LARGE CITY TECHNICAL EXCHANGE AND ASSISTANCE PROGRAM

FINAL REPORT

- Inter-jurisdictional Coordination for Traffic Management
- Interagency Fiber Optic Sharing
- Planning for Pedestrians in Large Urban Centers

November 2000

New York University
Robert F. Wagner Graduate School of Public Service

Rudin Center for Transportation Policy and Management

Partnering Institutions
Institute of Public Administration New York University Polytechnic University University Transportation Research Center at City College of New York

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EXECUTIVE SUMMARY

THE LARGE CITY TECHNICAL EXCHANGE AND ASSISTANCE PROGRAM

Over 25 million Americans live in large American cities. These large cities play a critical role in the economic, environmental, social, and cultural viability of the nation's key metropolitan areas. Transportation is a critical element in the success or failure of these large cities and the health of their surrounding metropolitan areas. Indeed, these cities owe their creation and much of their existing economic vitality to their role as transportation hubs.

The transportation systems of large American cities face enormous challenges ranging from limited financial and technical resources to high levels of congestion, aging infrastructure and highly diverse institutional structures and capabilities. But in spite of the many challenges and constraints faced by transportation professionals operating in large cities, examples of innovation seem to be commonplace. Whether it is Chicago's new program for graffiti proof street signs, Boston's Intelligent Visual Inventory System, Los Angeles' advanced bus priority program, Philadelphia's pedestrian safety program, Houston's incident management center, or Portland, Oregon's shared fiber optic network, innovation and excellence does occur.

The Large City Technical Exchange and Assistance Program facilitates the exchange of information and expertise among central city transportation professionals. The program is funded in FY'00 by the Federal Highway Administration through the Rudin Center for Transportation Policy and Management (CTPM) at New York University's Robert F. Wagner Graduate School of Public Service. The Rudin Center serves as staff to the National Association of City Transportation Officials (NACTO), an organization composed of senior central city transportation officials in the nation's ten largest metropolitan areas: Boston, Philadelphia, New York, Chicago, Baltimore, Detroit, Atlanta, Houston, Los Angeles, and San Francisco.

This report includes the results of case studies on three topics that NACTO members identified as of critical interest. The topic areas are: inter-jurisdictional coordination in traffic management; interagency sharing of fiber optic networks; and facilitating high-volume pedestrian activity. The first two topics address interagency and inter-jurisdictional issues, subjects of growing importance with the mounting awareness among both cities and suburbs of their interdependence in transportation, land use and economic welfare. The third topic, facilitating pedestrian activity, recognizes cities' re-emergence as centers of commerce, leisure activity and particularly tourism, and the growing importance of active downtowns to cities' economic fortunes.

Each case study write-up is intended to advance the understanding and expertise of transportation officials in managing transportation systems in large cities by sharing the successful experience of other large American cities.

INTER-JURISDICTIONAL COORDINATION FOR TRAFFIC MANAGEMENT

City and state transportation and transit officials across the U.S. have set up traffic management centers (TMC) to better plan and manage highways, roads, transit facilities and emergency response operations under their responsibility. TMCs have grown in sophistication and effectiveness, particularly with the advent of computerized traffic controls, traffic sensors, closed-circuit televisions and high-speed communications networks. Because traffic in major metropolitan areas crosses jurisdictional borders, local and state officials have increasingly recognized the benefits of coordinating their traffic, transit and emergency response management efforts.

Inter-jurisdictional coordination raises a host of issues and challenges, however. To assist local officials seeking to coordinate their TMC programs with neighboring and overlapping jurisdictions, the project team reviewed a myriad of reports and publications on this topic, including the extensive literature on Intelligent Transportation System (ITS) implementation. The project team also visited Los Angeles, Houston and New York, three major cities that are leaders in inter-jurisdictional traffic management coordination.

Chapter 1 discusses the major issues with inter-jurisdictional traffic management; reviews the relevant literature; reports on the experience of the three cities visited; and synthesizes findings from the literature and site visits. The chapter includes "lessons learned" and "neat ideas for large cities" culled from the site visits which should be of interest to large city transportation officials. Finally, the chapter also contains an extensive bibliography and contact names in each city.

Findings can be summarized for five major issue areas. Notably, while the literature survey showed a considerable diversity of experience among cities, the three cities visited evidenced remarkable consistency. This presumably owes at least in part to the effects of city and metro area size and complexity.

1. *Types of relationships among agencies, issues of what to share or coordinate and how to build trust.*

Agency relationships can vary from formal structures such a traffic management committee or a senior policy board or other decision-making body or process, to informal arrangements built on staff relationships and project-specific activities. Building of relationships can focus on defining each agency's role and responsibilities or on fostering close relationships between agency staff.

The three sites visited exhibit an interesting combination of characteristics. Formally, the relationships tend to be decentralized rather than centralized. Coordination tends to be directly between agencies in a web-like fashion rather than through a centralized decision-making body. This arrangement allows each agency to focus on accomplishing its own mission. Because each agency remains responsible for its own operations and facilities, issues of control over traffic information and operational responses to traffic problems are avoided. At the same time, peer-to-peer coordination enables the agencies

to take account of what is happening around them in managing their own facilities and thus reap the benefits of inter-jurisdictional coordination.

Despite relatively high organizational autonomy, the most productive inter-jurisdictional relationships usually involve close personal relationships among agency staff. TMC personnel prize face-to-face interaction even though they have the technical ability to communicate across large distances. Face-to-face interaction facilitates close relationships and builds trust and understanding between agency staff as they work on a succession of projects and tasks. Face-to-face interaction is more critical for quickly formulating responses to one-of-a-kind situations such as major accidents, spills and special events than for routine traffic management functions.

Technical expertise is critical to establishing, developing and maintaining all types of inter-jurisdictional relationships. In-house staffing at the TMCs visited proved vital to TMC coordination. Expertise is vital to building trust, and trust builds relationships. Staff in one agency will not trust the information coming from another agency, or trust the other agency to use its information responsibly, unless the staff in that other agency demonstrate knowledge and competence.

2. *Need, funding, costs, benefits and catalysts.*

The literature survey and our site visits produce concurring results. Successful inter-jurisdictional coordination occurs in response to visible public needs, e.g., over high levels of congestion or the need to manage traffic from large special events. The perception of need must be shared across agencies. Likewise, each agency must expect that coordination will further its mission.

Funding attracts participants. Bringing new money into a metro area attracts participation from agencies and prevents coordination from being viewed as a source of competition for a limited pot of funds. Conversely, participants attract funding, as when bringing politically influential departments such as the police into a TMC creates a powerful ally in seeking local appropriations.

It is critical to plan for operations and maintenance expenses up-front. While capital funds are often ample, most local and state governments are squeezed for operating funds. A few thousand dollars or even less can make the difference between inter-jurisdictional coordination proceeding or not.

The opportunity to "barter" using complementary agency capabilities also fosters inter-jurisdictional coordination. One agency may have a procurement process that is better suited to a particular procurement, for example, while another agency is suited to being the formal funding recipient and a third agency has vital staff expertise. By coordinating their activities, each agency can benefits from the strengths of the other agencies, thus furthering its core mission.

In many metro areas including the three visited for this project, high-level "champions" played critical roles in setting a vision and persevering until the fruits of inter-jurisdictional cooperation could be harvested.

3. *Role of planning processes.*

Comprehensive planning is sometimes advocated to ensure coordination of individual projects, build a shared vision of goals and project architecture, and ensure compatibility of technology. Experience in the three large cities shows that the importance of a shared vision cannot be underestimated. Their experience in developing inter-jurisdictional coordination, however, comes down firmly on the side of incremental, bottom-up, building block approaches. Particularly in early project development, agencies can more readily agree to a first step than an overall plan. The initial steps are far quicker to show results that can then be built upon.

