000	$0	$266,000
Subtotal—Phase 2	***$5,305,000***	**$0**	***$5,305,000***
Phase 3 (Over 5 years)			
Sioux City Transit	$265,000	$0	$265,000
MET Waterloo	$205,000	$0	$205,000
Keyline - Dubuque	$0	$0	$0
Bettendorf Transit	$0	$0	$0
CitiBus - Davenport	$0	$0	$0
FST-Cedar Rapids	$0	$0	$0
Coralville Transit	$215,000	$0	$215,000
Iowa City Transit	$462,000	$0	$462,000
Cambus – Univ. of Iowa	$500,000	$0	$500,000
CyRide - Ames	$0	$0	$0
DART – Des Moines	$2,755,000	$0	$2,755,000
Subtotal – Phase 3	***$4,402,000***	**$0**	***$4,402,000***
Grand Total	**$19,162,000**	**$549,840**	**$19,711,840**

Table S-5. Summary of Technology Cost for All Large Urban Transit Systems

Recommended Technologies	Phase 1 (1-3 years)	Phase 2 (3-5 years)	Phase 3 (over 5 years)	Total By Technology
CAD/AVL	*$5,296,000*	*$458,000*	*$0*	**$5,754,000**
APC	*$592,000*	*$174,000*	*$97,000*	**$863,000**
ATIS (web)	*$81,000*	*$217,000*	*$0*	**$298,000**
ATIS (itinerary planning)	*$91,000*	*$146,000*	*$0*	**$237,000**
ATIS (at stop)	*$0*	*$785,000*	*$0*	**$785,000**
Automatic Annunciation	*$1,165,000*	*$180,000*	*$950,000*	**$2,295,000**
Electronic Payment System (EPS)	*$840,000*	*$2,630,000*	*$2,010,000*	**$5,480,000**
Maintenance Management System (MMIS)	*$520,000*	*$215,000*	*$695,000*	**$1,430,000**
On-Board Cameras	*$570,000*	*$0*	*$150,000*	**$720,000**
Scheduling Software	*$300,000*	*$0*	*$0*	**$300,000**
Driving Simulator	*$0*	*$500,000*	*$500,000*	**$1,000,000**
Communications	*$549,840*	*$0*	*$0*	**$549,840**
Total By Phase	***$10,004,840***	***$5,305,000***	***$4,402,000***	**$19,711,840**

S-5. Program Funding

A specific funding program has not been developed for the Urban Transit ITS program at this point. The Urban Transit ITS Deployment Plan will be used to secure program funding. Transit ITS projects are eligible for federal funding through several programs. Typically in the transit industry ITS projects are funded through a combination of federal funding, state funding (where available) and local funding.

The final report presents a discussion of the potential funding sources that should be considered in funding the implementation of the Urban Transit ITS Deployment Plan.
The Steering Committee has identified several important conclusions that must be considered as part of the funding program.

- It is likely that most of the transit will be unable to implement the recommended ITS technologies without 80 percent funding from non-local sources.
- A goal of securing 80 percent funding from federal sources should be established. This may be accomplished through a mix of funding programs.
- It is acknowledged that traditional federal funding sources such as 5309 discretionary funding is limited and other needs, such as bus replacement, will likely be a higher priority.
- The state is supportive of the Urban Transit ITS Deployment Plan project and will contribute funding as the state is able to identify available funding. It is acknowledged that state funding for transportation projects is limited, and very competitive.

- Because of transit's important role in Homeland Security – related strategies security related funding should be pursued.

S-6. Recommendations and Next Steps

The conclusion of the Urban Transit ITS Deployment Plan is that ITS applications can be beneficial to the state's transit systems and transit agency managers have a high level of interest in these technology tools.

It is recommended that the urban transit agencies, working with Iowa DOT OPT and in the context of the Steering Committee pursue implementation of the recommendations included in the Deployment Plan report. It is recommended that urban transit agencies deciding to move forward begin the preparation of an Agency Technology Plan. This is a more detailed plan for technology deployment tailored to each individual agency.

Beyond the Deployment Plan, the following four steps should be taken before ITS systems are procured and implemented:

1. **Develop Funding Plan**

   The funding plan should identify sources of funding for the associated capital and ongoing operating and maintenance costs of technology deployment.

2. **Development of Specifications:**

   a. **Prepare Functional Requirements.** A functional requirement indicates what capability the system is required to achieve.

   b. **Prepare Functional Specifications.** The functional requirements should translate into a set of structured specifications.

3. **Procurement of ITS Technologies: This will include the following steps:**

   - **Develop and Issue a Request for Proposals** (RFP) that includes the functional pecifications.
   - **Develop Evaluation Plan** to guide the proposal evaluation process.
   - **Conduct a Pre-Proposal Meeting**
   - **Receive and Evaluate Proposals**
   - **Interview Short-listed Proposers** (if desired) and evaluate interviews.
   - **Issue a Request for Best and Final Offers** (BAFO)
   - **Make Final Vendor Selection**
   - **Negotiate and Award Contract**

4. **Implementation of Procured ITS Technologies:** This phase follows the procurement and results in the full deployment of the technologies.