

**COLUMBUS TRAFFIC SIGNAL  
SYSTEM**

**SIGNAL SYSTEM  
ASSESSMENT AND  
STRATEGIC PLAN  
EXECUTIVE SUMMARY**

**NOVEMBER 2005**

**PREPARED FOR THE**

**MID-OHIO REGIONAL PLANNING  
COMMISSION**

**BY**

**HNTB CORPORATION  
DLZ OHIO, INC.  
AND  
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## **Introduction And Background**

HNTB in association with DLZ and Dynotech was retained by the Mid-Ohio Regional Planning Commission and its partners the City of Columbus (City), Franklin County Engineer (County) and the Central Ohio Transit Authority (COTA) to conduct a technical/operational assessment of the City of Columbus Computerized Traffic Signal System (CTSS) and to develop a strategic plan for that system. The CTSS is a key element of ITS deployment in central Ohio but it was implemented many years prior to the development of the *Central Ohio Regional ITS Architecture*. Providing guidance as to how the CTSS should proceed and facilitate an open architecture that could serve stakeholders in central Ohio with system connectivity and interoperability was a key goal of this project. Major investments have already been made in the CTSS over the past 20+ years with significant additional investments planned. The desired outcome of this assessment would be a strategic plan which would provide recommendations as to how to move forward with future investments for the CTSS that would maximize the use of previous investments while bringing the system into the 21<sup>st</sup> Century and meeting the regional goal of system connectivity and interoperability.

The existing CTSS was first conceived and initiated in 1970's and provided state of the art control for its time. The system allows for the monitoring and operation of more than 1,000 signalized intersections, the co-existence/operation of traffic surveillance cameras, emergency pre-emption and bus priority. The CTSS was developed prior to the creation of the term of "ITS (Intelligent Transportation Systems)" and the concept of "open architecture" for implementing and operating signal and freeway management systems. This older type signal system is now classified as a "legacy" system in today's National ITS Architecture and would not be the preferred design for current or future systems.

Rapid changes and improvements in communications technology over the last couple of years has opened new avenues to explore for: resolving the communications issues between the operating system and the other system users; centralizing communications with the numerous closed loop signal systems that Columbus, Franklin County Engineer, local communities and ODOT operate; using different types of communications medium to change or phase out the proprietary devices; minimizing the problems with the use and cost of utility poles; allowing options for bus and light rail transit priority; and developing communications between the Signal Management System and Freeway Management System.



The CTSS is a center piece for ITS within the Central Ohio region and therefore MORPC has invested approximately \$16,468,000 since 1982 to update and expand the CTSS, and plans to invest an additional \$14,900,000 in CMAQ funds over the next six years.

### **Summary of Signal System Assessment**

The basic objective of this Signal System Assessment was to identify and analyze alternative approaches to meet the existing and future traffic control system needs of Central Ohio. Due to some of the problems that had occurred with previous phases, lack of an open system architecture, and the significant future investments scheduled for the system, the partner agencies determined it was appropriate to take a step back and perform a thorough assessment as to how to proceed. While technically a legacy system, which would not have to comply with recent Federal regulations regarding compliance with the regional architecture, the partner agencies believed it would be in the best interest of the region to move towards a system that would be compliant with the regional architecture and support the regional goals for traffic management.

A Project Advisory Committee was formed to include representatives from the partner agencies as well as FHWA. The committee met every other month throughout the study to review the project status and to provide input and recommendations on key decisions.

The project was structured into four major tasks, which:

- Surveyed the member agencies
- Evaluated communication options
- Evaluated alternative traffic control systems
- Developed a system implementation plan

The efforts associated with these individual tasks are summarized in the following paragraphs.

**Task 1. Survey of Member Agencies** – The objective of this task was to determine the existing traffic signal/system infrastructure, and policies and standards for traffic signal operation of the various member agencies. The information gathered through information and data gathering, field inventories, and interviews with local agencies was used to assess the current conditions and develop a strategic plan for moving forward with the CTSS. The information obtained during this task was summarized in a Technical Memorandum.



**Task 2. Evaluation of Communication Options** – The objectives of this task were to determine the communication needs and requirements, evaluate alternative communication medium and approaches to communication design, evaluate the applicability of NTCIP, and develop recommendations and a plan for addressing the communications needs for the signal system and regional integration. After gaining information on the existing communication infrastructure a series of recommendations were presented to the Project Advisory Committee as to how communications for the CTSS should proceed. To illustrate how the recommendations could be implemented, a conceptual design for the Phase 11 expansion of the CTSS was prepared. The results of this task were compiled into a Technical Memorandum.

**Task 3. Evaluation of Traffic Signal Control Systems** – The objective of this task was to help the Project Advisory Committee select a signal system and architecture that helps the region meet its goals for an open architecture and provide system connectivity and interoperability. Working with the Project Advisory Committee, a desired set of functional requirements was developed and then submitted to several traffic signal system software providers to determine if the requirements were readily available. Based on feedback from the vendors, a final set of functional requirements were developed and documented in a Technical Memorandum. Initially five candidate alternatives were presented. Following the evaluation of communication alternatives and development of system functional requirements, these alternatives were further condensed into three alternatives including the existing system configuration.

For developing cost estimates of the candidate systems assumptions were made regarding the size of the future CTSS.

Element	Scenario	
	Existing	To be Added
Signals	550	450
Cameras	45	36
Agencies participating in data exchange		12

For continuing with the existing system design concept cost estimates to expand the system to 1,000 intersections were based on extrapolating the cost that had been estimated for the Phase 11 expansion to another 450 intersections resulted in a total estimated cost for the existing system of \$20,191,594.



The cost for construction of the two remaining alternatives would be same since the only difference was in the way the systems would be operated. Table ES-1 shows the one time capital costs for each of the major cost categories.

