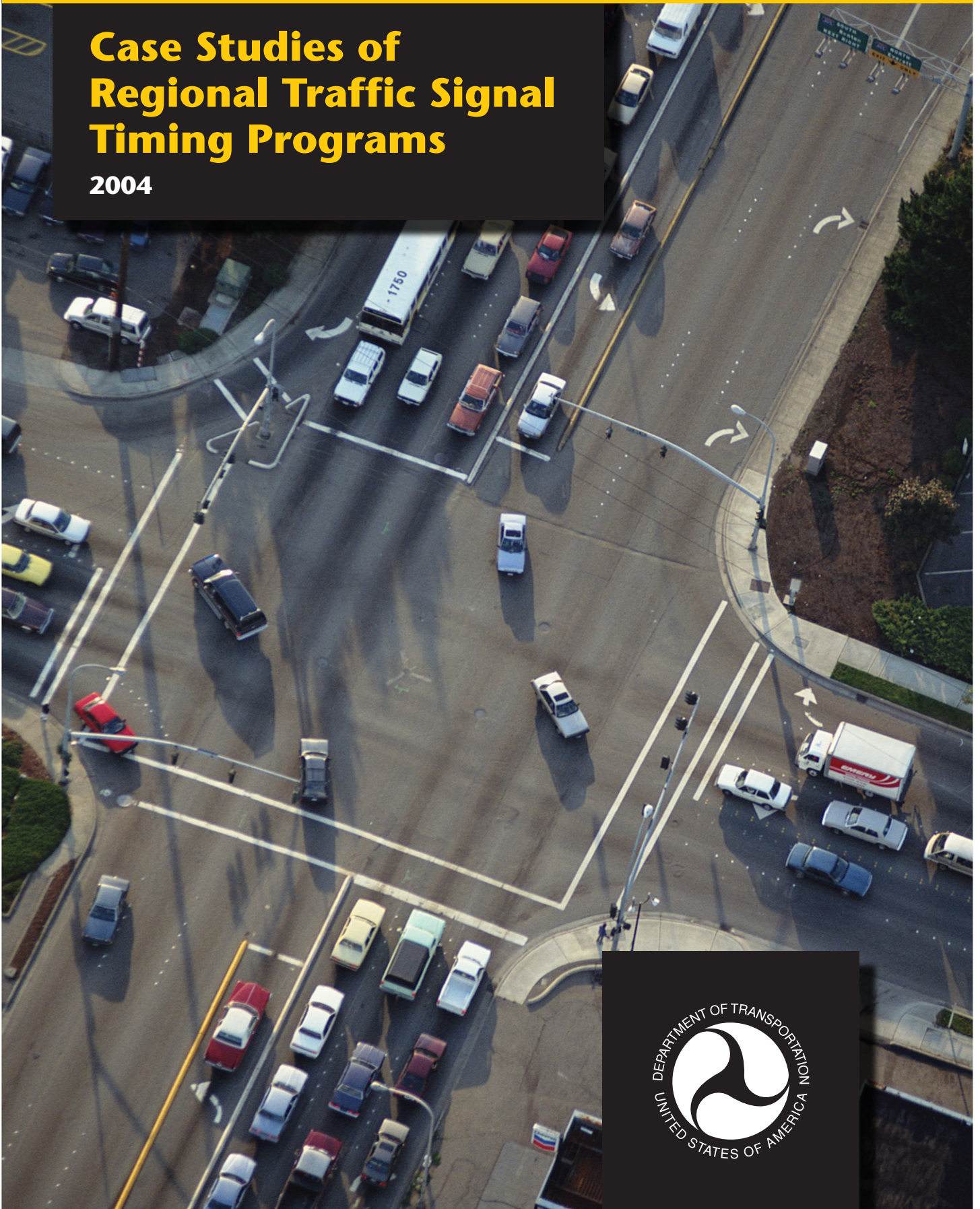


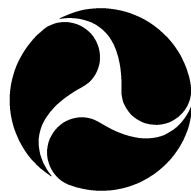
Case Studies of Regional Traffic Signal Timing Programs

2004



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Case Studies of Regional Traffic Signal Timing Programs



