Minnesota Department of Transportation

Evaluation of Cable Access Television (CATV) as a Medium for Advanced Traveler Information Systems (ATIS)

Final Report
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Final Report

1. Introduction

The Minnesota Department of Transportation began a number of Advanced Traveler
Information System (ATIS) initiatives in 1998 that were part of a statewide plan. The
purpose of this evaluation for the Cable Access Television Project is to investigate the
potential benefits and viability of expanding the use of CATV as a medium to deliver
traveler information to the public, specifically targeted to remote, rural areas of the state.

This final report summarizes what has been accomplished for this CATV/ATIS evaluation
project. The layout of the report follows the time sequence of the tasks completed in the
previous ten weeks. The final conclusion includes recommendations to Mn/DOT as to
possible improvements to the CATV system and the best future use of televised medium
for traveler information.

2. Public Feedback Based on the “TripUSA, 800#, CATV Advanced Traveler
Information Systems Focus Group Evaluation” Report

After over two years of the pilot broadcasts, a focus group study was conducted in
September 2001 to assess public opinion of the effectiveness and usefulness of the
CATV-TIS broadcasts. The findings and recommendations of the 2001 focus group study
are summarized in this report, and will serve as a baseline for investigating potential
program expansion and enhancements.

In general terms, users wanted the service continued and expanded but with
enhancements. Promoting public awareness of the service was strongly recommended.
Specific user recommendations included:

• Serious consideration should be given to enhance the clarity of the transmission. This
  should be worked out prior to moving forward with other enhancements. Keeping the
  service simple, easy to use and understand will be key to its success.
• Provide continuous broadcasts with new information in 15-minute cycles.
• Start with a statewide view and zoom-in on specific regions depending on the location
  of the broadcast.
• Consider integrating audio information. Specifically, National Weather Service
  information.
• Provide audio override capabilities for special travel messages and weather warnings.
• Tailor the service to winter weather by possibly incorporating enhanced real-time road-weather information.

• Investigate providing supplemental information on local/county roads if warranted by conditions or special situations.

• Add relevant metro area travel information.

The focus group participants had specific recommendations on improving the Cable TV project. The Cable TV ATIS program elements were functioning as they were originally intended but based on the results of this series of focus group sessions, areas for possible enhancements could be identified. As enhancements are made, it is important to ensure that the information presented to users is accurate, timely and in a format that is easy to understand and use. If the information is not accurate, timely and easy to understand and use, each project will eventually experience a drop off in repeat users and it will be difficult to continue to "grow" each project to attract new customers.

By incorporating users recommendations to enhance the existing service, the Minnesota Department of Transportation can position the CATV ATIS project to continue to satisfy repeat customers as well as attract new ones. The continued success of this ATIS project requires constant attention to the notion of making a better service for current and potential new customers.

3. Feedbacks from Cable Access Providers Interview

In March of 2003, in-depth telephone interviews were conducted with the cable access providers conducting business with MnSAT. An interview questionnaire developed to determine the capability and interest of cable providers in providing the service to their customers including:

• General interest level based on perceived or known customer demand;

• Availability of a channel or time slot for this information to be aired;

• Willingness to deliver information to customers free of charge;

• Ability and willingness of provider or network to pay minimal cost associated with receiving the information from Mn/DOT;

• Desired content (i.e. maps and images, narration, video images, etc.)

• Desired format (i.e. web based, satellite transmission, etc.)

• Factors that would limit or prevent providing the service (i.e. lack of technical resources, institutional issues)

The cable access providers interviewed were Dick Sjoberg of Sjoberg Cable TV in Thief River Falls, MN and Mary Lowden of ACS/Avrig Communication Systems in Detroit Lakes, MN. After Mn/DOT approved it, the questionnaire was emailed to each interviewee two
days before the phone interview. Each interview took about 35 minutes to 45 minutes to complete.

