Kansas Rural Transit ITS Deployment

Evaluation

Preliminary Results

Prepared for the
ENTERPRISE Pooled Fund Study

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1. Introduction

This document presents the results of an evaluation of the benefits of Intelligent Transportation Systems (ITS) deployed to support the operations of two transit systems in rural Kansas. The technologies evaluated in this project include Automated Vehicle Location (AVL) on transit vehicles, Mobile Data Terminals (MDT) in the transit vehicles and data communications between the dispatch center and vehicles, and Computer Aided Dispatch (CAD) systems. This evaluation was conducted as a project under the ENTERPRISE Program. The ENTERPRISE Program focuses on pooling their resources to develop, evaluate and deploy ITS. As part of its mission, ENTERPRISE seeks to facilitate the sharing of technological and institutional experiences gained from ITS projects, and the projects of its individual members. Therefore this document is intended to provide the Kansas Department of Transportation (KDOT), the local transit agencies, and the ENTERPRISE members with an understanding of the benefits of an AVL/CAD/MDT system in rural areas in order that KDOT and the ENTERPRISE members may assess the potential for future expansion or deployments.

2. Evaluation Goals

The following three goals were defined to complete the rural transit evaluation in Kansas.

Goal #1: To assess the benefits realized by the addition of the AVL, MDT, and CAD systems in the rural Kansas deployments, and understand the impacts of these benefits on the daily operations of the systems.

Goal #2: To assess any training or technical support issues or concerns with the current AVL/MDT/CAD software, including concerns over demands at KDOT Headquarters, and conduct a feasibility analysis of a possible migration to a related web-based software system called Novus.

Goal #3: To understand any potential barriers to acceptance that may prevent acceptance elsewhere in Kansas or other ENTERPRISE agencies.

3. Summary of Deployed Transit Systems

The Kansas Department of Transportation (KDOT), together with partner transit agencies in Hays, Kansas and Hutchinson (Reno County), Kansas, has deployed one system to support the transit dispatch and delivery activities in these two rural areas of the state. The key components of the system include:

- Automatic vehicle location (AVL) systems installed on the vehicles to capture the vehicle location and report this location to dispatchers;

- Mobile data terminals (MDT) located on board the transit vehicles to allow the driver to communicate and receive information from dispatchers; and
- A Computer aided dispatch (CAD) system to assist dispatchers in assigning vehicles to riders and planning routes.

The software system and technologies were developed by a team of Radio Satellite Integrators Inc. and Trapeze Software Inc.

The system architecture was designed such that one CAD system and one AVL server are located centrally in Topeka, Kansas (operated at the KDOT headquarters). Each dispatch center (Hutchinson and Hays) operates an operator display and local communications system on site. Access to the central CAD system is achieved by remote desktop access in to the central server in Topeka.

The goal of this architecture was to support multiple CAD/AVL/MDT systems around the state, avoid inconsistencies with vendor software and software versions, and to centralize all major hardware and software hosting. Figure 1 below illustrates this architecture.