4. *Technology compatibility.*

It only seems to make sense for neighboring or overlapping jurisdictions to adopt compatible equipment and software to make interconnections simpler, faster and less costly. This is easier said than done, however, given low-bid procurement requirements and rapidly changing technology. Compatibility can be sacrificed when necessary and in fact, technology itself can be the solution to compatibility issues in the form of "translation" software that allows different systems to communicate with each other.

5. *Public-private partnerships.*

Public-private partnerships have long been touted as a way for government to involve the private sector in sharing risks and costs of program development. Attempts at public-private partnerships have met with less success than was hoped for, however. Explanations include diverging missions, resistance to change, different languages spoken by public and private entities, lack of communication and difficulty fixing accountability.

The difficulties of pioneering in this area were evident in some of the site visits. Traffic management remains a public function in these cities, carried out for broad public benefit with a chary eye aimed at efforts to limit dissemination of information for private sector profits.

INTERAGENCY FIBER OPTIC SHARING

The first and second topics are closely linked since one of the most important features of a TMC is the communications network that links management centers with each other and with field equipment. The communications system "puts the intelligence in an intelligent transportation system." While a variety of communications technologies exist, fiber optic networks provide the high bandwidth and high data-transmission rates often needed for traffic management.

Fiber optic systems can be quite costly, however, particularly where new conduit must be laid beneath city streets or strung between poles. Considerable cost-saving opportunities appear to be available if city agencies can develop shared fiber optic systems.

Since there is virtually no literature on this topic, the research team focused on gathering information on the experiences of seven cities of varying size and location: Houston; Portland, Oregon; New York; Austin; Silicon Valley; Denver and Boston.

Chapter 2 discusses the key issues, lessons learned, neat ideas of interest to large city transportation officials, and detailed reports on the case study sites. Contact names are included for each case study.

Key issues and findings are:

1. *What agencies are involved in fiber optic sharing arrangements; whether sharing arrangements span distinct missions or all relate to transportation activities.*

Fiber sharing may occur among transportation agencies that need to communicate to accomplish their missions, or among agencies with diverse missions—e.g., transportation, schools, welfare agencies, etc. In most of the cities studied, fiber sharing is confined to transportation agencies, typically as part of an overall ITS program. Integration with ITS programs facilitates planning and funding of fiber optic networks.

Successful multipurpose sharing arrangements have been established in Austin and Portland among the cities studied. Even in these cities, however, there were complementary fiber networks devoted to transportation purposes. Transportation uses, particularly video camera feeds, create bandwidth demands that currently tend to exceed the capacity of multipurpose fiber optic networks. Whether this will remain true with opportunities to reduce costs per megabyte via wavelength division multiplexing remains to be seen.

2. *Type of relationship(s) between agencies.*

Relationships can be more formal or less formal, ranging from signing of extensive memorandums of understanding (MOU) to informal coordination among staff at different agencies. The best route seems to depend on the number of agencies involved, purposes of the fiber network, and degree of comprehensiveness of the relationship. While fiber optic systems involving a half dozen agencies necessitate formality, two transportation agencies can readily exchange access to their fiber systems without formal arrangements.

3. *Methods used to build the fiber optic system.*

There is a range of options, from building fiber optic systems based on a comprehensive plan to phased or incremental approaches. The differences relate to the type of planning conducted, sources of funding and timetable for construction. The most comprehensive approaches tend to accompany multipurpose, multi-agency agreements and large ITS projects.

On the other hand, incremental approaches have been quite successful in building conduit capacity by piggybacking on installations of private telecommunications companies and various public sector highway, bridge and transit construction projects. Piggybacking

allows cities to cheaply acquire conduit capacity—normally the most expensive part of building a fiber optic system—and then run fiber through conduit as needed.

4. What is shared.

Sharing can involve at least five types of arrangements: physical facilities, software, expertise, O&M and costs. There are examples of successful arrangements in each of these categories.

A key lesson from the cities examined is that successful sharing arrangements can take a variety of forms and that "more" sharing is not necessarily "better." Relatively "loose" sharing arrangements in which transportation agencies interconnect their fiber optic networks to share data while each agency builds, operates and maintains its own fiber facilities have worked quite well. On the other hand, extensive sharing arrangements can fruitfully encompass operations, maintenance and financing. These more extensive arrangement are particularly fruitful when many agencies, some with modest bandwidth needs, are served.

PLANNING FOR PEDESTRIANS IN LARGE URBAN CENTERS

A distinctive feature of large cities is their high volume of pedestrian activity. The energy and richness experienced in an active and diverse streetscape is a powerful part of the city's attractiveness over suburban and rural environments. Achieving that richness and texture, however, is a challenge given the often intense demand for scarce street and sidewalk space, the need to accommodate both pedestrians and motor vehicles, and safety concerns for both pedestrians and vehicle occupants.

The third chapter is a practical resource for large city transportation officials, detailing the experience of large cities with a broad array of strategies, markings, devices and signage conducive to high-volume pedestrian activity. The chapter discusses strategies for integrating the needs of all users into an organic, attractive environment; challenges involved with this task; and available financing. Throughout, the focus is on addressing the often-unique needs of large U.S. cities.

Based on a review of the extensive literature on pedestrian and traffic issues and interviews with city transportation officials and pedestrian advocates, four overall strategies are highlighted to facilitate high-volume pedestrian activity:

- Reducing vehicle speeds
- Shorten and simplify crossings
- Communicate pedestrian presence
- Expand and enhance the pedestrian domain.

Numerous methods of accomplishing each of these strategies are reviewed. These include simple traffic controls such as stop signs in place of traffic signals, leading pedestrian

intervals, recessed stop lines, neckdowns, wider sidewalks and tighter vehicle turning radii. Big cities' experience with other more controversial measures are discussed such as exclusive vs. concurrently timed signals, mid-block crosswalks, parking restrictions and fluorescent yellow-green pedestrian signs. High-tech solutions are also reviewed—countdown walk signals, sensored crosswalks and video enforcement.

While the best blend of devices depends on the pedestrian and traffic conditions at each location, it is clear from this review of large city experience that a multitude of often-simple steps can enhance the attractiveness of urban centers to pedestrians and thus strengthen the vitality of urban cores.

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CHAPTER 1

Inter-jurisdictional Coordination for Traffic Management

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1. INTRODUCTION

Across the United States, municipal, county and state transportation agencies have set up Traffic Management Centers (TMCs) for highways, roads and transit facilities under their jurisdiction. TMCs perform a range of functions. They most commonly include traffic signal control, incident management, traffic surveillance, special event management, coordination with emergency agencies, and dissemination of information for public and private use. Less frequently, TMC functions incorporate management of weather-related problems, HOV operations, hazardous materials management, ramp metering, and planning for construction diversions.[1]

Many metropolitan areas have installed highly sophisticated systems of computers, traffic sensors, closed-circuit television and communications networks to carry out these functions. Much of the design and construction of these systems has been federally funded under the Intelligent Transportation System (ITS) program. In recent years the capability for real-time management and response to traffic conditions greatly expanded the ability of TMCs to manage traffic effectively.

Because traffic flows across jurisdictional boundaries, it often makes sense to extend the benefits of traffic management by coordinating city, county and state traffic management programs. Inter-jurisdictional coordination takes many forms. Neighboring cities can coordinate signal timings on arterial roads that transverse both jurisdictions, for example, or city and state transportation agencies can coordinate between city arterials or city-operated highways and state highway facilities.

Inter-jurisdictional coordination can be difficult to achieve, however. In fact, institutional issues are often recognized as the most daunting barrier to realization of the potential benefits of coordinating TMC activities. What are the keys to successful coordination? How can institutional and organizational barriers be addressed? This chapter examines these questions with a focus on application to large U.S. cities to assist local and state officials seeking to coordinate their TMC programs.

[1] Kraft (1988) itemizes TMC functions and quantifies the frequency with which each function is currently performed, and will be performed in the future. See references list at end of this chapter.

2. ISSUES

Inter-jurisdictional coordination raises a host of issues and challenges. Discussions with transportation officials at the NACTO-member cities identified the following eleven specific questions or issues of particular interest.

