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16. Abstract

This letter report details the installation of the Texas Department of Transportation (TxDOT) Advanced Transportation Management System (ATMS) software in the TransLink® Laboratory. Two methods of delivering data to ATMS are presented. A discussion of future research goals, both near- and long-term, utilizing ATMS as a core component, is also presented.

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Report 1752-3

Recommendations on ATMS Software in TransLink® Laboratory

by
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Introduction

In the Intelligent Transportation System (ITS) arena, software applications play an important role in the collection and management of information from diverse sources. Typically termed Advanced Transportation Management System (ATMS) software, the Texas Department of Transportation (TxDOT) is a leader in the development and deployment of ATMS applications as part of a toolbox of ITS solutions.

The Traffic Operations Division (TRF) of the Texas Department of Transportation has, over the course of several years, developed an in-house version of ATMS software for use in small to medium sized cities. With a core set of functionality and an ongoing development process, the software is TxDOT's standard for implementing ITS across the state.

Within the scope of its mission of investigating concepts for linking elements of the surface transportation system together, TransLink has replicated a typical ATMS setup (software and associated standard hardware) in the laboratory. Utilizing the software in the laboratory more closely ties the research program with the day-to-day efforts of TxDOT staff deploying systems. Its use provides a platform for longer-term work to enhance the functions of ATMS with diverse field hardware, new communications technologies, and supplemental components, such as data archiving.

This report details the current status of the ATMS components, near-term efforts to utilize the system, and long-term research objectives.

Operational Status of ATMS in TransLink Laboratory

Overview

ATMS Version 2 is now operational in the TransLink laboratory. Both the server and client components have been installed along with the underlying database running Sybase® Adaptive Server Enterprise. Since installation, efforts related to ATMS have focused on enabling data flows into the system so that real time operations monitoring can take place. A method for delivering information to ATMS has been developed and is discussed below.

The map display components with the Javelin controls have not been installed with ATMS. While the TransLink laboratory has a separate video control system, TxDOT is also in the process of updating those components with new controls and features. When these upgrades are completed, the ATMS installation will be updated to incorporate the latest components for video control and map generation. Although no graphical display is in use, the monitoring capabilities of the ATMS server allow an operator to see the system inputs from each location.

Data Input to ATMS

In a typical field installation, the server is connected to one or more SCUs (system control unit), which is in turn connected to multiple LCUs (local control unit). Each LCU receives input from multiple inductive pavement loops, which are activated by the presence of a vehicle. Inductive pavement loops provide the LCU with information to determine speed, volume, and occupancy. Due to the fact that there are no physical connections to loops in the TransLink laboratory, researchers have come up with a method of delivering inputs (loop actuations) to ATMS.

The method of data delivery to ATMS centers on the use of hardware-in-the-loop. With hardware-in-the-loop, a TxDOT standard LCU and SCU are utilized along with a simulation model. The simulation model, TexSIM, activates loops when vehicles pass over them. This activation is translated into a change in voltage that is read by the solid-state relays. The complete set of solid-state relays is known as a controller interface device (CID). The CID translates the voltage information to the LCU, which sees it as physical actuations from an inductive pavement loop. The LCU aggregates this information every 20 seconds and passes on to the SCU. The SCU then reports this input to ATMS.

Figure 1 shows a schematic of this process. The simulation employed in TexSIM is a simple ramp-metering application that sends traffic onto the main freeway lanes. Loop detections for both the ramp and the freeway lanes are processed by the simulation and the hardware-in-the-loop interface, which communicates serially to the LCU. The LCU then transmits loop information to the SCU, which in turns supplies ATMS with the loop data. All of these communication processes take place serially.

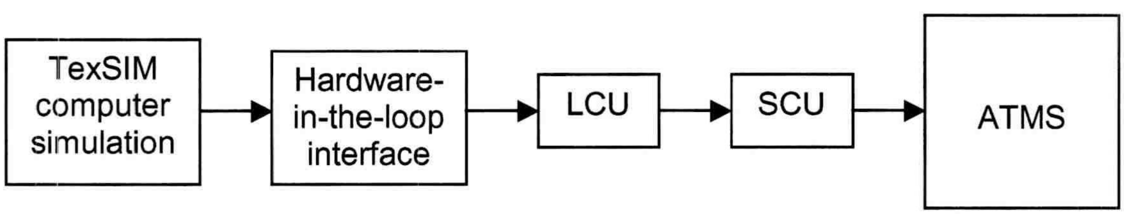

Figure 1. Diagram of Hardware-In-The-Loop Based Input into ATMS

Figure 2 shows the physical components of this process in the laboratory. The computer at the far left of the picture is running TexSIM and communicating with the hardware-in-the-loop interface, which is to the right of the LCU. Loop detections then go to the LCU, which is connected serially to the SCU. The SCU is also connected serially to the ATMS server.