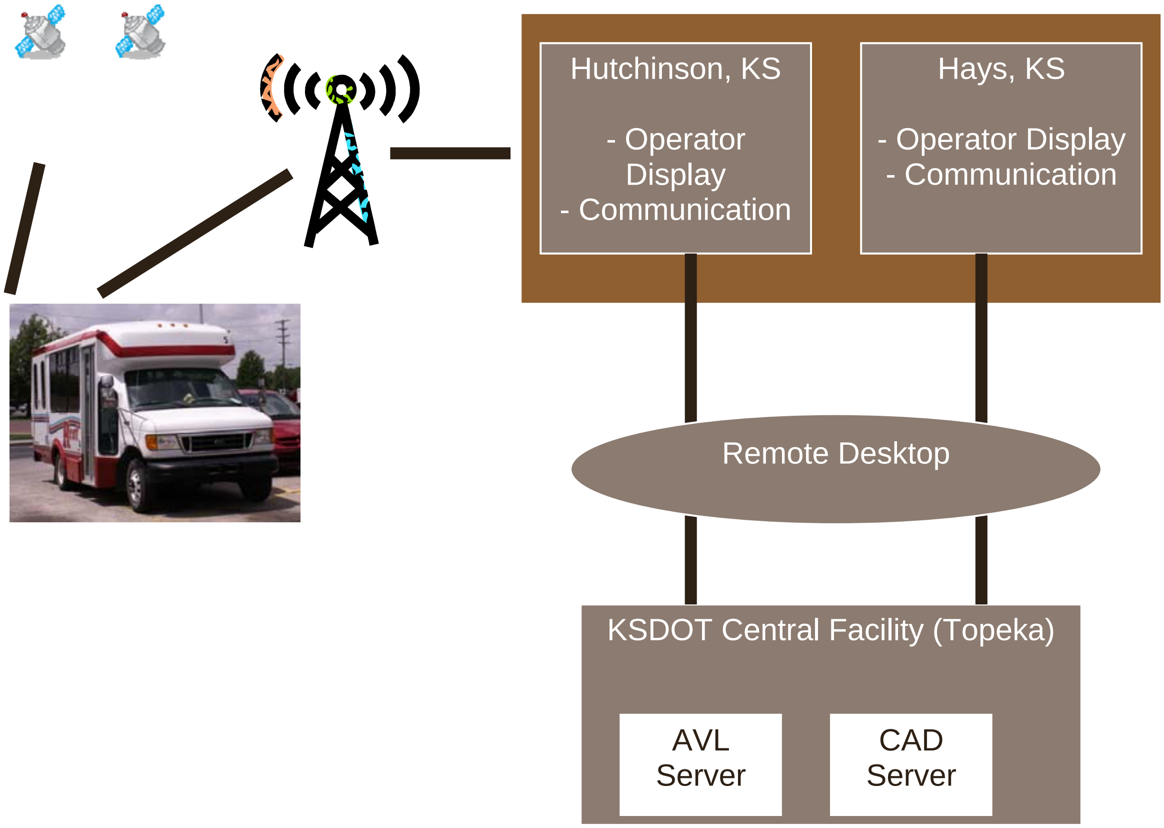

Figure 1 – Architecture of Kansas Rural Transit ITS System

4. Observations and Feedback

Site visits and interviews were conducted in Hutchinson and Hays, Kansas to observe the operation of the system as well as provide dispatchers, managers, and drivers the opportunity to provide feedback on the features of the CAD, AVL, and MDT system. The following subsections summarize the information gathered.

4.1 Observations and Feedback on CAD System

Table 1 – Feedback and Observations on CAD Features – Hutchinson Site

Location	Feedback and Observations
Hutchinson, KS	1. Dispatchers use the CAD quite a bit
	2. CAD system has resulted in reduced time for dispatcher training
	3. The use of CAD has increased the likelihood of dispatchers succeeding - Before CAD, dispatching required more multi-tasking abilities and a local knowledge of the network. - With CAD, dispatchers can operate the software system and let the system compute dispatching decisions
	4. Dispatchers have indicated that the CAD system does not always determine the best route assignments - Dispatchers sometimes disagree with the assignment of rides - Dispatchers sometimes override the system - Dispatchers who were dispatching before CAD are the most likely to not 'trust' the recommendations and to override the system and manually assign the ride to a driver - Dispatchers that are more comfortable with computers and the Internet were also more comfortable with the migration to CAD
	5. Supervisors described how the vendor originally conducted on-site interviews to assist in configuring the dispatch software. They believe that if they had another chance to answer the questions (and have the system re-configured) it would result in better routing and ride assignment (i.e. they believe they would answer the questions different now that they have experience with the system).
	6. The dispatchers who were dispatching before CAD was deployed were most likely to manually override the system or question the assignments and routes generated by the CAD system.
	7. While some dispatchers were concerned about the implementation of CAD, all dispatchers now enjoy and are comfortable with the system, when it works

	8. The architecture of the ITS deployments is such that when communication and connections are lost with Topeka, the CAD system is down completely. Therefore, dispatchers do become frustrated when the CAD system is not operational.