The results of the phone interviews with the cable access providers indicate that there is a general interest in the Travel Information programming. Although the technology is ready for making traveler information available to general public, current map quality, update frequency and information content still has room for improvement. Due to many programs competing for the limited bandwidth, traveler information needs to have dynamic contents and high quality image/video/audio with professional look and feel to guarantee its success.

The cable access providers were satisfied with the support provided by Mn/DOT and its consulting firms during the installation and operational phase. They are willing to participate future ATIS deployment and pay minimal cost associated with receiving traveler information if the product quality and information content can be improved.

4. Feedback from MnSAT, Sufficient Systems, Castle Rock and Mn/DOT Interviews

In March of 2003, in-depth telephone interviews were conducted with individual from Mn/DOT and Castle Rock to determine their perceptions of the benefits and limitations of the system. The subjects include:

- Effectiveness at providing traveler information
- Technical issues
- Institutional issues including coordination between the public and private partners

As suggested by Mn/DOT, Roger Hille and Patty Vogt of Mn/DOT and Dean Deeter of Castle Rock were interviewed. After Mn/DOT approved it, the questionnaire was emailed to each interviewee before the phone interview. Each interview took about 20 minutes to 35 minutes to complete.

Initiated in 1998, the CATV/ATIS was a pioneer ATIS project. It was designed and implemented based on technologies and traveler information available at that time. Nowadays, using the advanced Internet technology and abundant traveler information collected by other ATIS projects, CATV/ATIS should be able to improve and enhance its information contents.

Despite the fact that the people who were interviewed wouldn’t give specific comments on the institutional issues due to their lack of involvement in the entire process, the traveler information wouldn’t be available to the end users if there wasn’t a seamless coordination among Mn/DOT, MnCARS, MnSAT and cable access TV providers. Technically, there is room for improvement especially between MnCARS and MnSAT to enhance map quality and add dynamic traveler information contents.
According to the interviewees, attention should be paid to differentiate the role of 511 and CATV/ATIS. 511 has attracted lots of attention lately not only because of its nation-wide recognition but also because of its ability to serve different types of users. Therefore, the funding is more likely to be invested in 511 in the long run and this could affect the fate of CATV/ATIS in the future.

5. System Architecture Diagram

As shown in the Appendix A, the Map Server and Map Scheduler developed by the Sufficient Systems, Inc. are the core of the system. The Map Server located on the server side receives XML pages from MnCARS for creating maps that can be shown nicely on a television screen of different sizes. Satellite was used to transmit the maps to the Map Scheduler located at the cable TV providers. The Map Scheduler then sequences the map display before the final broadcast.

6. An assessment of the elements of the system architecture and of the architecture as a whole

The maps seen by audiences on their TV screens display the weather and traffic conditions for the state, region, and city with icons to show the exact location. These maps, created by the Map Server located in Lino Lakes, MN, are uploaded to satellite and transmitted to the Map Scheduler located at the cable TV provider. The information source for creating maps is the XML traffic information page received from MnCARS database. Maps generated by a computer could not be shown nicely on a TV screen due to image clarity lost in the process of converting computer digital signal to television analog signal. Hence, one of important features of Map Server is to create maps that can be optimally shown on the TV screen of different sizes. Meanwhile, another main function of Map Server is to customize the region and city maps to show the information of the service area for each individual cable TV service provider.

The Map Scheduler itself can be a low-end personal computer or workstation. The software developed by Sufficient Systems, Inc. is an Internet Explorer customized with a few functions written in Visual Basic program language to determine how much time should be allocated to each map and the sequence of showing maps on the web browser.