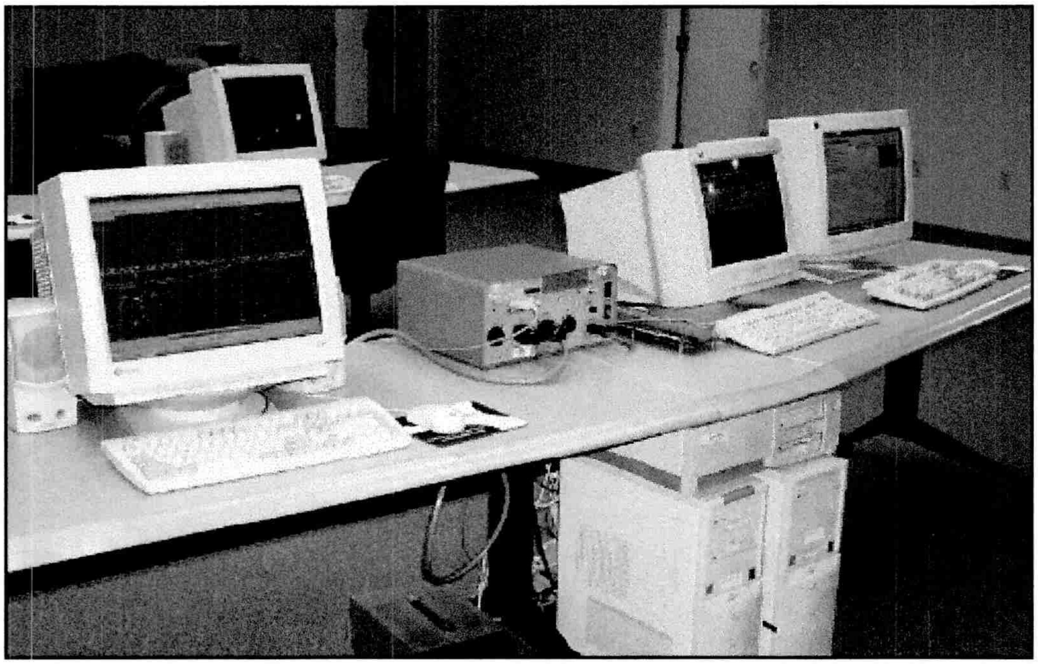

Figure 2. Photo of Hardware-in-the-loop Based input for ATMS

In a minor variation of the hardware-in-the loop method described above, a software-based LCU emulation was developed. This emulation removes the necessity for having a number of physical LCUs connected to the SCU in the system. A software-based LCU can emulate up to eight physical LCUs. The software-based LCU runs on a computer and communicates serially to the SCU, which in turn delivers the information (loop detections) to the ATMS. Figure 3 shows a screenshot of the software-based LCU interface.