Table 2 –Feedback and Observations on CAD Features – Hays Site

Location	**Feedback and Observations**
Hays, KS	1. The CAD system itself is used to enter all rides and assign rides to drivers, however a large portion of the time, rides are assigned manually by the dispatcher, rather than relying on the assignment algorithms.
	2. There is a lack of trust in the automated assignment of rides, and therefore this feature does not appear to be used very often; - At least when calls are received for immediate rides, the dispatchers seem to manually communicate with drivers using the radio to determine which driver can pick up the passenger. - Once a driver is assigned, the dispatcher manually assigns the ride to the driver using the CAD system and verbally communicates over the radio.
	3. Supervisors have indicated that training time has not necessarily been reduced by the use of CAD since they believe a training period is needed such that the dispatcher can experience various scenarios and situations before they have the experience to operate in a ‘non training’ environment.

4.2 Observations and Feedback on the AVL System

Table 3 – Feedback and Observations on AVL Features – Hutchinson Site

Location	Feedback and Observations
Hutchinson, KS	1. Dispatchers monitor vehicle location through the AVL display regularly, and use the system to monitor progress of the transit vehicles
	2. Dispatchers describe that the AVL has reduced the need to ask drivers for their location and cut down on verbal discussions over the radio
	3. AVL has assisted in being able to meet more requests for immediate pickups - The dispatcher is often able to view the location of a nearby van or bus and re-route them to pick up a passenger that would have previously been told they can not support the ride at this time.
	4. The AVL is helpful to assist dispatchers in answering calls from riders waiting to be picked up when a bus is running behind. For example, many calls are received with topics like “My ride was scheduled for 10:30, it is now 10:35 when is the driver going to be here”, and the dispatcher can now view the drivers location and give an answer estimating the exact arrival time.

Table 4 – Feedback and Observations on AVL Features – Hays Site

Location	Feedback and Observations
Hays, KS	1. Dispatchers in Hays do not appear to use the AVL portion of the system very much. During the observation time in the dispatch center, the screen displaying the transit vehicles was not used
	2. Delay was stated as one reason why the AVL display is not used - The town of Hays is very narrow (only 1-2 miles apart), therefore supervisors noted that if there is a 10-20 second delay in updating the vehicle location, this can misrepresent the vehicle
	3. Dispatchers expressed that they prefer if some dispatchers do not use the AVL because it can be distracting watching the progress of vehicles

4.3 Observations and Feedback on Mobile Data Terminals

Table 5 – Feedback and Observations on Mobile Data Terminal Features – Hutchinson

Location	Feedback and Observations
Hutchinson, KS	1. MDT use and communications with drivers in vehicles is used quite a bit
	2. Initially, drivers were apprehensive about the system, but they have come to love the system, and are very supportive of it
	3. It was noted that the majority of the technical issues are with the MDT and/or data communications with the vehicles.
	4. The use of the MDTs has reduced talk time over the radios.
	5. The drivers still perform manual paper logs of all rides given, due to concerns about the reliability of the MDT and not knowing when the system might go down.
	6. The dispatchers still hand enter the drivers logs each day to manually prepare reports of rides and details about the rides.

Table 6 – Feedback and Observations on Mobile Data Terminal Features – Hays

Location	Feedback and Observations
Hays, KS	1. In Hays, the drivers and dispatchers use the MDT, and like the system when it is working.
	2. The drivers still manually record all rides given using paper logs.
	3. At the end of each driver's shift, the dispatcher manually updates the CAD system using the paper logs from the driver to enter such information as the trip start/end time, locations etc.
	4. The drivers and dispatchers share a lack of trust in the MDTs because of observed technical reliability; - Frustration is due to the fact that there is no understanding of why the devices or communication don't work. - One example given was a summary that one day, the MDT in van #3 will not work and all the others will, then the next day maybe it is the MDT in van #4 that doesn't work and now #3 works fine; - The dispatchers and fleet technician expressed an interest in learning why the devices are not functioning. The noted that sometimes the vendor will help them reset the system or tell them to power down and power back up again. When this cures the problem, they wish they could have a summary of what the issue was, and how to avoid it in the future.
	5. Use of the MDT has resulted in little reduction in paperwork.

