ITS Field Operational Test Summary

Borman Expressway Advanced Traffic Management System

FHWA Contact: Office of Traffic Management and ITS Applications, (202) 366-0372

Introduction

The Borman Expressway ATMS Field Operational Test developed and evaluated the use of Advanced Traffic Management System (ATMS) technology along a three-mile section of the Borman Expressway in northern Indiana. The Expressway is a 16-mile stretch of Interstate 80/94 connecting the Indiana Tollway to the Illinois Tollway. The highway is one of the most heavily traveled expressways in the nation, carrying approximately 140,000 vehicles per day.

This operational test is Phase I of a project to establish an ATMS for the entire Expressway. The ATMS is a coordinated system of detection, communication, and response components controlled from a central management center. The ATMS will detect traffic incidents in real-time and provide traffic managers with a variety of tools to quickly respond to the incidents. The ATMS will help traffic managers mitigate delay and congestion on the expressway.

In Phase I, the Indiana Department of Transportation (INDOT) evaluated the use and viability of a variety of above-road vehicle sensing technologies and an advanced communication system. In Phase II (the actual deployment phase), INDOT intends to finalize the design and build the ATMS.

This field operational test (Phase I of the project) intended to independently assess the performance and applicability of a small number of vehicle sensors and the communication equipment connecting the sensors in the field to the central management facility.

Project Description

The field operational test installed, tested, and evaluated advanced technologies for traffic surveillance and communication systems. The traffic surveillance components measured basic traffic parameters including volume, speed, and occupancy of the traffic lanes. The test evaluated five traffic surveillance technologies including active microwave radar, passive infrared sensors, active ultrasonic sensors, active infrared laser radar, and traditional inductive loops. The communications components used several types of spread spectrum radio equipment as well as communications processors both at the remote sites and at the Traffic Management Center (TMC).

Test partners, led by the INDOT, installed and operated these components along a three-mile length of the Borman Expressway at three representative interchanges (Cline Avenue, Kennedy Boulevard, and Burr Street).

Phase I of the project installed and connected all ATMS components. The test evaluated:

- The system architecture, assessing the suitability of the data for traffic management algorithms and assessing the flexibility of the system for future growth
- The sensor technologies, assessing their performance and reliability

- The communications system, assessing its performance and potential interference problems
- The Incident Response Vehicle equipment, assessing its suitability and assessing the human operator factors
- The institutional issues, assessing the system's capability to integrate with existing local infrastructures.

The traffic surveillance equipment included video cameras and advanced vehicle detectors as well as inductive loops. The video cameras were used to detect incidents, monitor traffic flow, and provide visual information to emergency services during incidents. The test installed and evaluated 21 above-road (on overpasses, poles, and sign bridges) electronic sensors incorporating five technologies. These technologies included two different types of active microwave radar, an active infrared laser radar, a passive infrared sensor, and an active ultrasonic sensor. The traffic surveillance system measured basic traffic parameters (volume, speed, and lane occupancy) and preprocessed the data from the sensors

The tested communication system was an innovative application of spread spectrum technology. The spread spectrum technology compressed and transmitted voice, data, and video from the traffic sensors to an INDOT subdistrict. The communication system also linked the subdistrict to the TMC and linked the incident response vehicles to the traffic surveillance system.

The project also tested the concept of managing incident response directly from the incident response vehicle (IRV) rather than centrally from the TMC. The IRV was equipped with a radio link, an on-board computer, a video camera mounted on an extendible boom, and a GPS receiver. The IRV could clear up minor incidents, call for help from other authorities (police, fire, towing, etc.), operate the changeable message signs and the traveler information system, and design and implement detours.

Results

The evaluation of the system architecture was generally positive with some important reservations. The data collected by the traffic sensors is suitable for current traffic management algorithms. The data, however, may not be entirely suitable for future traffic management algorithms. For example, the currently installed detectors cannot classify vehicles as required by the congestion management systems under the Intermodal Surface Transportation Efficiency Act (ISTEA). In addition, although the temporal resolution of the detectors is sufficient, their spatial resolution may not be sufficient for traffic flow and vehicle counts on a lane-by-lane basis. In addition, the currently installed detectors cannot provide the functionality required to track vehicles from their origins to their destinations to develop origin/destination estimates and predictions. Evaluators considered that the surveillance system is flexible enough to accommodate near-term growth. They also found that the data processing equipment is sufficient for near-term growth but will probably require processors that are more powerful over a ten-year horizon. The communication system is flexible for future growth. In general, evaluators consider the overall system architecture to be flexible enough for growth in the next ten years but after that, the technology will likely require a substantial redesign.

Most of the sensor technologies did not meet the demanding criteria of the evaluation hypotheses. None of the sensors was able to detect 95 percent of the vehicles. The loop detectors suffered from calibration problems that could be easily corrected. The best of the above-road sensors (one of the active microwave radars) undercounted vehicles by about 10 percent. The 65 mph speeds and vehicle headways of less than one second made it extremely challenging for the current technologies. Only one technology (the same active microwave radar) met the 95 percent reliability requirement.

The communication system performed well and interference was at a negligible level. The transmission error rate remained within the acceptable level of the testing hypothesis. The majority of the field tests indicated that interference was not a significant problem, although the potential for interference will likely increase in the future.

The evaluators concluded that the IRV equipment was able to serve its intended function. They concluded that the required systems to support the IRV functions either exist or can be easily implemented. It is likely, however, that dynamic detour routes would be determined and coordinated at the TMC rather than at the IRV. The test did not collect enough data to determine the ability of the IRV operators to collect the required data and make correct decisions 99.5 percent of the time. Evaluators did, however, document satisfactory IRV operator performance.

The evaluation of the institutional issues produced mixed results. Although the IRVs were equipped to transmit automated emergency information, none of the emergency response agencies and establishments were capable of receiving the information in electronic form — these agencies still use telephones and manual records. These agencies are capable of receiving information via telephone but some do not yet have fax capabilities.

The evaluators concluded that Phase I of the Borman ATMS demonstrated the feasibility of the basic ATMS design. They felt that a cost-effective Phase II ATMS could be developed using the basic Phase I architecture. Several important issues must be addressed during planning for Phase II, including communication bandwidth requirements, performance and reliability of the sensor subsystem, and inclusion of other authorities and agencies.

Legacy

The field test of the technologies was Phase I of the project. INDOT has contracted the initiation of work on Phase II. The results of Phase I are being used in Phase II of the project.

Test Partners

Federal Highway Administration

Hughes Aircraft Company, Transportation Management Systems Office

Indiana Department of Transportation

References

Krogmeier, J et al., Borman Expressway ATMS Equipment Evaluation, Final Report, August 1996