- *What agencies were involved at the start of the TMC inter-jurisdictional process? How were these relationships structured? What was the role of direct inter-agency relationships vs. multi-agency coordinating committees and the like? What were the functions and responsibilities of each agency?*

- *What was shared—information, facilities, equipment, communications networks? What was coordinated—incident response, traffic signal control, variable message signs, emergency response? Why did coordination take the form that it did? What tradeoffs were involved? Would additional benefits be achieved with additional sharing or coordination arrangements?*

- *How was trust built between agencies?*

- *How were control issues addressed?*

- *Why did the agencies participate in this effort? What was the role of need to improve traffic flows? Of a regional vision? Of political forces?*

- *How were the projects funded? How was public, political and institutional support for traffic management systems built?*

- *What were the main costs and benefits of coordination?*

- *What were the catalysts to inter-jurisdictional traffic management? What role did bodies with regional jurisdiction play? Was there a champion who played a critical role? Were funding requirements important? Did the demands of traffic management for special events play a catalytic role?*

- *To what extent was coordination a product of planning processes? What was the nature and extent of the planning processes? Who was involved? To what extent did coordination proceed incrementally? What was the experience with each approach used?*

- *How were issues of compatibility of communications systems, data formats, etc. dealt with? Was this an important issue? At what point was it resolved?*

- *What was the use of private partners, particularly of interest if traffic information has commercial value.*

These eleven issues formed the basis for interviewing during the study team's site visits to Los Angeles, Houston and New York. Each of the eleven issues is addressed individually in the site visit write-ups later in this chapter.

3. LITERATURE REVIEW

Prior to conducting the site visits, the study team collected and reviewed numerous studies that address or touch on institutional issues and inter-jurisdictional cooperation. These studies include reports on TMC operations (JPO 1999; Kraft 1998; Mitretek Systems 1996; Peyrebrune 1996; Urbanik 1998); recommended practices for TMC management and operations (ITE 1995; ITE 1999); the experiences of professionals in the field (Edelman 1997; Wiersig 1997; Wilson 1996; ITS Online 1995;) and a large literature on ITS deployment which increasingly focuses on institutional issues (Volpe 1996; Volpe 1999; Wetherby 1998). Also useful to this discussion are studies of multi-modal transportation programs and partnerships (Crain & Associates 1996; Hauser 1999; Transmanagement, Inc. 1998), an understanding of the changing role of state DOTs (Lockwood 1998), and reports on new regional transportation organizations created for inter-jurisdictional coordination (Briggs 1999).

There is a growing focus on the importance of inter-jurisdictional coordination in traffic management. In a recent study of ITS management and operations, the first recommended practice is to "maintain multi-agency, multijurisdictional, multidisciplinary coordination of management and operation activities." (ITE 1999) A U.S. DOT review of TMC operations in eight cities concluded that future directions for TMCs include integration of freeway and arterial control, and integration of traffic management and transit (JPO 1999)—both of which necessitate inter-jurisdictional coordination. Many jurisdictions have already embarked in this direction. A survey of state highway officials documented growing cross-agency cooperation to facilitate increased state DOT involvement with incident management and emergency response. (Lockwood 1998)

Yet significant hurdles often stand in the way of inter-jurisdictional cooperation. An assessment of ITS program experience across the U.S. concluded that "institutional issues are the main barrier to implementing ITS" in the United States. (Mitretek Systems 1996) Indeed, institutional and inter-jurisdictional issues are at the top of the agenda of transportation officials in the nation's largest cities. (TRB 1999) A recent discussion among city and county government officials highlighted local governments' desire "to more efficiently collaborate and work through issues where traffic goes from arterials to freeways, and vice versa." (Hicks 2000)

These studies speak of obstacles to inter-jurisdictional cooperation, strategies to achieve cooperation, lessons learned and keys to success. The following discussion summarizes key findings from the literature in the context of the eleven issues identified by large-city transportation officials. In the following literature summary, the eleven issues are grouped into five categories below.

FINDINGS ON MAJOR INTER-JURISDICTIONAL ISSUES

1. Types of relationships among agencies, issues of what to share or coordinate and how to build trust.

Studies cited above suggest a range of approaches to structuring inter-jurisdictional relationships. One approach is to establish formal structures such a traffic management committee, a senior policy board or other decision-making body or process. These structures provide a forum to "deal with all activities from planning through operations." (ITE 1999, p. 8) A coordinating body aids "in fostering long-term coordination, cooperation and consensus building, especially in larger metropolitan areas where there are typically numerous involved agencies and organizations." (Kraft 1998, p. 18) Weekly meetings by teleconference can be effective. (Wetherby 1998, p. 27)

Regional management structures are often not created instantaneously but can be developed during a series of projects. "Regional management structures are often achieved through an evolutionary … process … based on the demands of previous interagency projects, existing relationships and the needs of the partners." (Volpe 1999, p. xviii)

Another approach focuses on defining each agency's role. Carefully delineating the roles and responsibilities of each agency avoids confusion about roles that can slow the system development process. (Wetherby 1998, p. 32) Clear definition of roles and responsibilities "enables project managers to assign work to participants that is consistent with their basic missions and allows the project to benefit from the strengths of individual participants." (Volpe 1999, p. xvi) Role clarity is complementary to establishment of formal structures. It may also make such structures less critical if management committees need to give less attention to ironing out agency responsibilities.

A third approach is to encourage and facilitate close relationships between agency staff. This can be achieved through shared facilities ("co-location") and personal relationships. Metropolitan areas that have taken the co-location route emphasize its importance. "Leaders from San Antonio's TransGuide … claim that this daily interaction [at the central management facility] has created new understanding for each other's missions, methods of conducting activities and cultures. They do not believe that the same level of cohesiveness could have been achieved through electronic connections." (Briggs, 1999, p. 41)

Others suggest, however, that today's technology makes shared quarters unnecessary. "Advancing computer, communications and network technologies make it conceivable to effectively coordinate the activities of a number of TMCs located throughout a metropolitan area or geographic region." (Kraft 1998, p. 17) A decentralized approach may be necessary and even desirable. The hub-and-spoke organization of Atlanta-area TMCs, linked by a fiber optic network, was developed because "George DOT personnel felt that the Atlanta region was too large to have an all-encompassing central facility. They

viewed area specialization as advantageous. … [It also allows new Transportation Control Centers] to be added from anywhere in the region or state." (Briggs 1999, p. 41)

Typically, several approaches are utilized in inter-jurisdictional coordination. The combination depends on the particular situation. No one approach fits with every inter-jurisdictional relationship even within a metro area. Each interagency relationship can need a separate strategy tailored to the particular needs of each agency. (Edelman 1997, p. 82)

One of the primary issues raised by staff at large-city transportation agencies is control. Should interagency relationships be confined to sharing information about traffic conditions? Or should there be shared control of video cameras, text on variable message signs, signal timings or other facets of operating the transportation system? Will sharing of information potentially compromise an agency's responsibilities to its constituents or create legal liability for either party should something go wrong?

A second issue raised by central-city staff was identification of a lead agency. Should there be a lead agency? If so, who should take that mantle?

Little of the literature reviewed for this study addresses these two issues, which were more extensively explored in the case studies. An interesting point from one pioneer in inter-jurisdictional coordination, however, was the benefit of having no central authority overseeing inter-jurisdictional coordination. In the New York area, it was the "very lack of centralized authority which creates an environment in which different jurisdictions are willing to cooperate." (Edelman 1997, p. 82)

2. Need, funding, cost, benefits and catalysts.

Large-city transportation officials feel crunched by their current responsibilities. How can they take on the added and often complex tasks of coordinating with neighboring or overlapping governmental authorities? How can they find the time and leadership to reach out to other agencies, find common ground and get inter-jurisdictional coordination set up and underway? How can agencies generate the external political and financial support needed to proceed with these programs?