7. Cost and scope of three alternatives for the continued use of televised medium for traveler information

To eliminate monthly satellite uplink costs, it is recommended that the Internet be used for data transmission. Because a modem dial up with 56 kbps communication speed would be too slow for data transmission, the cable TV service providers must have a DSL or cable TV type of high speed Internet connection. For security consideration, a Virtual Private Network (VPN) is recommended to serve as a tunnel between the CATV/ATIS server and the cable TV provider’s workstation to provide secure data access.
Three alternatives are considered to continue and enhance the existing CATV/ATIS project. They are expansion of the existing system, modification and then expansion of the existing system, or creating an entirely new system. For each of the alternatives, the scope of required changes and the costs are estimated.

The cost of each option includes the cost for system development, operation and maintenance. A few one-time installation costs are also considered. The majority of these estimates are based on the previous experiences learned from the CATV/ATIS project.

**Option A: Expansion of existing system**

The Map Server and Map Scheduler are the two main programs that Sufficient Systems, Inc. specially designed for this CATV/ATIS project. With a few enhancements, features in the Map Server and Map Scheduler can help to minimize the system development effort. Hence, this option is to keep both Map Server and Map Scheduler and use them as the foundation to build a system that supports new needs.

The proposed changes to Map Scheduler include:

- Building a virtual private network (VPN) connection with Map Server
- Changing its existing structure to let it listen to the Map Server’s broadcast for receiving audio and map files through VPN.
- Processing audio file
- Overall Map Scheduler security enforcement

Recommended changes to be made to the Map Server include:

- Modifying existing connection method between the Map Server and MnCARS. Currently, the Map Server extracts XML pages from the MnCARS web site for producing maps. A robust and dedicated connection and Application Programming Interface between MnCARS and Map Server should be established.
- Microsoft Windows Media Service was used by the Map Server to notify the listener, the Map Scheduler in this case, that the data is coming. This is done through satellite broadcasting and should be revised for the Internet distribution.

The efforts needed to expand the Map Server and the Map Scheduler are shown in the following:

- System development and modification: It is estimated that it could take 3 months or 480 hours of a software engineer’s time to make the required changes to the Map Server and Map Scheduler.
- System operation and maintenance: 2 hours per week
- One time VPN configuration and server security inspection: 20 hours
Option B: Modification and then expansion of the existing system

The easiest way for this option is to keep Map Scheduler but remove Map Server.

As shown in Option A, the Map Server needs to undergo a few changes to better utilize the existing MnCARS Application Programming Interfaces (APIs) for receiving map and audio files. If this effort and cost are more expensive than that of adding the same features to MnCARS itself, then it would be worthwhile to remove the Map Server and connect the Map Scheduler on client side to MnCARS directly. However, the map optimization and customization features of the Map Server for TV screen display should be migrated to MnCARS and this requires careful planning.

In this approach, the needs of Map Scheduler modification are still same as those shown in Option A.

The estimate efforts for this approach are shown in the following:

- System development and modification: Although this process largely depends on the flexibility of MnCARS and its APIs, the best estimate of retrieving maps and audio files from MnCARS and making required changes to the Map Scheduler for handling audio files and sequencing maps display is about 640 hours of a software engineer’s time.
- System operation and maintenance: It is estimated that it could take 2 hours per week for the system operation and maintenance.
- One time VPN configuration and server security inspection: 20 hours

Option C: Creation of an entirely new system

This option suggests removing both the Map Server and the Map Scheduler and building a new one from scratch.

There are two possible approaches for this option: 1) develop a new server-client program to replace the Map Server and Map Scheduler or 2) use a simple File Transfer Protocol (FTP) to push maps and audio files to cable TV service providers periodically.

Option C1: Create a new server-client software similar to Map Server and Map Scheduler

Unless there are unrecoverable flaws in the Map Server and Map Scheduler, it is not cost effective to develop a new server-client software program.