	- The drivers are still completing manual paper logs; - The dispatchers still give the drivers printed route schedules when they begin their shift.

4.4 Observations and Feedback on System Reports

Table 7 – Feedback and Observations on System Reporting Features - Hutchinson

Location	Feedback and Observations
Hutchinson, KS	1. Hutchinson uses the CAD/AVL/MDT report feature very rarely
	2. The limited use of the reporting feature is partially due to the comfort level in previous spreadsheets and reporting procedures
	3. The limited use of the reporting features is also related to the lack of trust in the data - If the CAD system loses communication with Topeka, the dispatchers can not enter any rides in to the CAD system until it is restored. Therefore, often many of the rides are recorded solely on paper. - RCAT must present monthly updates to the county describing the ridership, number of rides etc. If the system generate reports miss the rides that occur while the CAD system is down, it will not properly represent the services provided and could affect funding received.

Table 8 – Feedback and Observations on System Reporting Features - Hays

Location	Feedback and Observations
Hays, KS	1. The reports are described as challenging to use.
	2. The reports are understood to take considerable time to understand;
	3. The dispatchers do manually reconcile CAD system records daily with the drivers' manual logs, therefore when reports are generated from the system, they are accurate and detailed.

5. Understanding the Benefits of the ITS Deployments

This section summarizes the actual benefits that have been observed by drivers, dispatchers, and supervisors at each location.

Hutchinson:

1. Improved on-time performance (riders are picked up and delivered on-time more often as a result of using the ITS systems;
2. Less pressure on the dispatchers to make decisions and assign rides to drivers;
3. More consistent routing (less deviations according to the dispatcher on duty, therefore drivers experience more consistency;
4. The riders experience a system that is more reliable;
5. Training of dispatchers is quicker and easier;
6. There is a greater chance that new dispatchers will be successful in their position (better able to fill dispatcher positions with available salary levels and demands of the position).

Hays:

1. Belief that the riders receive more reliable service;
2. At times, the riders receive better service (more ride requests can be met than before) however limitations of the automated routing can prevent this benefit from happening at times;
3. The increased efficiency has allowed DSNWK to introduce two additional services (‘Safe Rides’ evening ride service, and a limited fixed route to the university) that otherwise might not have been possible;
4. The record keeping now has additional details about the rides performed.

6. Understanding the Concerns Related to Technologies

The implementation of the ITS systems in Hutchinson and Hays, Kansas has reduced the training needs of dispatchers. The increased technologies were not viewed as having negative impacts on the training or technical preparations needed by other staff members.

The following bullets describe the concerns related to the technology and also the specific centralized architecture that was developed to support the Kansas transit initiatives.

Hutchinson:

- It was noted that the architecture and shared operations of systems in several different locations has created several layers that make troubleshooting a challenge;
    - When a portion of the system is not working, it could be related to the central server in Topeka, the radio links in Salina, the CAD software, the mobile data devices, or local connectivity to the outside world. A series of phone calls to numerous individuals is typically required.

- It was noted that the central server is being operated in Topeka, and that the technical support contacts for the server don't work the same hours as the needs for dispatching;

- It was noted that there are times when the vendors are contacted to resolve issues believed to exist with the devices supplied by the vendors. Often, the system is down at a time when the vendors are not in the office for contact.

- Hutchinson would have liked to have hosted the central server. There are frustrations when the connection to Topeka is down and therefore the CAD system can not be used. The CAD system may be operating just fine, but since the access through remote desktop in to the Topeka server is not functioning, the dispatchers lose all use of the system

Hays:

- Reliability of the system is the main concern for users and supervisors in Hays;

- Because there is no predictable pattern of system outages, or understanding of why the outages occur, they are performing paper manual backups continuously. Therefore, while the outages may be once weekly, they are continuously performing paper backups to prepare for the outages;

- They believe they need to gain a trust in the system that they currently do not have.