**U.S. Department of Transportation
Federal Highway Administration
Office of Transportation Management**

2004

1. Report No. FHWA-HOP-05-002	2. Government Accession No.	3. Recipient's Catalog No.	
1. Title and Subtitle Case Studies of Regional Traffic Signal Timing Programs		2. Report Date October 2004	
4. Author(s) Kathy Falk and Eric Perry		3. Performing Organization Code FHWA	
9. Performing Organization Name and Address Science Applications International Corporation 301 Laboratory Road Oak Ridge, TN 37831		8. Performing Organization Report No.	
12. Sponsorship Agency Name and Address Federal Highway Administration Department of Transportation 400 Seventh Street, S.W. Washington, DC 20590		10. Work Unit No. (TRAIS)	
15. Supplementary Notes Contact Person – Pamela Crenshaw		11. Contract or Grant No. DTFH61-901-C-00180	
16. Abstract As development in urban and suburban areas throughout the country continues to increase, the resulting traffic often leads to increased delays and congestion. Building on the Cross-Jurisdictional Signal Coordination Case Studies, this report includes five case studies from around the country that showcase how agencies within various sized regions work together to achieve traffic signal coordination across multiple agency boundaries within a region.		13. Type of Report and Period Covered Final Report	
17. Key Words Regional traffic signal timing		14. Sponsoring Agency Code FHWA	
18. Distribution Statement No restrictions. This document is available to the public from National Technical Information Service Springfield, Virginia 22161		15. Supplementary Notes Contact Person – Pamela Crenshaw	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 18	22. Price

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Acronyms

CMAQ	Congestion Mitigation/Air Quality
DIA	Denver International Airport
DOT	Department of Transportation
DRCOG	Denver Regional Council of Government
FHWA	Federal Highway Administration
MDOT	Michigan Department of Transportation
MoDOT	Missouri Department of Transportation
NCRTPB	National Capitol Region Transportation Planning Board
NCTCOG	North Central Texas Council of Governments
RCOC	Road Commission for Oakland County
SEMCOG	Southeast Michigan Council of Governments
TMC	Transportation Management Center
TSSIP	Traffic Signal System Improvement Program
TxDOT	Texas Department of Transportation

Executive Summary

This report includes five case studies that demonstrate how regions can work together to achieve traffic signal coordination.

As development in urban and suburban areas throughout the country continues to increase, the resulting traffic often leads to increased delays and congestion. An increasing number of transportation agencies in multi-jurisdictional regions throughout the United States have discovered that regional traffic signal timing initiatives can provide a cost-effective means of improving traffic flow. These regional initiatives focus on improving traffic signal timing within and between the jurisdictions of various traffic signal operating agencies to improve the flow of traffic on major roadways, especially those that extend across jurisdictional boundaries.

Building on the Cross-Jurisdictional Signal Coordination Case Studies (FHWA, February 2002), this report includes five case studies from around the country that showcase how agencies (state departments of transportation, metropolitan planning organizations, city and county traffic engineering departments, and other transportation organizations) within various sized regions work together to achieve traffic signal coordination across multiple agency boundaries within a region. The intent of highlighting these case studies is to share the lessons learned from these programs with other agencies so that the lessons learned can be used by others as a model, guide, or framework for establishing successful programs in other regions in the country. The five case study locations are Dallas, Texas; Washington, DC; Denver, Colorado; Oakland County, Michigan; and Springfield, Missouri.

The criteria for selecting the case study locations included geographic distribution, size of region, number of agencies involved within the region, and strength of experience with regional coordination. Once potential locations were identified, an Interview Guide was sent to at least one person within each region. The guide included with approximately 20 questions related to regional signal timing coordination. A telephone interview was then conducted with each respondent to assist in completing the Interview Guide. Most of the questions were targeted towards understanding the number of agencies involved in each region, how the regional coordination began and how it continues today, and how the metropolitan planning organizations are involved. A few questions were related to technical aspects of the various systems.

The results of these five case studies show that regional traffic signal timing coordination takes many forms and involves anywhere from just two or three agencies to many more. In some regions, there are formal committees and agreements among agencies, while in others the agreements are informal. Generally, the type of traffic signal equipment used by neighboring jurisdictions does not create stumbling blocks to coordination, and the engineers and technicians operating the traffic signal systems all work together toward common goals. ♦

Introduction

Optimizing traffic signal timing can reduce congestion, travel time, collisions, fuel consumption, and air pollution.

An increasing number of transportation agencies in multi-jurisdictional regions throughout the United States have discovered that regional traffic signal timing initiatives can provide a cost-effective means of improving traffic flow. These regional initiatives focus on improving traffic signal timing within and between the jurisdictions of various traffic signal operating agencies to improve the flow of traffic on major roadways, especially those that extend across jurisdictional boundaries.

Regional transportation agencies in a number of regions throughout the United States have begun to recognize the benefits of developing and maintaining up-to-date traffic signal coordination plans. Optimizing the traffic signal timing, which reduces the stops and delays occurring at signalized intersections throughout the region, can result in 10- to 20-percent reductions in travel times and can save significant amounts of energy by allowing vehicles to move at the most efficient operating speeds.

In 1994, the Government Accounting Office issued a report to the House of Representatives' Committee on Energy and Commerce that noted that the benefits of coordinated traffic signal systems were not being fully realized. The report concluded that upgrading or retiming existing traffic signal systems could provide significant user benefits by reducing congestion, travel time, collisions, fuel consumption, and air pollution. However, the report also acknowledged that one of the hurdles facing many traffic signal operating agencies is having sufficient manpower and computer resources to develop optimized traffic signal timing.