- System development and modification: It could take 6 months or 1040 hours for one software engineer to create a new server-client software program to replace the existing Map Server and Map Scheduler.
- System operation and maintenance: 2 hours per week
- One time VPN configuration and server security inspection: 20 hours
Option C2: FTP Approach

If the FTP approach is chosen, MnCARS will need to perform the map and audio customization so that they can be properly displayed on a TV screen. Also, map and audio display software will need to be developed and installed on client side to display maps and audio files sequentially for final broadcasting. In addition, if it is a push FTP approach, which means MnCARS sends data to cable TV providers in a fixed time interval, the cable TV providers will need to have a steady IP address for receiving data from MnCARS. However, most of cable TV providers do not have such luxury for the time being.

- System development and modification: Although the FTP setup can be completed in less than 10 minutes, it is estimated that it could take one month or 160 hours for a software engineer to develop a software to sequence map display and audio play on the client side based on the FTP approach.

- System operation and maintenance: Unlike the server-client approach, in which the communication between MnCARS and the cable TV providers is handled by a set of pre-defined messages to ensure its continuous operation, the FTP approach relies on the operator to manually check if the program still functions properly. Hence, the maintenance and operation cost for FTP approach will be much higher than that of other options. It is estimated that it takes 5 hours per week for the operation and maintenance. In addition, FTP has a high security risk such that the server needs to be inspected regularly. It could easily take 5 hours per week of a system engineer’s time to inspect the system.

- One time VPN configuration and server security inspection: Although VPN is not applicable to this scenario, FTP has a high security risk such that the server needs to be inspected thoroughly at the beginning of system deployment. It is estimated that 20 hours is required to tighten the system on client side for preventing security breach.

There may be no cost for the VPN setup if the selected computer Operating System already has this functionality embedded in it. For instance, IPSEC (Internet Protocol Security) in Microsoft Windows 2000 can be used to implement the VPN function for free.

Also, according to Castle Rock’s enhancement, the costs required for the MnCARS improvement to support CATV/ATIS project are:

- Modifications to generate the map files and make them available for download over the Internet: $5,000
- Modification to the sound file creation to allow the generation of wave files describing events in a give area that can be played on the T.V. to accompany the image being on the screen: $15,000

To summarize, Table 1 shows the cost estimate for each of the options mentioned above and the cost for operating and maintaining current CATV/ATIS is shown in Table 2. Obviously the major difference is the saving on the satellite uplink and Internet dial-up connection fee.
Besides the cost for system development, operation, maintenance and the one-time configuration cost, the costs on the cable TV provider side also need to be considered. Regardless of which option is chosen, the hardware components the cable TV providers need for broadcasting traffic information include the video switch, whose cost is in the range of $400 to $3000 depending on its functionality, a character generator, a low end computer workstation, and a cable modem or DSL modem with a high speed Internet connection.

<table>
<thead>
<tr>
<th>Option</th>
<th>System Development (Hours)</th>
<th>Maintenance and Operation (Hours/week)</th>
<th>One-Time setup and Installation (Hours)</th>
<th>Security Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option A</td>
<td>480</td>
<td>2</td>
<td>20</td>
<td>High</td>
</tr>
<tr>
<td>Option B</td>
<td>480/640</td>
<td>2</td>
<td>20</td>
<td>High</td>
</tr>
<tr>
<td>Option C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1: New system</td>
<td>1040</td>
<td>2</td>
<td>20</td>
<td>High</td>
</tr>
<tr>
<td>C2: FTP</td>
<td>160</td>
<td>10</td>
<td>20</td>
<td>Low</td>
</tr>
</tbody>
</table>

*: 480 hours are needed if maps optimization and audio files creation is done by MnCARS
640 hours are needed if MnCARS only provides data; maps optimization and audio creation are handled by the future CATV/ATIS enhancement project.