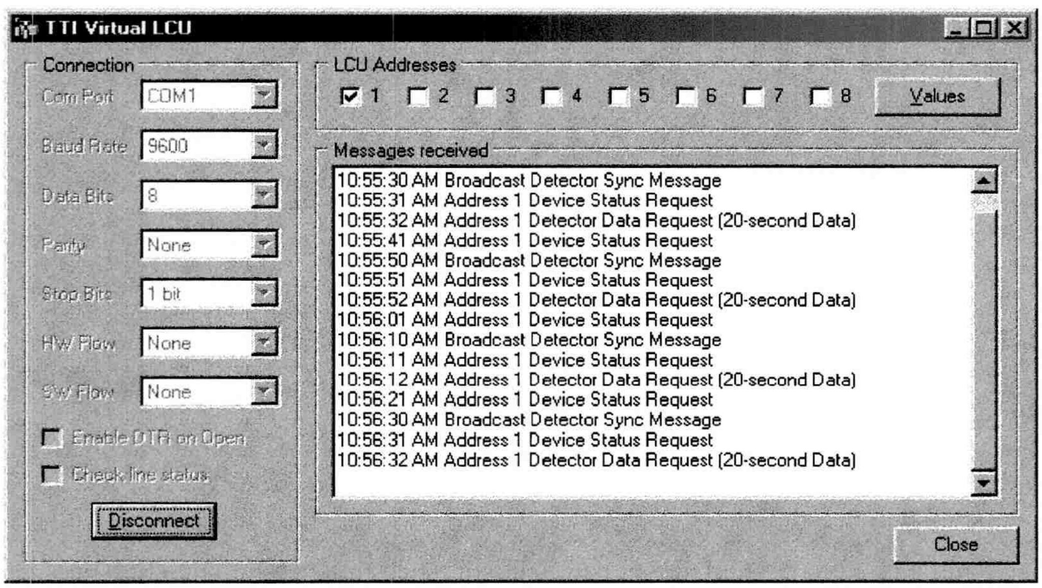

Figure 3. Software-Based LCU Emulation

It should be noted that the two methods of data input are not exclusive. They can be running at the same time and delivering data to the SCU and ATMS simultaneously. This allows more than one simulated environment to be operational at the same time.

Installation Issues

As the ATMS components have been operational in the TransLink laboratory only for a short time, the initial investigations have been limited. Efforts have focused on replicating the typical structure of ATMS installations, configuration of the installed components, ensuring proper operations, and obtaining data for input into the ATMS system.

While limited, these work efforts have resulted in the identification of the issues discussed below. All information with regard to these issues has been reported to the ATMS development team, which has worked very closely with TransLink staff to support the installation in the laboratory.

During installation, two issues were identified and resolved. The first issue, reported as number 261, dealt with an SCU response to the first ATMS polling. A workaround was determined and a test for the occurrence of this situation will be part of ATMS Version 2.1.

The second issue, reported as number 166, dealt with the ATMS client package requesting support files for video components. These files were identified and obtained. Version 2.1 will address this issue by not requiring these files if video hardware will not be in use on the client computer.

As another installation note, the ATMS installation in TransLink utilizes a different version of the Sybase server package as a result of a change in the currently available version from Sybase. TransLink is operating on Version 12.0 of ASE (Adaptive Server Enterprise). The current version in use within TxDOT is 11.9.2. The successful installation and operation of ATMS in the laboratory confirms that the package will run on the next major version of Sybase without requiring changes or modifications to the core database structure or communications.

Future Research Efforts

Near-Term

The near-term research efforts for ATMS are two-fold. First, TransLink will undertake an evaluation of the graphical user interface (GUI) in use within ATMS. This evaluation will focus on the human interface aspect of operating the server components of the system, in particular the process of adding new information into the database of available equipment.

TransLink will also start to work on a data storage mechanism for the operational data received by ATMS. The storage of these data is outside the current scope of the ATMS database and will have to occur in a new database specifically designed to accommodate the structure of the data received by ATMS. In addition, a retrieval and analysis mechanism is necessary to be able to examine the operational data for trends and performance measures. The preliminary plan for this research is shown in Figure 4.