In recognition of the limited resources available, a number of regional and statewide transportation agencies have developed programs to provide the technical support and resources needed by traffic signal operating agencies to develop and implement traffic signal retiming in their regions.



Traffic congestion can be reduced with regional signal timing initiatives.

Unfortunately, the various lessons learned from these regional experiences are often not communicated to transportation professionals interested in solving similar problems in their regions. In the Cross-Jurisdictional Signal Coordination Case Studies (FHWA, February 2002), the Federal Highway Administration's (FHWA's) Office of Transportation Management examined the problems that were overcome and the challenges that were met by successful traffic signal coordination programs between two adjacent jurisdictions. But the greatest efficiencies of a cross-jurisdictional program are achieved when coordination of traffic signal timing is accomplished among three or more agencies on a regional level.

The Office of Transportation Management wants to develop a model and framework grounded in the successes and lessons learned from the various regional traffic signal timing programs. This model could then be used as a guide for other traffic signal operating agencies and their transportation partners in establishing successful forward-looking traffic signal coordination programs in their regions. ♦

Case Studies

Case studies of five regions were conducted: Dallas, Texas; Washington, DC; Denver, Colorado, Oakland County, Michigan; and Springfield, Missouri.

Questionnaires were distributed to and interviews were conducted with transportation officials in each of five different regions of the United States where regional traffic signal timing programs have been implemented. The results of these five case studies are described in this section of the report. The case studies are arranged in descending order based upon the population of the region. For each region, the material presented includes the region's organizational approach and history, the operational characteristics of their traffic signal systems, the support for their programs, and the lessons learned from their experiences.

Dallas, Texas

The Dallas region has a population of approximately 5.8 million. Agencies involved in regional traffic signal timing include Dallas County and the cities of Garland, Dallas, Plano, Richardson, Addison, Farmers Branch, Duncanville, and Carrollton.

The Texas Department of Transportation (TxDOT) does not operate any traffic signals within cities that have populations larger than 50,000. They have responsibility for funding the installation and capital upgrades of traffic signals that are on the state highway system, but each city operates and maintains all traffic signals on the state highway system through a maintenance agreement with TxDOT. Therefore, with respect to operational issues, such as regional coordination, TxDOT is not involved.

Organizational Approach and History

The original champion for cross-jurisdictional traffic signal coordination in the Dallas region was the Assistant Director of Transportation for the City of Dallas during the 1980s and early 1990s. He foresaw the benefits of providing seamless traffic signal coordination across the many city limit boundaries in the region, and led the effort to convince Dallas County to include the North Dallas County Signalization Project in its 1984 bond program. The voters subsequently approved the project, which included 224 signalized intersections in six contiguous cities – Dallas, Garland, Richardson, Addison, Farmers Branch, and Carrollton. Each of the six cities and Dallas County entered into an inter-local agreement that committed each of them to work together to achieve seamless traffic signal coordination. The agreement also established a Steering Committee, with voting membership that included a staff

member from each city. A consulting firm was selected to develop the traffic signal timing plans and to design the traffic signal equipment upgrades that were necessary for each city to be able to implement the coordinated traffic signal timing on a time-of-day, day-of-week basis. This project paid for controllers and loop detectors. The expansion of computer control to all signals citywide was paid for by Congestion Mitigation/Air Quality (CMAQ), and city, county, and state bonds. The other five cities each implemented a closed-loop traffic signal system. Each system was physically separate, but all cities agreed to keep their system clocks synchronized to a common time reference (the WWV time broadcast) so that coordination across jurisdictional boundaries could be accomplished.



Nine agencies cooperate in regional signal timing initiatives in the Dallas area.

In the early 1990s, after all of the project's improvements had been implemented, the North Dallas County Signalization Project's Steering Committee was dismantled. However, the traffic signal timing staffs of the various cities have continued to cooperate on traffic signal timing issues and most of that project's cross-jurisdictional coordination continues to exist to some extent.

In the mid-1990s, the various traffic signal operating agencies in Dallas County decided that all CMAQ projects would be administered by the county. That program included several traffic signal timing projects, and required that, where appropriate and practical, coordination be achieved across city boundaries.

The next formal effort to achieve cross-jurisdictional traffic signal coordination was the North Central Texas Council of Governments' (NCTCOG) Thoroughfare Assessment Program. Its primary champion was the NCTCOG's Director of Transportation. The project was CMAQ-funded and was a key element of the Dallas region's air quality attainment efforts. During this time, the project was approved through the region's technical advisory committee (called the Surface Transportation Technical Committee) and the policy advisory committee (called the Regional Transportation Council).

There are no plans at this time for the NCTCOG or any other regional agency to assume a role in traffic signal operation or even in traffic signal operational decisions. Each city will retain responsibility for the operation and timing of the traffic signals within its jurisdiction. There may be formal agreements to require cooperation on traffic signal timing decisions, but those decisions will be made by the staffs of the affected cities. City traffic engineers usually coordinate their independent traffic signal control systems directly with each other without oversight by a committee or a COG.