Table 1: Break Down Cost Estimate for Different Options

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satellite uplink &amp; Internet connectivity</td>
<td>$1,200.00</td>
<td>2 months @ $600/month</td>
</tr>
<tr>
<td>Project Management (MnSAT)</td>
<td>$320.00</td>
<td>2 months @ 4 hours/month @ $40/month</td>
</tr>
<tr>
<td>Phone connections</td>
<td>$120.00</td>
<td>2 months @ $60/month for both lines</td>
</tr>
<tr>
<td>Maintenance</td>
<td>$1,000.00</td>
<td>2 months @ 5 hours/month @ $574/month</td>
</tr>
<tr>
<td>Project Management (Sufficient Systems)</td>
<td>$300.00</td>
<td>2 months @ 1 hour/month @ $150/hour</td>
</tr>
<tr>
<td>Project Close-Out (optional)-cancelled</td>
<td>$(3,000.00)</td>
<td>20 hours @ $125/hour plus $500 travel costs</td>
</tr>
</tbody>
</table>

Table 2: Current CATV Operation and Maintenance Cost

Currently the one-time hardware cost for cable TV providers to receive and broadcast satellite-based traffic information is about $2,000. It includes the expenses for a video switch, a character generator and a computer workstation. Now the cost could be still around to $2000 after the cable modem or DSL modem is added due to price drop of computer hardware. However, it is possible that the cable TV providers already have either a character generator or a video switch or both in house. Hence, the one-time hardware cost to cable TV providers for the new system may be further reduced.
To provide better customization and to ensure its integrity and security, it is recommended that the hardware and software needed for providing CATV/ATIS service be grouped into four packages to allow cable TV providers to select the most appropriate package based on their individual needs. Table 3 shows the combination of each package.

<table>
<thead>
<tr>
<th>Package</th>
<th>Cable/DSL Modem</th>
<th>Workstation w / client software installed</th>
<th>Video Switch</th>
<th>Character Generator</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>$2000</td>
</tr>
<tr>
<td>B</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
<td>$1700</td>
</tr>
<tr>
<td>C</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
<td>$1200</td>
</tr>
<tr>
<td>D</td>
<td></td>
<td></td>
<td>√</td>
<td></td>
<td>$1000</td>
</tr>
</tbody>
</table>

Table 3: Estimate Cost to Cable TV Provider

However, cable TV providers who select Package B, C or D need to have an in-house computer engineer to ensure the hardware compatibility and security of their own system. Hence, the cost of choosing Package B, C and D could be much greater if the additional expense of system operation and maintenance is considered.

Unfortunately, there will be a monthly high speed Internet connection charge to cable TV providers if they do not have a compatible or better Internet service currently. The cost could be in the range of $40 to $60 per month depending on the area.

8. Conclusions

Based on the feedback received from the user group workshop and the phone interview with cable TV providers, Mn/DOT staff, and consultants who designed the MnCARS and CATV/ATIS, several enhancements to the existing system are recommended. The system architecture was reviewed to investigate the possibility of future improvement. To eliminate the monthly satellite uplink cost, four Internet-based data transmission options are proposed along with the cost estimate for each of these options.

Although the cost assessment is for the future CATV/ATIS enhancement, the final decision of which option to choose is largely dependent on what role the MnCARS will play not only in this CATV/ATIS project but also in the overall Mn/DOT 511 and ATIS programs. If the idea of adding audio files and customizing maps for showing on television screen can be beneficial to other projects and applications, then Option B will be the best choice. If all these features are only good for CATV/ATIS, then Option A is recommended because it is cost effective, its framework already exists, it is working and the risk of system enhancement is low. However, both Option A and Option B are based on the assumption that Mn/DOT owns the right and the source codes to enhance and modify the Map Server and Map Scheduler. Obviously, besides adding new features, there are still many areas the Map Server and Map Scheduler can be improved. Among these, one of the key requirements is to improve the installation process on client side so that cable TV providers can perform system installation easily.
In addition, regardless of which option is chosen, the idea of creating modular client side hardware and software packages, to give the system integrator more control in system development and to reduce the uncertainty of system integration on the cable TV provider side, will be crucial for system expansion in the future.
Appendix A – Existing CATV/ATIS System Architecture