The studies listed earlier cite a combination of strategies that help move agencies into and through the process of launching and funding inter-jurisdictional coordination. Four inter-related strategies stand out: to focus on visible public needs, identify common interests, find new money for the new tasks, and proceed with a high-level champion.

The importance of focusing on visible public need is a common thread of various case studies. Examples of need are high levels of congestion (Volpe 1996, p. 4) and the need to monitor and manage traffic from special events. (Volpe 1996, p. 14) The perception of need must be shared across agencies. Transportation officials will oppose a freeway or information management system "if they believe such a system would adversely impact local traffic." (Volpe 1996, p. 14) The goals of inter-jurisdictional coordination must "support and [be] consistent with the mission of … member agencies." (Wilson 1996)

Naturally, funding attracts participants. Bringing new money into a metro area not only attracts participation from other agencies, it also wards off resistance that arises when agencies compete for a limited pot of funds.

Participants also attract funding. In San Antonio, Texas DOT found that in bringing the police into TransGuide, the police "not only offered assistance in the core mission of reducing incident response and clearance times, but also an ally and powerful advocate in the competition for resources for additional ITS deployments." (SAIC 2000a)

Finally, some studies note the importance of high-level "champions" who commit themselves and their agencies to moving forward and persevere until inter-jurisdictional coordination shows results. "Key individuals or champions have played critical roles in the development of all new regional [traffic management] organizations." (Briggs 1999)

3. Role of planning processes.

Comprehensive planning is sometimes advocated to ensure coordination of individual projects, build a shared vision of goals and project architecture, and ensure compatibility of technology. The Institute of Transportation Engineers (ITE) recommends development of an ITS regional strategic plan to "identify the 'big picture' vision for the future development of ITS in a region and state." Plan development "is intended to broaden the thinking beyond individual agencies and serve as a catalyst for promoting greater consideration of region-wise M&O issues …" (ITE 1999, p. 12)

ITE notes that the level of detail in regional strategic plans will vary, and that small metropolitan areas or communities may not need a complex, multiyear ITS strategic system plan. (ITE 1999, p. 12)

Planning is also useful to identify funding sources and ensure that appropriate resources will be brought to bear. "The funding, phasing, training, personnel and other resources required to support the potential operations and future support needs identified for systems in a region should be identified." (ITE 1999, p. 12)

A more modest view of the planning process emphasizes building a shared vision and mutual understanding of each agency's needs but without the level of detail implied by comprehensive planning. Review of four federally-funded ITS model deployment sites emphasized the need for each agency to develop a regional perspective. "A regional perspective means that project participants view projects from the standpoint of the other project participants as well as their own." (Volpe 1999, p. xii)

Other studies emphasize incremental approaches. It is easier for agencies to agree to a first step than an overall plan, and it is quicker to show results which can then be built upon. "While there is an appropriate role for comprehensive, all-inclusive, top-down plans, real-world successes were often best achieved using an interative approach. First, a tangible product is developed. … This can result in buy-in by various stakeholders more readily than trying to have them reach an up-front agreement on a thick paper plan." (Mitritek Systems 1996, p. 29)

Many accounts of ITS deployment and inter-jurisdictional cooperation note the building-block nature of project development. In Phoenix, state, county and city staff all cited earlier coordination of traffic signal control systems "as instrumental in teaching transportation agencies how to build up interagency and cross-border cooperation." (Volpe 1999, p. 5) The same was noted in San Antonio (Volpe 1999, p. 6), Houston (Wiersig 1997) and Seattle (SAIC 200b, p. 17).

4. Technology compatibility.

It only seems to make sense for neighboring or overlapping jurisdictions to adopt compatible equipment and software to make interconnections simpler, faster and less costly. This is easier said than done, however. Each city, county, state or other agency must follow its own procurement procedures which are typically designed to select the lowest qualified bidder for equipment purchases. The low bidder for one project may not be low bidder for another project. Agencies may attempt to specify compatible technology. Procurement officials may not permit narrowly written specifications, however. If allowed, they may drive up prices. Another problem is the rapidly changing nature of the technology. Equipment and software is constantly improving while costs are often reduced. A prohibitively costly technology may become quite affordable, as has occurred with fiber optic networks in many instances. Thus, agencies often end up with different generations of technology intra-agency as well as across agencies.

The issue then is, how can agencies cope with compatibility issues? Are there ways to ensure compatibility? Are there ways to make incompatibility less important?

U.S. DOT established a National Architecture to lay out a common approach for design and implementation of integrated ITS systems. While providing a framework for system elements, the National Architecture "does not prescribe any technologies, designs, or policies." (JPO 1996) Thus, it remains with local and state agencies to coordinate their uses of technology. Inter-jurisdictional committees or teams can "continuously work to standardize and implement compatible systems." (ITE 1999, p. 8)

5. Public-private partnerships.

Public-private partnerships have long been touted as a way for government to involve the private sector in sharing risks and costs of program development. Attempts at public-private partnerships have met with less success than was hoped for, however. (Mitritek Systems 1996) A variety of explanations are offered. These include diverging missions, resistance to change, different languages spoken by public and private entities, lack of communication and difficulty fixing accountability. (Hauser 1999) A federal assessment of ITS deployment in seven metropolitan areas found that, "The role of traffic management has been traditionally the role of the public sector and this perception has not changed. Also, public transportation officials have not been able to define a specific role for the private sector, other than as vendor or contractor." (Volpe 1996, p. 14)

An analysis of a public-private partnership to broadly disseminate traveler information in the San Francisco bay area concluded that:

> … it was necessary to adjust the public and private partners' differing expectations of TravInfo in order to work toward the common goal of disseminating accurate, reliable, timely and multi-modal information to Bay Area travelers. The public partners expected to make TravInfo available for better congestion management, while the private partners expected to test and market products that would make a profit. It took a long time to reconcile their differing objectives. (Yim & Deakin 1999)

In the face of this experience, how should large cities approach the possibility of seeking such public-private partnerships?

COMPARISON WITH LARGE CITY CASE STUDY FINDINGS

In some respects, the study team's findings for the three large cities visited mirror results from the literature review. In other respects, previous literature only partly captures this study's findings. Below is a summary of how the literature compares with the experience of the three cities visited.

Note that while naturally the literature showed a considerable diversity of experience, the three cities visited evidenced remarkable consistency. This presumably owes at least in part to the effects of city and metro area size and complexity.

Type of relationships: Inter-jurisdictional relationships in the three large cities visited exhibit an interesting combination of characteristics. Formally, the relationships tend to be decentralized rather than centralized, characterized by coordination directly between agencies in a web-like fashion rather than a hub-and-spoke system. Despite relatively high organizational autonomy, the most productive inter-jurisdictional relationships usually involve close personal relationships among agency staff. Because it enhances close staff relationships, TMC personnel prize face-to-face interaction even though they have the technical ability to communicate across large distances.

Need, funding, benefits and catalysts: Site visits firmly echoed the literature's emphasis on focusing of visible public needs, identifying common interests and finding new money for new tasks. The leadership of high-level champions was also critical to early program development in all three cities.

Role of planning processes: Experience in the three large cities comes down firmly on the side of incremental, bottom-up, building block approaches to developing and coordinating traffic management. This is particularly the case for early project development.

Technology: Just as the federal ITS program has moved from a focus on implementing technology to a focus on addressing operational, management and institutional issues, the three cities saw a focus on these issues rather than on solving technology constraints.

Public-private partnerships: The difficulties of pioneering in this area were evident in some of the site visits. Traffic management remains a public function in these cities, carried out for broad public benefit with a chary eye aimed at efforts to limit dissemination of information for private sector profits.

4. FINDINGS

To evaluate how large cities have successfully dealt with the institutional issues described above, the project team visited three cities—Los Angeles, Houston and New York. These cities were selected based on their successful experience with implementing traffic management coordination and ongoing programs to enhance inter-jurisdictional coordination. The study team was thus able to see both the fruits of completed projects and discuss current efforts and issues.