The NCTCOG will continue its participation in regional signal timing through continued funding and possibly managing other CMAQ projects to optimize signal timing on arterial street networks in the region.

Operational Characteristics

With one exception, all cross-jurisdictional traffic signal coordination efforts prior to 2002 had been informal. The traffic signal operations staffs of adjacent cities would agree on common cycle lengths and then work together to implement timing plans that achieve progression across the mutual boundaries. The cities of Dallas, Richardson, Garland, Farmers Branch, Carrollton, and Plano all have experienced traffic signal operations engineers on their staffs and there is "give and take" in determining appropriate cycle lengths. The Cities of Addison and Duncanville generally rely on consultants to do their traffic signal timing, and in those cases the City of Dallas is the lead in the timing decisions.

None of the traffic signal control systems in the Dallas region are physically connected to the traffic signal control system in an adjacent city. The central clocks of almost all of the systems are synchronized to WWV. In some cases, this resynchronization is automated, but in other cases a staff member must manually resynchronize the central clock. Since each system is independent and not physically connected to another system, there are no issues relative to compatibility of communications systems or data formats.

The City of Dallas operates a central computer system that monitors and controls all 1,284 traffic signals citywide. The center is manned from 6:30 AM to 6:30 PM on weekdays and at other times during special events (e.g., American Airlines Center, the Cotton Bowl, and the State Fair).

With the possible exception of a few control sections in the City of Irving, none of the traffic signal control systems in the Dallas region select timing plans on a traffic responsive basis.

Support for the Program

Over the last 20 years, a variety of funding sources have been used for cross-jurisdictional traffic signal coordination projects. These sources have included city operating budgets, city bond funds, the 1984 Dallas County Bond program, state funds, oil overcharge funds (which in Texas was called the Traffic Light Synchronization Program), CMAQ funds, and other types of federal funds.

Lessons to Share

In high-growth areas, signal timing needs to be updated every three to five years. Based on past experience in the Dallas region, it is likely that funding will be needed from a variety of sources.

If NCTCOG's current thoroughfare assessment program is successful, a continuation of that program may be one such source. Also, if successful, that program may serve as a model for other regions.

Washington, DC

The Washington metropolitan area, which has a population of approximately 4.2 million, serves as the nation's capital and is one of the most congested urban areas in the country. Approximately 20 transportation agencies are responsible for traffic signal operation in the region, including the District of Columbia, 2 states (Maryland and Virginia), 7 counties (Montgomery, Prince Georges, Frederick, Arlington, Fairfax, Loudoun, and Prince William), and 11 cities (Bowie, College Park, Gaithersburg, Greenbelt, Takoma Park, Rockville, Alexandria, Fairfax, Falls Church, Manassas, and Manassas Park). Because of the recurring traffic congestion, the various transportation agencies understand the importance of cooperating with each other to coordinate traffic signals across the many jurisdictional boundaries within the region.



The Washington, DC, area is one of the most congested urban areas in the country, with approximately 20 agencies responsible for traffic signal operation.

Organizational Approach and History

While regional coordination with regards to traffic signal operation was not originally part of the planning process, the traffic engineers within the Washington region understood that it was essential to work through the National Capitol Region Transportation Planning Board (NC RTPB) at the Metropolitan Washington Council of Governments on traffic signal coordination efforts. Additionally, it was recognized that regional cooperation through the auspices of the NC RTPB was the best avenue of securing funding for the region's transportation projects. The Washington region was fortunate to have several champions, including representatives from the Virginia DOT and the University of Maryland, who took the lead in advocating regional cooperation and in establishing working groups and subcommittees under the NC RTPB. As a result, the Traffic Signal Subcommittee was organized to coordinate the efforts between the various transportation agencies. In addition, existing interagency relationships played a key role in the formulation and coordination of the traffic signal coordination efforts. Those interagency relationships have grown to the extent that the agencies now work together without direct involvement from the NC RTPB.

Agreements between the various agencies had been informal until 2002, when a signed agreement was executed to improve air quality in the region.

Each transportation agency uses monies from its own budget for funding traffic signal timing efforts, including coordination with neighboring jurisdictions throughout the region. An example of this is the work that is currently being done between the District of Columbia Department of Transportation, the Maryland State Highway Administration, and the Montgomery County Department of Public Works and Transportation. Traffic signal coordination efforts are proceeding incrementally, with the first phase consisting of coordination along three different corridors, each of which involves all three agencies. Efforts during the second phase will expand the project to include a significant number of additional corridors as part of the regional agreement to improve air quality.

