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Procurement Procedures and Specifications for Performance Measure Capable Traffic Infrastructure Data Collection Systems

Introduction

Traffic signal systems represent a substantial component of the highway transportation network in the United States. Unfortunately, most agencies struggle to meet the challenge of finding enough resources to properly update signal policies and timing plans to accommodate changing traffic demands. The traffic engineering community has been aware of system underperformance for several years, but most proposed solutions have been too expensive or not well enough understood to see widespread implementation. Incremental system upgrades can return some benefits, but the more fundamental problem that they do not address is that system performance information is not measured or reported in any meaningful or systematic manner.

This project continues the INDOT-Purdue traffic signal systems research program, bringing previous findings closer to the deployment and implementation stage by taking on the major hurdles to system wide traffic signal performance measures. The problem of establishing data communication in a geographically distributed signal system is addressed, and methodologies for systematizing, processing, and making use of the data are explored.

Findings

This project developed a collaborative pilot deployment partnership between INDOT, Purdue University, and three commercial equipment manufacturers. One outcome of the collaboration has been the creation of a standard specification for traffic signal event data, which is nearing completion.

This project led to a paper defining an architecture for a centralized traffic signal management system that can be used on a large geographic scale by both maintenance and technical services staff. This architecture leverages wireless IP communications to integrate performance measures into a database environment and a performance measure dashboard. Adoption of this architecture in the INDOT network breaks a 40-year traffic industry "tradition" that remote data collection is infeasible for widespread deployment for a highly distributed system.

In addition to this architecture, several uses of high resolution signal controller event data are explored. An extended discussion of a visualization technique called the "Purdue Coordination Diagram" is presented, which enables new methods for visualizing and assessing 24-hour corridor operations without field visits or searching through hours of recorded video. A paper explaining the educational value of this visualization tool received the 2011 Exceptional Paper Award from the Traffic Signal Systems committee of the Transportation Research Board.

Additionally, a new methodology for using data from peer intersections to estimate fundamental traffic flow characteristics is proposed. In this methodology, phase status from an upstream intersection is fused with downstream detector status to obtain link travel time and platoon dispersion characteristics. This methodology can replace otherwise extensive manual observations otherwise needed to obtain the information. Lastly, the signal event data is integrated into an optimization engine for determining cycle length, phase sequence, and offsets.

Implementation Recommendations

This project successfully developed a performance measure dashboard for use by agency technical and maintenance personnel. At the time of the conclusion of the project, INDOT traffic engineers were able to retrieve performance measures from approximately 70 traffic signals in corridors in Indianapolis, Noblesville, Merrillville, Fort Wayne, and Martinsville.

It is recommended that INDOT continue to deploy data collection enabled traffic signal controllers throughout its highway network as scheduled equipment change outs take place. The current database configuration for harvesting and storing data is expected to be able to serve the agency until such time as industry provides a product that can meet INDOT's system-wide needs.
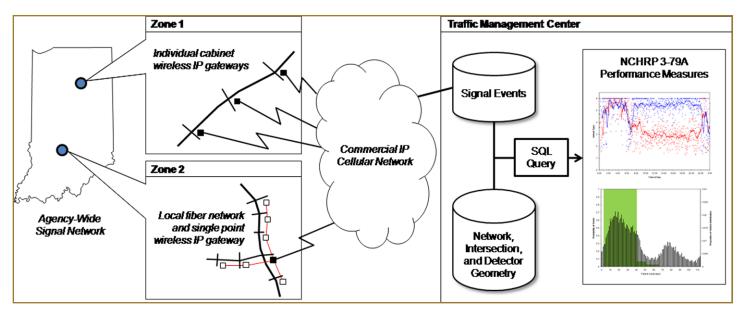
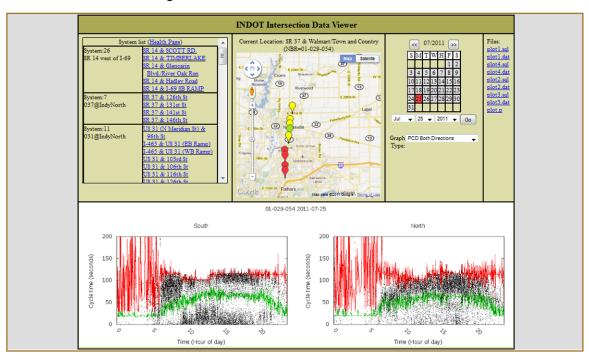**Figure 1.** Remote data collection architecture.

Figure 2. Prototype performance measure dashboard.

References

C. M. Day, Brennan, T. M., Ernst, J. M., Sturdevant, J. R., & Bullock, D. M. *Procurement Procedures and Specifications for Performance Measure Capable Traffic Infrastructure Data Collection Systems.* Publication FHWA/IN/JTRP-2011/18. Joint Transportation Research Program, Indiana Department of Transportation and Purdue University, West Lafayette, Indiana, 2011. DOI: 10.5703/1288284314642.