Houston

The City of Houston is part of the TranStar TMC where all participating agencies are housed in a central facility. Each agency maintains operational control over their jurisdictional system, but the agencies readily share information, technical expertise, jointly fund projects, barter activities based on the individual capabilities of each agency and cooperate in a wide ranging program of regional activities including incident management and emergency management. Participation in TranStar has strong support from the current Mayor. A previous Mayor was instrumental in the establishment of TranStar and is viewed as "the champion" of this effort as well as the architect of the common vision for Houston which is shared by all agencies.

The City of Houston is currently developing a traffic signal control system in conjunction with the county.

Los Angeles

The City of Los Angeles has been a leader in the development and implementation of an Automated Traffic Surveillance Center (ATSAC). ATSAC staff monitor conditions on city highways, monitor the control strategies programmed into the central computer and intervene in unusual conditions and special events. This system is in place for many of the signals in the city and is in its second generation of control strategies. The TMC is tied to many high visibility city activities including special event planning, emergency management, data archiving, goods movement from the Port, economic development, neighborhood protection, and fire and police protection. The TMC and ATSAC have strong political support at all levels of government. The champion for this effort was a former director of the L.A. DOT and the current director is viewed as the current champion.

One unique feature of L.A.'s system is that it was developed with in-house staff and is being maintained and upgraded again by in-house staff. The City shares information with the State TMC and several other TMCs in the area. The City has cooperative agreements with several other jurisdictions in the area.

L.A. took a leadership role in working with the State DOT (Caltrans) and other agencies in the Santa Monica Smart Corridor Program in the mid-1990s. Two other projects were included as part of the case study: (a) a bus priority program with the Los Angeles County Metropolitan Transportation Authority and (b) a county-wide signal

synchronization program, involving the MTA, L.A. County and municipalities throughout the county.

New York City

The City of New York has had a long-standing program of upgrading and interconnecting traffic signals in the city and establishing a central TMC including video surveillance. The TMC has recently been upgraded and has been operational for several years. The responsibility for traffic management has been modified in recent years where the Police Department now has a major responsibility for day-to-day traffic management and incident management. The Police traffic functions are co-located in the same building with the City TMC. Co-location has resulted is numerous cooperative activities which were not possible in the past.

N.Y.C. DOT is also part of the three state regional TMC (TRANSCOM) through which DOT shares information with the other members of TRANSCOM. In addition, N.Y.C. DOT recently obtained federal financing for a fiber optic network that will enable coordination with New York City Transit and MTA Bridges and Tunnels.

The State and City TMCs are co-located in the same building. The plan is to have N.Y.C. DOT eventually take over the state TMC and traffic management of the state highways in the city (consistent with state law). Currently the State DOT is installing the ITS infrastructure as part of highway reconstruction projects and is operating the systems during construction as part of the construction traffic mitigation program. After construction is completed the ITS systems will be turned over to the city as well as operational control.

The degree of political support for the TMC in New York is not as pronounced as in the other cities and the TMC activity is basically below the political radar screen.

Table 1 summarizes agency involvement, functions and initial focus of TMC coordination in each of the three cities.

Results from the case study visits are synthesized in the next three sections. The first section highlights a dozen lessons learned from the case studies, organized in three groups. Further detail for each of the case studies is provided in the discussion of each city later in this report. The second section discusses what the study team did *not* find. These are areas that the study team expected might be important but were not. The third section itemizes technological and institutional innovations found to be successful in the three cities. Other large cities may wish to borrow some of these “neat ideas.”

Table 1. Summary of Features of TMC coordination.

	Los Angeles			Hous-ton	New York City		
	Smart Corridor	County-Wide Signal Synchronization	Bus priority	TranStar	TRANSCOM	Coord. Between NYC agencies	NYCDOT, MTAB&T, NYCT sharing
Agencies involved							
City transportation dept.	✓	✓	✓	✓	✓	✓	✓
County transportation dept.		✓		✓	✓[2]		
State transportation dept.	✓	✓		✓	✓		
Police, Fire, emergency services (some or all)	✓			✓	✓	✓	
Transit agency	✓	✓	✓	✓	✓		✓
Functions							
Incident management	✓	✓	✓	✓	✓	✓	✓
Traffic management	✓	✓	✓				
Emergency response	✓			✓	✓	✓	
Special events	✓	✓		✓	✓	✓	✓
Construction coordination					✓		
Transit service		✓	✓	✓			✓
Form							
Central organization acting as clearinghouse or facilitating coordination					✓		
Sharing information between separate locations	✓	✓	✓	✓			✓
Sharing information at central location				✓		✓[3]	
Primary needs driving program at outset							
Special events	✓						
Traffic incident management	✓	✓		✓	✓	✓	✓
Traffic management/congestion reduction		✓		✓			✓
Construction conflicts					✓		
Transit service improvement			✓	✓			✓

[2] Counties outside New York City were involved. There is no separate County government overlapping with New York City.

[3] Currently separate city and state traffic centers and city police center in adjacent rooms at one location.

LESSONS LEARNED

People-Related Lessons Learned

Inter-jurisdictional coordination is ultimately not between agencies but between individuals. The first three lessons learned address ways to build trusting, effective relationships between staff at different agencies.

Develop in-house technical expertise

In all three cities, technical expertise was critical to establishing, maintaining and developing inter-jurisdictional relationships. In the cities visited, in-house staffing proved vital to TMC coordination.

There are several reasons for the importance of technical expertise. Perhaps most important is that expertise is essential to building trust. Staff in one agency will not trust the information coming from another agency, or trust the other agency to use its information responsibly, unless the staff in that other agency demonstrate knowledge and competence. Expertise thus builds trust, and trust builds relationships.

A closely related point is the importance of similar levels of expertise for healthy peer relationships. In L.A., for example, officials wanted to be sure that neither agency is too far "ahead" or "behind" the level of staff capability or expertise of the other. Comparable levels of expertise build a more equal, mutually beneficial relationship.

Second, staff expertise is vital to integrating new technology into existing systems. It takes a considerable level of expertise to understand how the existing system works and how new systems and equipment can improve the operation, and then to successfully implement those improvements. Since inter-jurisdictional coordination develops with implementation of new technology, staff expertise is critical to the coordination efforts.

Often, in-house staff's ability to be expert in multiple areas is critically important. An excellent example is seen in Los Angeles, where in-house traffic engineers have developed the software for an advanced adaptive traffic control system. Managers in L.A. commented that outside software developers could not have matched these traffic engineers' understanding of traffic dynamics needed for the adaptive traffic control system.

Third, staff provide continuity. Inter-jurisdictional relationships develop over long periods of time and continuity is critical.

Finally, staff capability can play a vital role in obtaining funding. L.A. DOT, for example, has been able to attract and retain staff by continually challenging them with new projects. The department has been successful in obtaining external funding for this in-house staff so they are off-budget.

Critical role of face-to-face interaction

Face-to-face interaction is a key aspect of the TranStar operation in Houston, and in N.Y.C. DOT's coordination with the city Police Department in New York City. Staff in both locations extolled the value of face-to-face interaction. Staff proximity (in the same large room in Houston and in adjacent rooms in New York) enables agencies to become immediately aware of events as they transpire. In Houston, the ability of staff to simply call across the room is cited as a major benefit of TranStar. Proximity also exposes staff from each agency to the functions of other agencies. Staff see the issues, problems and complexity that their colleagues must deal with. This appreciation promotes understanding and greases the way to better cooperation.

Face-to-face interaction is particularly important to emergency situations and complex problem-solving. Relatively routine traffic management is more readily conducted using electronic communications. Looser forms of coordination, in which agencies share information but each agency independently decides what actions to take, are also readily carried out from remote locations. Staff proximity is most productive where the task is to coordinate traffic and emergency response to a freeway spill of hazardous materials, for example.

Officials in New York and Houston attributed their success in developing new forms of interagency cooperation to their ability to deal with each other in person. Face-to-face interaction was important to a NYPD police sergeant's gaining appreciation for the technical capability of N.Y.C. DOT traffic engineers, and thus critical to expanding coordination from incident management to signal adjustments in complex intersections such as Herald Square.