Operational Characteristics

There are no physical connections between the various traffic signal systems in the Washington region. Synchronization across jurisdictional boundaries is provided by using the same cycle length and appropriate offsets in each jurisdiction, with the reference points of their cycle lengths based on a common time-of-day reference. Adjacent agencies in the region generally coordinate their traffic signal timing plans throughout all times of day that coordination is provided. The jurisdictions use input from the public to determine if there are problems

with the synchronization between systems. The neighboring jurisdictions then alert each other to correct any unsynchronized traffic signals. In addition, the agencies communicate with each other regarding any major traffic signal timing changes along the coordinated corridors.

In some cases, adjoining agencies have worked together to develop incident management traffic signal timing plans that can be used in the event of an unexpected emergency. These special timing plans can be automatically downloaded to the affected corridors to handle the unusual traffic characteristics associated with these events.

Although the agencies have not calculated specific measures of effectiveness for determining the success of their interagency coordination, each agency uses the same traffic signal timing software to model and optimize their systems. Accordingly, measures of effectiveness such as travel speed, level of service, and emissions could be obtained, if desired.

Support for the Program

The NCRTPB at the Metropolitan Washington Council of Governments has provided public, political, and program support for the various interagency traffic signal timing efforts that have taken place.

Lessons to Share

Among the lessons learned from the experience in the Washington region were the following:

- It is very helpful for the local MPO to provide a forum for traffic signal operating agencies to discuss and share common interests and problems.
- It is important that each traffic signal operating agency has an equal voice such that there is no dominating agency.
- All agreements should come from the traffic signal operating agencies, and executing the agreements should be voluntary.
- Begin with easier corridors that make sense and that do not require substantial efforts from staff or substantial funding. Celebrate successes before proceeding to the more difficult corridors.

Denver, Colorado

The Denver region, with a population of approximately 2.5 million, is served by the Denver Regional Council of Governments (DRCOG). There are 28 local agencies (cities and counties) and 3 Colorado Department of Transportation regions that operate traffic signals in the Denver metropolitan area.

Organizational Approach and History

In 1989, the region's traffic engineers concluded that there was a need for cross-jurisdictional traffic signal timing and coordination, and they asked the DRCOG to develop a program for the area. The DRCOG was chosen as the entity to coordinate a program because of its function as a regional agency and its broad capabilities,



The DRCOG coordinates Denver's cross-jurisdictional traffic signal timing and coordination but does not operate any of the traffic signals, a unique arrangement.

not necessarily because of a specific champion within the organization. The program was started with an energy grant, and in the first few years, the program funded a traffic engineer to conduct traffic signal timing and coordination efforts. The program did not include funds for capital improvements. Although the program's successes were modest, they served as an excellent proof of the concept. With the adoption of the Intermodal Surface Transportation Efficiency Act, the Denver region secured the minimum amount of CMAQ funds. Because the members of the DRCOG's Board of Directors were sufficiently impressed with the concept of cross-jurisdictional traffic signal timing and coordination, as demonstrated by the initial program, the regional Traffic Signal System Improvement Program (TSSIP) was awarded CMAQ funding beginning in 1993 (\$1 million per year at that time). Since then, the funding for the program has grown to more than \$3 million per year. The expenditure of funds in this program is directed by the TSSIP document. The TSSIP is updated every three to four years, and approval from the DRCOG's Board of Directors is obtained for the activities that are included in the program. A working group consisting of representatives from the various traffic signal operating agencies assists in the updating process by identifying and verifying current conditions, identifying critical needs, suggesting evaluation criteria, and recommending improvement priorities.

Traffic signal operating agencies in the region maintain and operate the traffic signals, maintain the traffic signal timing, and review, approve, and fine-tune the traffic signal timing plans. The DRCOG identifies corridors that need retiming, develops and fine-tunes traffic signal timing plans, and documents improvements. It is unique for a council of

governments that does not operate any of the traffic signals to perform traffic signal timing, but this arrangement works well in the Denver region. The traffic signal operating agencies in the Denver area recognized that there was a need for a neutral regional center of traffic signal timing expertise, while at the same time recognizing their own responsibilities to operate and maintain the traffic signals.

Operational Characteristics

There are no direct physical connections between the various traffic signal control systems within the region. Thus, hardware compatibility is not an issue. Coordination is achieved by synchronizing the background clocks of the various systems to a common base, which is WWV time, and then developing traffic signal timing plans with common cycle lengths. Physically connecting adjacent systems is currently being examined in some test bed situations. For the most part, coordinated timing plans are operated during the AM peak, off-peak, and PM peak periods on weekdays. Some systems include two additional off-peak plans (a mid-day plan and a shorter cycle length off-peak plan), and others include special weekend plans. In the first ten years of the program, all of the timing plans were selected based on time-of-day, day-of-week schedules. Some of the agencies are currently experimenting with traffic responsive timing plan selection. The most recent TSSIP includes traffic responsive timing plan selection as an accepted strategy for appropriate situations.

The majority of the funding in the TSSIP is directed to capital improvements – implementing and upgrading traffic signal systems. Every TSSIP capital improvement project requires that affected traffic signals be retimed. Each of the traffic signal operating agencies provides input on an annual basis regarding their traffic signal retiming needs. Although the DRCOG would like to retime the major corridors every three to five years, it is not economically possible with the current funding levels.