7. Software Options

The Kansas Rural ITS Transit software system and technologies were developed and deployed by the team of Radio Satellite Integrators, Inc. and Trapeze Software Inc. One of the goals defined in Section 2 of this document indicates conducting an analysis of migrating from the current Trapeze CAD Software to the related web-based software called Novus.

7.1 Trapeze NOVUS Technology

The Trapeze NOVUS™ software is described as a browser-based, web-enabled technology to manage dial-a-ride, community transportation, or coordinated service using automated scheduling and real-time dispatching. NOVUS uses thin-client technology where all data and business logic is housed on central servers. Users access the system through customizable web interfaces.[1]

As part of this project, research was conducted through marketing material and product information received from Trapeze to describe the Novus system and the potential for deployment in Kansas. In addition, several agencies were contacted to document any experiences with the Novus system.

Based on the research and the feedback from the Kansas transit users, this report recommends that the following factors be considered when evaluating the Novus system for use in Kansas:

- The Novus architecture, features and functions;
- The experiences of other agencies deploying and using Novus;
- The expected extent to which Novus implementation would address current reliability challenges; and
- The costs and timeline for deployment.

The remainder of this section addressed the first two bullet points (architecture, features and functions; and experiences of other agencies). The expected extent to which Novus would address current reliability challenges will be a portion of the next phase of the evaluation when details are researched about the reliability problems reported. The costs and timeline for deployment would be negotiated between KDOT and the contractor, and would not be possible to estimate in this evaluation.

[1] http://www.trapezegroup.com/solutions/ct_novus.php

7.1.1 The Novus architecture, features and functions

The NOVUS concept of a central server housing the data and business logic combined with thin-client web accessibility for users of the system appears to be most appropriate for locations where dispatching is performed from one or more remote locations. The agencies contacted that are currently using NOVUS make use of the functionality that allows users at different locations to dispatch in a common system. However, these architectures are slightly different from the Kansas architecture. The other sites contacted were supporting multiple users at different locations all dispatching in the same transit organization. The KDOT architecture is slightly different in that multiple transit agencies at different locations are seeking to use the same central core system for their dispatching. In other words, users in Hutchinson would never dispatch Hays vehicles. However, in other locations where NOVUS is used, one dispatcher may be located at Location A while another is at Location B and both are dispatching the same vehicles. Regardless of this difference in approach, the architecture of the NOVUS system appears to support the multi-site dispatching as needed in Kansas. The following points identify some details to be considered:

- ***Multiple Locations***. Western Community Action (WCA) in Marshal, Minnesota is using the NOVUS system for multi-site dispatching. One comment received from WCA is that the NOVUS system currently does not support filtering of clients. Therefore, dispatchers who only dispatch for one city must sort through the list of all clients (from all cities within the system) causing longer search times. Based upon this feedback, it appears that use in Kansas may require all of Hutchinson dispatchers to view the Hays clients when searching (and vice versa). Also, when Kansas expands the transit system to additional locations, the problem would grow as well.

  WCA did comment that they have passed the feedback on to the vendor and reported that the issue is being addressed, although more specific details were not known.

- ***Automatic Scheduling.*** The NOVUS system specifications describe that it offers automated scheduling. While automated scheduling is not used by all operators in Kansas, it is used at times in both locations and offers potential for expanded use and benefits. There are concerns by both Hutchinson and Hays about the current automated scheduling algorithms and it is recommended that these concerns be discussed in regards to a NOVUS upgrade before a final decision is reached (e.g. the NOVUS scheduling may address some of these concerns).
- ***Real-time Dispatching.*** The NOVUS system specifications describe real-time dispatching as a function of the system. Real-time dispatching is used thoroughly by all dispatchers and is critical to the Kansas deployment.
- ***Client Management.*** The NOVUS system describes client management services to track details of clients such as special needs, payment types and the ability to track incidents, cancellations and no-shows. Based on the need to service clients with special needs and to support payments in both cash and certificates, client management offers considerable benefits to the Kansas transit agencies. This

evaluation did not discuss the extent to which the current CAD system meets the client management needs of the agencies, however there were no expressions of issues with the current system in this area.