**Table ES-1  
Estimated Capital Cost**

<b>Program Element</b>	<b>Cost</b>
Multi-Purpose Communications Backbone	\$ 2,817,786
Signal System Modernization	\$ 990,020
Signal System Expansion (450 Intersections)	\$ 7,646,707
CCTV System Expansion (36 locations)	\$ 1,686,525
Interagency Data Exchange	\$ 1,373,520
City-owned Coaxial Cable Replacement	\$ 14,533,405
Contingency	\$ 5,809,593
<b>Total</b>	<b>\$ 34,857,556</b>

A utility cost evaluation was performed of the candidate systems and while the cost was the same for both candidates, the Distributed Regional Control Capability alternative was determined to provide the higher utility/cost ratio. It is recommended that the partner agencies move forward with this recommended system and take the next steps to develop the level of cooperation and operational policies and agreements that will allow this system to achieve its full potential. Recognizing that these institutional hurdles are more time consuming and can create greater roadblocks than technological barriers the recommended system is configured to allow the CTSS to move forward from a hardware and software implementation standpoint while the institutional arrangements are worked out.

**Task 4. System Implementation Plan** – The analysis conducted as part of the signal system assessment has been captured in a system implementation plan which will guide the future expenditure of funds for the CTSS and is documented in the final report. The implementation plan addresses/contains:

- The requirements for making the system more compliant with the Central Ohio Regional ITS Architecture.
- The details of phasing/staging future expansion of the CTSS and the integration with the existing system and legacy technologies.

- A fiscal year-by-year estimate of costs to carry out the plan.
- A schedule of interim milestones, project durations, and key activities necessary to carry out the plan.
- An analysis of existing staff, future staffing requirements, and a Staffing Plan.
- An analysis of existing member agency roles and responsibilities, and a proposed concept of operations.

On February 18, 2005 MORPC submitted a draft version of the Fiscal Year 2006-2009 Transportation Improvement Program (TIP) to ODOT for review and which was subsequently approved. Included in the TIP are four projects for advancing the CTSS. Based on the cost estimate for the recommended system presented above, the total cost to upgrade and expand the CTSS is greater than the funds currently programmed by more than \$8.5 million. Revisions to the TIP will need to be made and new funding secured to cover the shortfall. An implementation plan has been prepared that lays out a logical course of design and construction utilizing the available funding and assumes that an additional \$8.5 million can be secured to fully fund the recommendations contained in this report.

### **Summary of Recommendations**

This plan looked at dividing the overall CTSS program into four phases of implementation that would be similar in size to those outlined in the TIP and would provide the greatest benefits towards achieving the goals of an open system architecture that will support system connectivity and interoperability. A summary of the capital cost associated with each phase is presented in Table ES-2. Detailed estimates for each phase as well as the overall program are presented in the full report.

The costs contained in these estimates are for CTSS related elements only. Additional cost associated with ADA enhancements at intersections that are unrelated to the CTSS improvement, but will be required if any work is done at an intersection are not included in the cost estimates included in this assessment.



**Table ES-2**  
**CTSS Capital Costs by Phase (\$1,000)**

Cost Category	Phase A	Phase B	Phase C	Phase D	Total Program
Detailed Design	\$470	\$1,516	\$684	\$372	<b>\$3,043</b>
Construction	\$3,809	\$12,265	\$5,534	\$3,009	<b>\$24,617</b>
CE&I	\$377	\$1,213	\$547	\$297	<b>\$2,434</b>
Const. Contingency	\$737	\$2,374	\$1,071	\$582	<b>\$4,764</b>
<b>Total</b>	<b>\$5,393</b>	<b>\$17,368</b>	<b>\$7,836</b>	<b>\$4,260</b>	<b>\$34,858</b>

Based on the funding by fiscal years that was included in the TIP, a preliminary implementation schedule was developed for the four phases of implementation that would begin in 2006 and conclude in 2013.

An assessment of the staffing for operations and maintenance of the existing CTSS as well as the expanded system was performed and recommendations presented. Table ES-3 presents a summation of the existing and recommended staff levels for both traffic signal operations and maintenance. In addition to the increased staff levels that have been recommended, the upgraded system will require new skill sets and training for existing maintenance personnel.

**Table ES-3**  
**Existing and Recommended Staffing Levels for Traffic Signal Operations and Maintenance**

Staff Category	Operations		Maintenance	
	Existing	Recommended	Existing	Recommended
Management	2.0	3.0	2	2
Staff	6.5	9.5	13.0	17
Data Collector	0	3.0		
<b>Total</b>	<b>8.5</b>	<b>15.5</b>	<b>15.0</b>	<b>19</b>



## **Next Steps**

This assessment has provided the partner agencies with recommendations and a course of action for how to move forward with future expenditures for the CTSS. The recommendations will permit a phased implementation that will support the regional goals of system connectivity and interoperability and build upon the investments that have already been made. Because the recommendations contained in this report rely upon multiple agencies participating together to achieve the overall program goals, a critical first step will be to reach consensus on the funding of the shared resources that will be utilized in the CTSS program.

The second major step directly related to the multiple agency arrangement is to develop and approve a memorandum of understanding (MOU) regarding the maintenance responsibilities and cost sharing for the operation and maintenance of the shared facilities, primarily the communications backbone and interagency data exchange network.

Once the institutional agreements regarding funding and operations and maintenance have been resolved, the next step to advance the CTSS program will be to develop an RFP and advertise for detailed system design services.

To achieve the full benefits of a computerized traffic signal system, optimized timing plans need to be developed, implemented, observed in the field and fine tuned. This is especially important in the areas where signals previously were uncoordinated and will achieve that capability as the system is expanded.