To date, no incident management signal timing plans have been implemented within the region. However, as part of the TSSIP and working in conjunction with the Colorado DOT, the Denver International Airport (DIA), and the cities of Aurora and Denver, DRCOG developed an incident management traffic signal timing plan for the freeways near the airport. The data for the DIA incident management traffic signal timing plan were loaded into the databases of the Aurora and Denver traffic signal control systems so that this plan could be tested later this year.

The DRCOG prepares and distributes technical briefs or reports that document the operational benefits for each of its projects in terms of decreased travel time, reduced stopped delay, increased average speed,

reduced fuel consumption, and reduced emissions. DRCOG also maintains all of the program data.

Support for the Program

The traffic signal operating agencies worked together to obtain political and institutional support for the regional TSSIP after realizing that such a coordinated approach provided a better opportunity for each agency to receive funding for capital improvements and support for timing efforts. The program is well-publicized and received favorable publicity after completion of some of its larger projects, such as those in Denver and Parker. Every project is documented with a technical brief or report, which is subsequently distributed to traffic engineers and local officials in the Denver region. Interagency cooperation has never been a problem, as the various agencies realize that they are working towards a common objective. Public support for the program was gained because the citizens in the region had the intuitive sense that “somebody” should look at traffic signal timing from a regional perspective.

In 1989, the TSSIP started without any funds for equipment upgrades. At that time, the region was in need of equipment upgrades. After funds were secured for capital improvements and a fair, sound, reasonable, stakeholder-involved process for allocating the majority of the funds was initiated, the technical community embraced the program 100 percent. After making a small portion of those funds eligible to be allocated for “miscellaneous equipment” so that every agency has a chance to obtain funding for some kind of improvement, even the few reluctant policy decision makers came on board. The DRCOG’s traffic operations staff no longer promotes increased funding; instead, the stakeholders now take on that role. Since the TSSIP funds local government and Colorado DOT systems improvements, support for the program is widespread. The TSSIP is moving into transit priority, so even the transit agency is supportive.

Lessons to Share

Implementing and upgrading traffic signal systems is vital to operating effective multi-jurisdictional traffic signal timing. Securing funding for such capital improvements and assuring that all agencies have an opportunity to affect how the funds are spent is a key to success. When the benefits of the program are demonstrated to the stakeholders, they become advocates and move the program forward.

Oakland County, Michigan

The Oakland County region has a population of approximately 1.2 million. There are many agencies involved in regional traffic signal timing in the area, including the Counties of Oakland, Wayne, and Macomb, the Cities of Royal Oak, Pontiac, and Ferndale, the Michigan DOT (MDOT), the Southeast Michigan Council of Governments (SEMCOG), and the Traffic Improvement Association. In this region, SEMCOG distributes funding to the various traffic signal operating agencies that are responsible for developing and implementing the traffic signal timing and coordination plans.

Organizational Approach and History

What began as a citywide mobility study for the City of Farmington Hills eventually spread to the rest of Oakland County and the Southeast Michigan region. In the spring of 1998, the City of Farmington Hills completed a citywide mobility study. One of the findings of the study was that motorists have to stop at one out of every two signals through which they travel. As a result, one of the conclusions was that traffic signal retiming and system progression have a major benefit to improved travel and congestion reduction. In 1999, the city applied for and was awarded CMAQ funding to retime approximately 100 signals in the city.

At approximately the same time, a parallel effort was underway with the first meeting of the Oakland County Traffic Signal Summit in August 1999 to discuss traffic signal timing and progression as it relates to development growth in the region. This summit included MDOT, the Road Commission for Oakland County (RCOC), cities, consultants, universities, and the Traffic Improvement Association. The concern was that traffic signal retiming had not been performed on a regular basis (some traffic signals had not been retimed in more than 10 years).



The regional traffic signal timing program in Oakland County continues to expand over time to include more corridors.

Subcommittees were formed that dealt with signal progression, timing, and actuation; timely installation of signals; and all red intervals and red light violations. As a

result of the traffic signal summit, and in order to address concerns about traffic congestion and travel delays, the RCOC, MDOT, and all of the local communities within Oakland County joined forces and developed a project to optimize the traffic signal system across the entire county. The goal was to retime approximately 1,000 pretimed and semi-actuated traffic signals within three years. Those signals that operate traffic responsive (with the Sydney Coordinated Adaptive Traffic System) are not included in the signal retiming effort, since they operate in a manner that automatically changes the traffic signal timing based on real-time traffic flow. In a move to expand the signal summit, the name was changed to the Michigan Signal Summit, and new subcommittees were developed to include short-term and hardware issues, long-term vision, retiming status and data warehousing, and evaluation.