Value of staff moving among agencies

In a few cases, inter-jurisdictional cooperation was built on collegial relationships built before some agency staff moved to another agency. A good example is L.A. DOT's operation of Culver City's traffic signals. Culver City's traffic engineer formerly worked at L.A. DOT. He understood how LA's system worked and trusted the operating decisions of L.A. DOT staff.

Resources and Technology

The next four lessons learned focus on ways to make the best use of the resources and technology at the disposal of each partner in interagency coordination.

Let each partner focus on its strengths

A major payoff from inter-jurisdictional or interagency cooperation is that each agency can be in charge of the aspects of the overall project that are best-served by its strengths. An example is procurement, where one agency has procurement procedures that are better adapted for moving forward more quickly or easily. Another example is staff expertise. In the design and construction of Houston's TranStar facility, for example, the

State let the construction contracts, Metro was responsible for the communications systems, the City handled the finances and the County maintains the building.

In New York, the Police Department issues stiff fines to construction companies that violate their N.Y.C. DOT permits. This enforcement sharply reduced infractions concerning the number of lanes that can be closed or time of day of the closures, thus improving traffic flow.

Plan for O&M costs up front

This lesson echoes the national literature. While capital funds are often ample, most local and state governments are squeezed for operating funds. A few thousand dollars or even less can make the difference between inter-jurisdictional coordination proceeding or not. For example, several smaller jurisdictions were unable to procure beepers in the early TRANSCOM days, more because of paperwork than cost. TRANSCOM provided the beepers free and these jurisdictions became active members. In the southeast portion of Los Angeles County, fairly small differences in operating costs governed selection of communications technologies for a new signal coordination system to ensure participation of several smaller cities.

Take advantage of opportunities to barter

Formal interagency agreements can be difficult and time-consuming to consummate. Difficulties may be compounded when substantial amounts of money are involved. Various forms of bartering among agencies can help sidestep these challenges. In Houston, for example, agencies have kept a running tab on the contribution of each agency as various projects are developed and procured. Over time, they have worked out what they feel is a fair apportionment of costs. While one agency may invest particularly heavily in one project, therefore, it may invest less in another. Project tasks can thereby be allocated built upon staff expertise, procurement requirements, funding sources, staff time availability and other pertinent factors without worrying about the exact cost apportionment of each particular project.

Don't lock in technology

Much of the technology used in the three cities is compatible across agencies. In some cases, agencies set up procurement mechanisms to ensure that each agency buys the same software. For example different agencies in Houston are purchasing software from the same supplier.

While acquisition of the same software can be desirable, compatibility can be sacrificed when necessary. This sacrifice may be necessary because technology is changing rapidly. Signal controllers that were unaffordable a couple of years earlier may be affordable now. Incompatibility may also arise because of legacy systems, or because of agencies' procurement requirements such as low bid requirements. Technology can be the solution to this technology problem. An example is the countywide signal synchronization program in Los Angeles County, which utilizes a software kernel that translates between each city's software.

Keys in Early Stages

The final lessons learned are particularly applicable in early stages of inter-jurisdictional coordination that face the challenges of overcoming inertia and mistrust and gaining support for something new.

Address high-visibility problems

Agencies in all three cities began their inter-jurisdictional cooperation focused on problems with significant public and political visibility. Los Angeles focused on preparing for the 1984 Summer Olympics, which were widely feared, might produce nightmare gridlock. New York's TRANSCOM began by coordinating different agencies' construction projects after several well-publicized traffic tie-ups from construction-related closures on parallel routes. Houston first focused on building a 103-mile network of high-occupancy vehicle (HOV) lanes.

Beginning with high-visibility problems helped focus each agency on the task at hand, overcome institutional inertia, and rally the necessary funding and staffing. Once initial projects show results agencies are able to tackle less-visible problems. For example, the NYPD and N.Y.C. DOT broadened their coordination efforts from incident management to less-visible day-to-day operational issues such as enforcement of the terms of construction permits.

Identify common interests

One of the greatest barriers to inter-jurisdictional cooperation is that agencies' different missions and constituencies can create diverging program objectives. A state DOT, for example, may focus on moving traffic through an area while city officials may be more concerned with minimizing neighborhood traffic impacts. Diverging interests typically kill attempts at inter-jurisdictional cooperation. Thus, all three cities identified and focused on areas of common interest, particularly at the beginning. The high-visibility problems listed earlier show this commonality of interests.

Officials in the three cities explicitly address possible conflicts to prevent one agency's actions from affecting another agency's facilities. For example, Caltrans does not divert freeway traffic to local streets no matter how congested the freeways become. Variable message signs advise motorists of alternate freeway routes but not arterial routes. In setting up ramp metering, Caltrans prevents cues on the entrance ramps from backing up onto city streets.

Proceed incrementally

Inter-jurisdictional coordination in traffic management in the three sites cities has proceeded incrementally over a considerable period of time. Individual projects are conceptualized, planned, developed and implemented in response to specific needs identified by agencies and elected officials.

There are many benefits from taking a bottom-up, incremental approach. These include ease of planning and implementation, strong focus on needs, showing results relatively

quickly, building support for additional funding based on demonstrated results, and building trust as a basis for further efforts.

Proceeding incrementally is most important in the early stages of inter-jurisdictional coordination. In L.A., for example, the more comprehensive, area-wide efforts have followed demonstration or showcase projects. In Houston, integration of emergency management with traffic management followed well after the original design and implementation of TranStar.

Ultimately, incrementalism expands the scope of possible coordination and its potential benefits. Completion of one project spawns cooperation in other areas. In New York, for example, TRANSCOM's incident detection led to highway advisory services using the same information. Congestion data from EZ-Pass speed probes is used to measure the extent of delays, providing agencies with data to decide whether to take such actions as issuing alerts or reducing construction lane closures.

Don't overpromise

New programs are built on promises but officials interviewed for this project stressed the importance of only making promises that they felt confident of achieving. Their success came from demonstrating incremental improvements rather than trying to hit the home run. This approach built institutional, public and political support.

Be lucky, have a champion

All three cities emphasized the critical role of a high-level champion. Houston's TranStar was championed by a Mayor who had also held top jobs as a member of the Texas Transportation Commission and chairman of the transit agency. L.A.'s traffic management center was the priority project of L.A. DOT's general manager. New York's TRANSCOM was established by a top official at the Port Authority of New York and New Jersey and supported by earmarked funding sponsored by a New Jersey Senator.

These high-level champions brought financial and political support to traffic management inter-jurisdictional coordination. They cut through institutional resistance and kept agencies focused on responding to high-visibility problems. These champions also brought tenacity, sticking with the projects until they produced results. As inter-jurisdictional coordination demonstrated value, the champions became less important. Traffic management became institutionalized and recognized as a good thing. But it is quite notable that in each city, champions played critical roles in initial stages.

WHAT WE DID NOT FIND

Just as there are lessons learned, there are lessons not learned. These include issues that were raised at the outset that did not prove to be major issues in practice; possible constraints that were not in fact significant issues; and approaches recommended by some that did not prove in practice to be workable.

Non-Issues

Giving up operational control

The issue of sharing or transferring operational control was a major concern raised by large-city staff in planning the case studies. It was not an issue in the three sites visited because agencies virtually never gave up operational control and shared control in only modest ways.

In some cases, agencies share pan, zoom and tilt capabilities of CCTV cameras and authority to post messages on variable message signs. While these are significant examples of sharing, they fall far short of transferring control of traffic signals or one agency directing another agency's emergency response, for example.

None of the officials interviewed felt that they should go further in shared control. They cited a number of reasons centered on the importance of each agency meeting its legal, operational and political obligations. Even on a purely technical level, staff felt that shared control was unwise. For example, Caltrans, county and L.A. DOT staff pointed out that if Caltrans took over traffic signals near freeway entrances, Caltrans staff would need to understand the ramifications of changing signal timings on construction projects and special events over a wide area. No one thought that this would work out well. The solution was coordination rather than shared control.