- ***Report Generation.*** The NOVUS specifications describe ‘quick report generation’. The difficulty and complexity of report generations in the current CAD system are a current area of concern. Therefore, if NOVUS offers simpler report features that are easier to use, this would be a major benefit to the dispatchers.
- ***Secure Remote Access.*** The NOVUS specifications describe secure access by remote offices. One concern expressed in Hutchinson is the security of any Internet connections. The web based architecture of NOVUS might offer more reliable connections than the current system.
- ***Off-site Hosting.*** The architecture of the NOVUS system would allow for off-site hosting by the vendor. This solution could remove the reliance on the KDOT central office and still deliver the benefits of a centrally operated system. It is recommended that KDOT consider this off-site hosting when considering the upgrade.

7.1.2 Experiences of Other Sites Using NOVUS

Two public agencies were contacted who currently use the Trapeze NOVUS system, Western Community Action in Marshall Minnesota, and Hope Source in Ellensburg, Washington. Both sites had previously used the Trapeze Pass Lite system before migrating to NOVUS. The common feedback from both sites is that the NOVUS system is easy to use, and that they are happy to have migrated. The following bullets identify some details from the feedback gathered from the sites:

- WCA commented that it took their agency five years to become comfortable with the Trapeze Pass Lite system but only one year to become comfortable with the NOVUS system. Therefore, as Kansas looks to expand to other locations, they should expect a quicker learning curve and less time until the agencies are comfortable with the system if operating NOVUS.

- Both sites commented that Trapeze offers on-line training and this has allowed them to benefit from training from Trapeze after the initial training sessions.

- Hope Source commented that they initially had a one week training session from Trapeze, which was more than sufficient.

- WCA commented that they had an initial training session of two days.

- Hope Source commented that they served as a Beta test site for NOVUS and that they passed considerable feedback on to Trapeze and that Trapeze was very responsive about responding to the requests and comments.

- Migration to a web based system was received by dispatchers in each agency with hesitation at first, but after users realized the efficiency in tracking and dispatching rides as well as moving away from using paper to book trips the system was well received. Dispatchers quickly learned of the time savings.

- Each agency is still providing feedback on modifying the software to meet specific needs such as filtering capabilities, so that a satellite office does not have to look through all the client records.

- Hardware needed to be replaced at WCA in order to run the Trapeze NOVUS software, therefore hardware specifications should be requested during the KDOT review of NOVUS.

7.2 Summary of Software Migration Research

The preceding section identified information about the Trapeze NOVUS solution that KDOT is considering. In summary, the migration to NOVUS has the potential to accomplish one or more of the following benefits:

- ***Reduced complexity.*** The current Trapeze CAD system supports large transit systems and the local dispatching of mostly par transit services in Hutchinson and Hays does not require a lot of the advanced features. Similarly, the reporting features of the current system were described as being too complex. NOVUS could offer a simpler interface and be more appropriate for deployments in other rural areas of Kansas.
- ***Built-in Internet Support.*** Currently, the Kansas rural transit system uses remote desktop services to login and access the central servers at KDOT in Topeka. NOVUS would support web connections using Internet connectivity with built-in security, thus allowing access from any Internet location. This might help simplify expansion to additional locations.
- ***Reliability.*** The primary challenge facing the systems in Hays and Hutchinson is system reliability, with the communication to the mobile terminals being the primary problem reported by system users. It is unclear whether a migration to NOVUS would improve the system reliability, although the potential for Trapeze to host NOVUS off-site and allow fully supported access from each location would reduce the problems reported with the lack of 24/7 support at the location where the server is hosted.

In summary, the NOVUS system appears to be a very powerful system that is appropriate for the size of transit agencies supported by the KDOT system and to the architecture for statewide coverage in Kansas.