SEMCOG became involved and continues its involvement to address funding (using CMAQ monies). This involvement has grown to include integrating this county effort across the region and into a long-range plan for traffic signal operation and maintenance. SEMCOG also assists with data collection and analysis. As the program continues to expand, SEMCOG will also perform some corridor prioritization to choose the most deficient corridors while also keeping track of which signals had already been retimed, and when.

Operational Characteristics

The various traffic signal control systems in the Oakland County region operate independently of each other. Coordination is maintained through three time-of-day plans (AM peak, PM peak, and off-peak) and each system uses the atomic clock (WWV) to maintain synchronization with each other. Each operating agency relies on information from the system itself, as well as public, police, and staff observations to determine if the traffic signals are maintaining synchronization. If synchronization is lost, personnel from the appropriate agency are dispatched to the problem locations to perform repairs. Since all of the traffic signals operate on fixed time, there is no need for a communications link to tie the traffic signal systems together. Also, except for a few arterials, there is no mechanism for operating incident management response systems.

A report is prepared to document each traffic signal timing plan change. These reports contain information comparing before-and-after conditions, such as travel times and accidents.

Although agreements between adjacent agencies tend to be informal, the role of each agency is usually well-defined.

Support for the Program

Funding for traffic signal timing and coordination in the Oakland County region is 100 percent from CMAQ funds. Accordingly, it was easy to gain political support. SEMCOG is also proposing to use CMAQ funds for signal retiming in the 2030 Regional Transportation Plan. The public supported the idea of reducing travel time and improving air quality.

Lessons to Share

Among the lessons learned from the Oakland County, Michigan region were the following:

- All traffic signal operating agencies need to come to an agreement on objectives and constraints. Areas where adjacent traffic signal operating agencies might have conflicts regarding their responsibilities need to be identified and resolved at the beginning of the process.
- Those involved need to all think about a future vision.
- The lead entity should not try to take charge, but rather should offer to help the other agencies through the process.
- Commitments to provide appropriate staffing at multiple agencies are required to keep signal retiming coordinated and on schedule.
- Retiming and signal hardware modernization both need to be instituted on a regular basis.

Springfield, Missouri

The Springfield region, which has a population of approximately 300,000, encompasses the City of Springfield and Greene County. The transportation agencies involved in regional traffic signal timing include the Missouri Department of Transportation (MoDOT), the City of Springfield, and Greene County.

Organizational Approach and History

A 1982 citywide traffic signal system master plan developed by the City's Traffic Engineering Department provided the first recommendation to bring both the MoDOT's and City of Springfield's traffic signals into one system. A City of Springfield Capital Improvements Sales Tax program was passed in 1989, which funded interconnection of 90 traffic signals and provided the first cross-jurisdictional coordination between MoDOT's and the City's closed-loop systems. MoDOT and the city agreed on common standards for hardware and software and began operating the joint traffic signal system in 1992. The two agencies established a shared Transportation

Management Center (TMC) in 1998, thus allowing the two agencies to operate the system together under one roof. Communication expansions continue to be made to bring additional traffic signals into the shared coordinated system.



The MPO in this area is fairly new and has not yet been involved in traffic signal timing within the region. There are only three traffic signals under Greene County's jurisdiction and the City of Springfield maintains and operates the three traffic signals for them. As a result, the only two agencies currently operating traffic signals in this region are MoDOT and the City of Springfield. These two agencies already communicate effectively with each other without direct involvement from the MPO.

In the Springfield region, MoDOT and the City of Springfield cooperate in signal timing.

Operational Characteristics

The City and MoDOT work together to establish common cycle lengths for the major arterial grid network within Springfield to ensure coordination of City and MoDOT roadways that intersect at many locations. The two agencies established the TMC, which houses the central system database and communications processor used by both agencies. While each agency is responsible for its own traffic signals (with the exception of Greene County, whose traffic signals are maintained and operated by the City of Springfield), engineers from both MoDOT and the City of Springfield work side-by-side to develop traffic signal timing plans, and each agency is notified of any changes made over time. In rare instances, temporary changes are made to traffic signal timing by one of the agencies to address an immediate need in responding to an incident from the TMC. These changes are documented and reported.

The City has taken the lead in managing the day-to-day activities of the TMC. Most of the other functions remain decentralized. Agreements between the two agencies are informal and very loose. The two agencies know through system failure monitoring, driver complaints, field observations, video cameras, and queues when the traffic signals lose coordination.

Since the traffic signal timing plans need to be coordinated, the two agencies work together, and sometimes these efforts get delayed due to

challenges in coordinating the agencies' schedules and priorities. System-wide retiming has also been delayed due to construction improvements at several major intersections throughout the city. Both the city and MoDOT realize that they need to find a way to place more emphasis on traffic signal retiming, and that traffic signal retiming needs to be performed after intersection improvements take place. It has been three years since traffic signal retiming has been accomplished on some of the arterials.