Centralized vs. decentralized

From a distance, TRANSCOM and TranStar appear to be centralized while the Smart Corridor project in L.A. is decentralized. In actuality, the study team found less difference than meets the eye. There is an obvious difference in the centralization of place in Houston (staff under one roof) and in TRANSCOM's serving as a centralized hub for information flow in New York. As discussed earlier, however, basic operational responsibilities were not centralized. Even with respect to TranStar, which appears to be the most centralized of the three cities, officials described the organization as a "loose umbrella" in which staff "work separately together."

It is notable that current developments are marked by greater decentralization *and* closer coordination between agencies. For example, the countywide signal synchronization program in L.A. County will have no hub or center, instead providing direct links between multiple agencies. In New York, TRANSCOM is focusing more on packaging traffic information for public consumption while several member agencies are developing closer direct ties. In both cases technology such as fiber optic networks and software solutions

that link different computer systems make it easier for agencies to deal directly with each other while making less important a central hub or clearinghouse for information gathering and dissemination.

It is also notable that the decentralized, "no one in charge" model applies to inter-jurisdictional coordination but not necessarily to intra-jurisdictional, interagency coordination. Coordination between N.Y.C. DOT and NYCPD was greatly aided when City Hall anointed the Police as in charge of incident response. With the PD clearly in charge, each agency could focus on carrying out its functions without worrying about being held accountable for problems outside their domain.

Non-Constraints

Technology

All officials interviewed agreed that the needed technology exists, both hardware and software. Technology was not a constraint to development of traffic management or to inter-jurisdictional coordination. In fact, new and rapidly advancing technology helped advance the cause of inter-jurisdictional coordination, as discussed earlier.

Federal regulations

Federal regulations did not arise in discussions concerning planning or implementation issues with traffic management or inter-jurisdictional coordination.

Capital funding

Officials interviewed in the three cities felt that sufficient capital funding was and is available to move their projects forward.

Nonsense

Comprehensive plans

As discussed earlier, inter-jurisdictional coordination in traffic management in the three sites has proceeded in an incremental, building-block fashion.

While some literature suggests that a planning process can help form a shared vision among agencies, the experience of the three cities is the reverse. During the process there develops a common shared vision of capabilities and objectives for the systems being developed. This shared vision is very important and leads to further system development. In L.A., for example, the more comprehensive efforts followed the initial demonstration programs that built a common vision and demonstrated that different systems can work together. But none of the cities visited had first developed a comprehensive plan for inter-jurisdictional coordination or for traffic management itself. Nor did any think that a comprehensive plan would have been useful.

Formal agreements

There are different types of formal agreements. L.A. and Houston developed formal contingency plans for various incidents that could arise. N.Y.C. DOT and N.Y.S. DOT are developing a formal interagency agreement. Officials interviewed tended to cite formal agreements as a necessary (and often challenging) step in coordinating their activities. While important in taking the necessary steps of formalizing inter-jurisdictional relationships, these formal agreements were not felt to have helped the process move forward. Much more important were the staff relationships and need to respond to visible problems.

NEAT IDEAS FOR LARGE CITIES

The detailed case study descriptions will present a number of technological and institutional innovations that have proven to be successful in the areas visited. In this section we set forward innovations or approaches (not in priority order) that we feel have particular relevance to large central cities.

1. Transit priority system (TPS) - Los Angeles. The Los Angeles Department of Transportation is designing and implementing a transit priority system in conjunction with the Los Angeles County Metropolitan Transportation Authority (MTA). Using the existing coordinated signal system (ATSAC) and the in-house expertise, L.A. DOT is able to support and contribute to a regional objective to create a traffic signal priority system for busses to improve bus speeds and attract more riders to the transit system.

2. Co-location of traffic and police personnel in an ITS facility - New York City. Following the transfer of some traffic enforcement functions from the N.Y.C. DOT to the N.Y.C. Police Department, the personnel of the two agencies which did not have a history of cooperative activities were co-located in the city DOT TMC. The agencies have now found many ways to work together to enhance each agencies' programs that go well beyond the previous responsibilities which were transferred.

3. Emergency management and incident management co-location with ITS in a TMC - Houston. Co-locating two functions with high political visibility and support (emergency management and incident management) with a less politically visible function (ITS) has produced many new cooperative programmatic approaches to solving problems as well as raising the visibility and support for traffic management.

4. Constructing the ITS infrastructure as part of a highway reconstruction or rehabilitation project and using the ITS capability as part of the maintenance and protection of the traffic component of the construction project - New York City. New York DOT instituted a program to construct the ITS infrastructure as part of each contract to reconstruct and/or rehabilitate the major highway facilities in New York City. Since the maintenance and protection of traffic is a critical (and expensive) component of any construction project in the city, the use of the ITS capability is very helpful during construction and establishes a working model for operation after construction.

5. Developing, funding and maintaining in-house expertise for traffic management and communications technology - Los Angeles. L.A. DOT has successfully developed their traffic signal coordination and control system (ATSAC) using in-house staff supplemented by consultants. Having in-house capability has proven to be very cost-effective and has been instrumental to the success of ATSAC. The in-house staff is also available to tackle additional ITS applications with other agencies in the area where L.A. DOT can contribute expertise to a cooperative venture. Training and funding for the staff has also been successfully provided.

6. Portable video units at incidents linked to the TMC - New York City. One of the major desires of the managers at TMC's in New York City is to have a picture of what is happening on and near the facility, especially during an incident. New York City is developing a number of approaches to dispatching portable video units to the scene of incidents which will allow the managers at the TMC to see what is happening and make the necessary adjustments.

7. Toll tags as traffic probes- Houston, New York City. One of the challenges for a TMC is to determine changes in traffic flow due to incidents or unusual conditions where video surveillance is not present, as a basis for intervention with traffic management strategies. The use of toll tags as traffic probes is being used successfully in Houston in conjunction with the Texas Transportation Institute (TTI) and in New York through a TRANSCOM demonstration project.

8. Developer mitigation/franchising to accomplish programmatic objectives- Los Angeles, Houston, Portland. In many instances, developers or other organizations requesting permission to operate and/or build in a large city must obtain approvals from non-transportation agencies. By actively participating in the approval processes, transportation agencies can obtain funding and facilities to enhance transportation objectives. Examples in Los Angeles and Houston show where developers have contributed to the installation of an overall coordinated signal system upgrade as part of a developer traffic mitigation plan. In Portland, the agencies promoting a coordinated fiber optics system used the franchising process to have a developer install a missing link in the fiber optics system.

9. Public-private motor assistance program (MAP)- Houston. Houston was able to develop a motorist assistance program through a unique public-private partnership. The MAP vehicle drivers and motorist assistants are county sheriff deputies and their salaries are paid for by METRO, the regional transit agency. Texas DOT provides the dispatcher. Houston Cellular donates a cell number and the Houston Area Auto Association donates the vans on a four-year replacement cycle.

5. LOS ANGELES CASE STUDY

PROJECT OVERVIEW

Traffic management in Los Angeles has grown and developed with a series of projects. The study team looked in detail at inter-jurisdictional coordination of three projects: Smart Corridor, bus priority, and county-wide signal synchronization.

Smart Corridor

The Santa Monica Freeway Smart Corridor Demonstration project is an operational test of various Intelligent Transportation Systems (ITS) technologies and traffic management strategies. The Smart Corridor project boundaries consist of a 14 mile segment of the Santa Monica Freeway (Interstate 10) from the Santa Ana Freeway (Interstate 5) to the San Diego Freeway (Interstate 405) and five parallel major arterial streets; Adams, Washington, Venice, Pico, and Olympic Boulevard.