However, the current CAD/AVL/MDT features and functionalities are not being fully utilized primarily due to the lack of reliability of certain portions of the system (that may or may not be related to the CAD system), and the lack of trust in the system that has resulted by users and managers. Therefore, it is recommended that KDOT resolve the reliability issues (or receive confirmation that a NOVUS migration will improve reliability) before investing in the conversion.

8. Results and Conclusions

This section presents some conclusions, recommendations, and suggestions for additional states and/or transit agencies throughout Kansas considering ITS deployments.

System Architecture:

Kansas has implemented a centralized architecture with the intent of supporting several additional rural transit agencies using the same centralized CAD software currently hosted and operated on servers located in Topeka, Kansas.

- The architecture relieves the local agencies from the need to operate central servers and ITS software locally. It also reduces the number of software systems to purchase and maintain and avoids different areas within the state deploying different software systems and/or versions of software systems.

- The architecture introduces additional layers in to the troubleshooting and resolution of problems. When any portion of the ITS systems is not functioning, the Hutchinson and Hays technical representatives often make several calls to different responsible agencies before the system can be corrected.

- It is not clear whether the architecture is contributing to the reliability issues with the mobile data communications to the vehicles. It is recommended that the reliability issues be resolved before ITS devices are deployed at additional transit agencies throughout the state using this same architecture.

- With the current architecture, the core CAD system is operated at the KDOT Central Office in Topeka. Dispatchers in Hays have described challenges presented because the operational hours of the KDOT Topeka operations center do not match their dispatcher work hours. There was discussion that if the system migrated to the web based Novus system, then the central software could be hosted at the vendors 24/7 hosting facility.

System Reliability

The evaluation did not include a formal assessment of the system reliability. Instead, the personal interviews with users of the system revealed concerns about the reliability of the system. The following conclusions are based on the personal feedback shared by operators, dispatchers and managers of the system:

- Rural transit agencies are required to keep extensive records of the services provided. One use of ITS applications is to reduce the manual record keeping activities while still maintaining accurate and complete records. When examining the reliability of the system, it was estimated that portions of the system go down an estimated one time per week. While the number of partial system outages may not seem high, it is enough that both locations are continuing to perform manual paper backups of all data records. Therefore, even though the system is down only a small portion of the operational time, the net effect is that the operators perform manual entry 100% of the time because they can not predict when they will lose the system.

- Given the reliability impacts on reporting, it is recommended that the reliability be improved to the point where transit agencies are comfortable enough to discontinue using paper backup reports before expansion of the systems to additional Kansas locations.

Use of System Functions and Features

The evaluation included personal interviews and observations of the use of the system. The intent was to understand if the systems and features were being used to the intended potential or not.

- While it was very obvious that dispatchers, drivers, and managers value the system, it was also observed that there are features not being used by dispatchers. Most notably, the ride assignment and routing features of the CAD system do not appear to be used extensively in Hays, and while it is used more often in Hutchinson there are times when it is not used. Adjustments to the algorithms and system configurations are recommended and may help dispatchers feel more comfortable using these functions of the system, as might additional training or demonstrations of the benefits.

- The system reporting capabilities are not used extensively to generate the needed reports. This was acknowledged to be a combination of the difficulty using the reporting feature as well as each agencies familiarity with previous report creation techniques.

- In order to achieve the maximum potential for the transit ITS systems in the existing locations and future locations, it is suggested that each site complete a concept of operations that documents the ideal use of the technologies. If the ultimate intended use is not to take advantage of the ride assignment portion of the system (or other portions) this should be documented.

Benefits

With the existing reliability status less than perfect, the automated system reports not used extensively, and the fact that operators do not utilize all features of the CAD or mobile data terminal devices, the users of both systems still cited benefits of the system. Therefore, the evaluation results have shown that the transit ITS systems are benefiting the rural areas in Kansas under the current architecture. However, it is believed that far greater benefits are possible if the reliability concerns can be overcome and the manual record keeping eliminated, and if the dispatchers can fully benefit from the dispatch support functions.