Support for the Program

Since traffic congestion is the number one issue among the citizens in the area, public support has been built by starting with minor improvements and publishing the positive results. The improvements have been increased in magnitude slowly over time as support and funding have increased. A video about the Traffic Management Center and its potential benefits was developed and was shown on the city's public access television. The results of travel time studies were also disseminated to the public to show that even though traffic volumes have increased over time, travel times have remained constant. Public support was also enhanced by locating the TMC in the Discovery Center, an interactive museum and educational facility, thus giving the public an opportunity to see traffic management in action.

Political support was primarily built through a series of City Council presentations.

Funding for traffic signal timing and coordination is derived from several sources, including:

- Agency operating budgets
- Capital Improvements Sales Tax (1/4 cent)
- Separate sales tax program for transportation improvements (1/8 cent during a four-year period)
- Federal and public/private partnerships
- City leverages that match 50% of state funds

Lessons to Share

Before implementing a traffic signal system, an agency should locate funding sources and assign traffic signal operational responsibilities. Agencies within the same region need to realize that they are working together towards a common goal and need to trust each other. ♦

Summary and Conclusions

Each of the cases studied represented willingness among agencies to help the traveling public by decreasing delays within arterials within a region.

The results of these five case studies show that regional traffic signal timing coordination takes many forms and involves anywhere from just two or three agencies to many more. In some regions, there are formal committees and agreements among agencies, while in others the agreements are informal. Generally, the type of traffic signal equipment used by neighboring jurisdictions does not create stumbling blocks to coordination, and the engineers and technicians operating the traffic signal systems all work together toward common goals.

Regional traffic signal coordination within the Dallas area has been strong since the mid-1980s, when the voters approved the 1984 bond program, which included retiming 224 signals in six contiguous cities. That program has grown over the last 20 years such that the North Central Texas Council of Governments is the current champion of regional signal timing projects through its funding and in some cases management of CMAQ funds to optimize signal timing on arterial street networks within the region.

What began as efforts by the NCRTPB at the Metropolitan Washington Council of Governments to coordinate more than 20 transportation agencies responsible for traffic signal operation in the region has grown such that interagency relationships are the means for coordinating traffic signal operations, rather than direct involvement from the NCRTPB. Corridors that span areas under the jurisdiction of Washington DC, the State of Maryland, and Montgomery County are currently being timed through cooperative agreements, and the number of corridors will continue to grow as the jurisdictions all strive towards improving air quality.

In Denver, Colorado, the DRCOG plays an active role in identifying the corridors that need retiming, developing and fine-tuning traffic signal timing, and documenting improvements. While it is unique for a COG that does not operate any traffic signals to perform traffic signal timing, this arrangement works well in the Denver area, since the various agencies in the region recognized there was a need for a neutral, regional center of traffic signal timing expertise. Every three to four years, the TSSIP is updated with help from the various traffic signal operating agencies, and activities for the program are approved by the DRCOG's Board of Directors.

The Oakland County, Michigan region involves several counties, MDOT, the SEMCOG, and the RCOC in its regional signal timing program.

Traditionally, SEMCOG's role has been primarily that of distributing CMAQ funding to the program, however more recently SEMCOG has been instrumental in integrating the Oakland County effort across the region and into a long-range plan for traffic signal operation and maintenance. The RCOC manages the current retiming effort in the region by working with consultants to develop and implement timing plans for over 1,000 signals in the region.

Although the Springfield, Missouri region is smaller than the others highlighted in this report, the City of Springfield began thinking about regional signal timing back in the early 1980s. The idea of interconnecting MoDOT signals with those in Springfield began with a 1982 citywide traffic signal master plan, developed by the City's Traffic Engineering Department. In 1989, a City of Springfield capital improvements sales tax program was passed, which funded interconnection of 90 signals between MoDOT and the City. Since that time, the City has continued to use various sales tax programs to fund transportation improvements, along with federal and public/private partnerships, and state funds. The Springfield case study is the only region in this report that does not obtain funding through the CMAQ program. Since traffic congestion is the number one issue among the citizens in the area, public support has been built by starting with minor improvements and publishing the positive results. In addition, the City and MoDOT located their TMC in the Discovery Center, giving the public an opportunity to see traffic management in action.

Each of these five case studies presents successes in regional traffic signal timing coordination. While each program varies in size, complexity, and organizational structure, all represent willingness among the agencies involved to help the traveling public by decreasing delay along arterials within a region.

Among the lessons learned were the following:

- It is important to identify funding sources and allocate the funding appropriately among the various agencies.
- Stakeholders need a voice in a fair, equitable process.
- Each participating agency needs to commit to provide appropriate staffing levels for signal retiming projects.
- There needs to be a forum for traffic signal operating agencies to discuss and share common interests and difficulties and to establish goals.
- The benefits and results of the program should be documented to stakeholders so that they will be advocates and will move the program forward.
- Start with a small, manageable project for which benefits can be achieved and grow the program from successes. ♦



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Publication No. FHWA-HOP-05-002