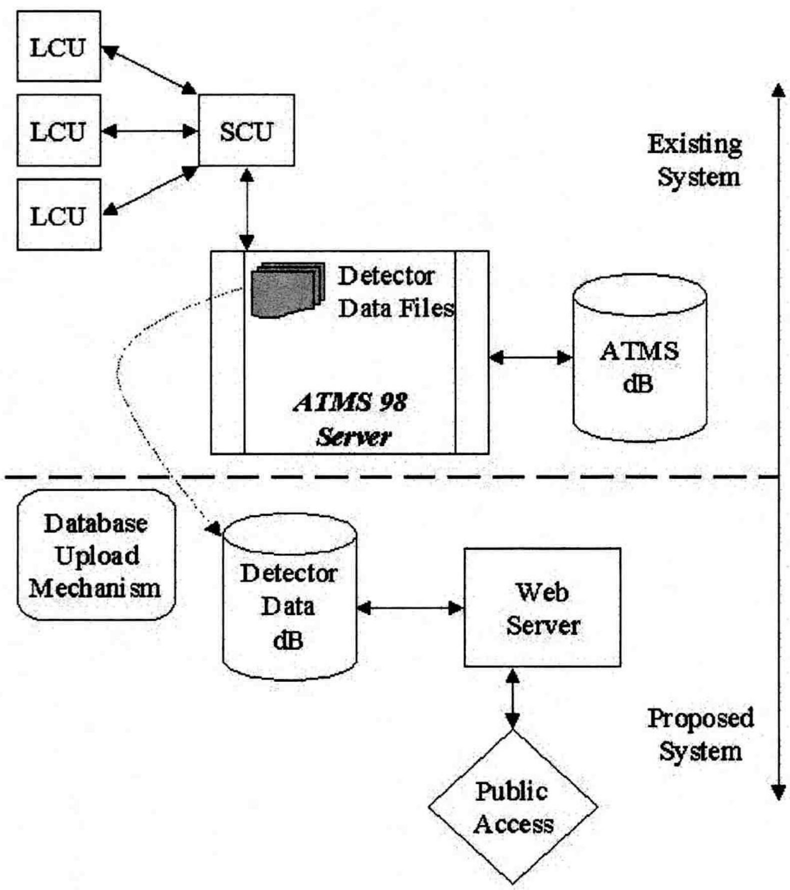

Figure 4. Schematic of Proposed Addition to ATMS for Data Storage

The top portion of the diagram is the existing ATMS implementation in the TransLink laboratory. It also represents any ATMS implementation in use by TxDOT given the standard LCU and SCU device interfaces. The bottom portion of the diagram portrays an upload mechanism of the detector data files to a new database, separate from the existing ATMS database. A web server interface will be used to query and retrieve information from the detector database. The advantage of storing information in this manner is that it is portable to other ATMS installations and does not affect the core functionality and software code base of ATMS.

Long-Term Research Strategy

The TransLink Research Center will be using the ATMS software as the core component of a research tool for advancing the state of the art in traffic operations. By marrying the operations capability of ATMS with simulation components that supplement the live data components, a more robust operating environment can be examined. This marriage allows ATMS to be used in research for issues affecting not only freeways but also situations such as arterials, frontage roads, ramps and intersections. A key feature of this tool is the ability to store and analyze the operational data and, ultimately, feed those results back into the simulated environment. Figure 5 illustrates the general concept.

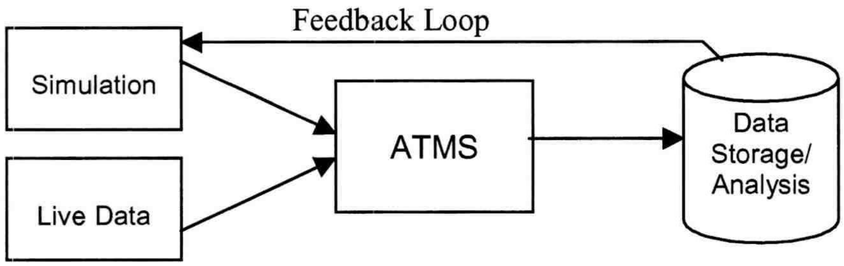

Figure 5. ATMS-Based Research Tool for Traffic Operations

Several of the near-term efforts, as described above, will be used to construct portions of the research system. Long-term efforts will focus on building the rest of the components necessary to have an effective research tool.

A research tool as shown in Figure 4 enables the investigation of numerous issues. A sampling of some of the questions that will face ATMS in the future include:

- Do research tools and industry devices conform to national architecture standards?
- How should ATMS be used in a system of traffic management centers, with both like and unlike software and defined operations?
- How can new and emerging technologies and research tools be integrated into ATMS?
- What software/system 'hooks' need to be provided so that integration of additional data, devices and software can occur?
- How can data produced by ATMS be used for operational improvements?

An additional aspect of future research efforts is supplementing the core of ATMS with additional capabilities. Working in concert with staff at TRF and the statewide integrator, any additions to ATMS will be coordinated to provide functionality that directly translates to an increased ability to monitor and operate the transportation system. A key component of TransLink's ability to work with new technologies is the field testbeds that have been developed as part of the research program. The available testbeds, which include the Wellborn Road Rail Corridor, Highway 6, and AVL tracking allow for the collection of a number of data types not currently supported in ATMS.

Conclusion

As the deployment of systems aimed at mitigating congestion and increasing the safety and efficiency of the transportation system continues across Texas, the use of a core system of functionality is essential. ATMS is poised to deliver a consistent architecture and capability as well as centralized support to TxDOT. This support will facilitate a truly integrated statewide strategy and capabilities for combating the transportation problems of today and tomorrow. In its role as a research partner, TransLink is committed to assisting TxDOT with the development of ATMS capabilities for both deployment and future research needs.