The agencies involved in this joint regional corridor project include: Caltrans District 7, Los Angeles County Metropolitan Transportation Authority (MTA), City of Los Angeles Department of Transportation (L.A. DOT), California Highway Patrol (CHP), and the cities of Santa Monica, Beverly Hills, and Culver City. The operational test began in 1996 and was considered a national example of successful implementation of inter-jurisdictional traffic management. The expert system, however, was deactivated in the late 1990s as Caltrans felt that a different organizational model would be scalable to cities in the entire county.

Bus Priority

L.A. DOT collaborated with the MTA to implement an advanced Transit Priority System project for buses along two major transit corridors. Under the project, signal timings can be adjusted as buses approach an intersection in order to help buses catch up to schedule when needed. Four types of signal priority action can be taken, including providing an early green signal and extending the green when a bus is approaching. The system also provides information on bus locations and travel times for MTA managers.

This demonstration project has been implemented on Ventura Boulevard and Wilshire/Whittier Boulevards. The Ventura Corridor connects the Metro Red Line subway station at Universal City with Warner Center, a major commercial and business center in the West San Fernando Valley. The Wilshire/Whitter Corridor connects East L.A. with the central business district. Together, the two corridors include 200 signalized intersections on over 38 miles of arterial road.

County-wide Signal Synchronization Program

This project, led by MTA with the active support of the county, involves synchronizing traffic signals across jurisdictional boundaries. The MTA divided Los Angeles County into eight areas and formed a “forum” or working group for each area. The working group in

the southeast part of the county is planning major traffic signal improvements in five corridors in the area. The synchronization program will involve direct information sharing on a distributed network among the County, MTA, Caltrans and nine municipalities in the southern part of LA County.

Although the City of Los Angeles is not currently directly involved in this program, MTA and County staff were interviewed because it was felt that the program provides a demonstration of future coordination that will involve the city.

MAIN LESSONS LEARNED/USEFUL IDEAS FOR LARGE CITY TRANSPORTATION OFFICIALS

1. There are many benefits from taking a bottom-up, incremental approach. These include ease of planning and implementation, strong focus on needs, showing results relatively quickly and building support for additional funding based on demonstrated results, building trust as a basis for further efforts. The more comprehensive, area-wide efforts have followed these initial demonstration or showcase projects and are necessary to develop a common vision of the future and to ensure that different systems can share information and communicate. It is also important to implement projects in manageable (geographically and technically) pieces. For example L.A. DOT has developed ATSAC in geographic increments where the area boundaries make sense from a traffic control perspective. In each area, they upgrade the signals (130-150 signals/area) with new controllers, interconnect the system and connect to the hub, install loop detectors and add about 5 cameras/120 signals connected by fiber optics to the TMC. Each incremental area represents a fundable project.

   It is also possible to adapt new technologies or improvements in technology on an incremental basis. L.A. DOT is adopting and implementing a program to change ATSAC from UTCS to an Adaptive Traffic Control System (ATCS) while continuing to maintain both platforms. Other incremental changes are the transition from a mainframe system to a P.C.-based system and changing signal controllers from 170's to 2070's.

2. Each governmental unit maintains management control of its own facilities. Information is shared, traffic management functions are closely coordinated and control of non-threatening resources such as traffic cameras may be shared. But fundamentally, each agency maintains and remains focused on its own local responsibilities for traffic management. All involved parties agree that there are valid substantive and management as well as political reasons for taking this approach. The inter-jurisdictional arrangements and technologies are built around maintaining local control.

3. Successful implementation requires dealing with operations and maintenance funding issues up front in the planning process. In some cases, technology choices are made to minimize operating costs—in the case of smaller municipal governments this means choosing communications technology that costs a few thousand dollars less on an annual basis.

4. Critical role of funding agencies to use federal, state and locally generated funding to support municipal capital costs and mandate inter-jurisdictional coordination as a condition for receiving funding. In this case MTA is not the MPO but has local statutory authority for planning and programming for a significant portion of funding.

5. Importance of in-house technical expertise in building a successful traffic management program. In Los Angeles, the L.A. DOT has been able to attract and retain internal staff by continually creating new and interesting projects and has been successful in attracting external funding for this in-house staff so that they are off-budget. L.A. DOT has one person dedicated to these administrative and grants writing activities for the ATSAC program.

6. Initial face-to-face discussions on roles, responsibilities and project objectives are critical to find out what can be done and what can't be done. However the resulting coordination is best done at the technical level. While much up front time was spent in developing Memorandums of Understanding between agencies and emergency management plans, such as at the start of the SMART Corridor, the experience has been that once the technical operators begin dealing with real time concerns, the coordination and cooperative approach to problem solving is built up with experience and the MOU and emergency contingency plans are rarely used.

7. There is an opportunity to use developer mitigation funding to advance the TMC program. In Los Angeles, the L.A. DOT is responsible for reviewing developments greater than 50,000 sq. ft. and approving developer mitigation plans. They have required the developers to convert signals to the ATSAC format as part of the mitigation plan. They estimate that 10% of the $150 m program has been funded with mitigation funding.

8. One success factor has been to link up the ATSAC/TMC to as many other governmental programs as possible, including emergency management, data archiving for planning agencies and research organizations, movement of goods from the major ports, economic development, neighborhood protection, fire department, police, etc. L.A. DOT developed ATSAC to be fully justified on the benefits within the city including coordination with other city agencies. Any benefits from sharing information and coordination with other levels of government were viewed as additional benefits.

9. Use peer reviews and professional evaluations extensively before launching into a major effort.

10. Have a vision on where you want your system to be in the next 10 years

DISCUSSION OF KEY ISSUES

(1) What agencies were involved at the start of the TMC inter-jurisdictional process? Why were they selected? What was the role of direct inter-agency relationships vs. multi-agency coordinating committees and the like? How were these relationships structured? Was there a lead agency, and if so, who was it? What were the functions and responsibilities of each agency?

The origins of inter-jurisdictional traffic management coordination trace to efforts in the late 1970s and early 1980s that culminated in coordination for the 1984 Olympics and the Smart Corridor project that officially opened in 1996.

The relationships in Smart Corridor and subsequent efforts are structured primarily as direct inter-agency relationships; there is no central clearinghouse or control center. Bus priority involves coordination between L.A. DOT and MTA. The Countywide Signal Synchronization program will involve direct information sharing on a distributed network among the County, MTA, Caltrans and nine municipalities in the southern part of LA County.

(2) Why did the agencies participate in this effort? What was the role of need to improve traffic flows? Of a regional vision? Of political forces?

Traffic congestion is legendary in Los Angeles and affects nearly every resident of the metropolitan area. As the era of freeway building neared its close, there seemed to be a clear consensus among not only traffic engineers but also elected officials and the public that traffic management could help to alleviate traffic congestion. Early on, the focus was on special events and incident management. The perceived success of traffic management efforts during the 1984 Olympics helped build public support for further efforts and expenditures. The opportunity for further successes created a positive environment for cooperation between Caltrans, L.A. DOT and MTA financial and planning support. Within the City of Los Angeles, upgrades to traffic signal equipment and use of centralized control proceeded with City Council support; Council members felt that they wanted upgrades when they saw results in other areas of the city.

Traffic management coordination thus began from within the transportation agencies, showed results, gained political support and continued to expand. As the system gained a foothold, its expansion was added as an element of regional transportation plans.

(3) What was shared—information, facilities, equipment, communications networks? What was coordinated—incident response, traffic signal control, variable message signs, emergency response? Why did coordination take the form that it did? What tradeoffs were involved? Would additional benefits be achieved with additional sharing or coordination arrangements?

Los Angeles officials defined coordination as having 5 possible levels:

1. Do nothing

2. Share information only
3. Share limited control on special events/incidents
4. Share control on day-to-day operations
5. Complete redundancy.

They feel that ATSAC is at level 3.

With only a few exceptions, transportation agencies in the L.A. area share information and technology in order to coordinate their operations, but do not share control over agency responsibilities such as traffic signals, bus movements, ramp metering, variable message signs, etc. Traffic management staff from the agencies we interviewed felt that this arrangement best meets traffic management, operational, political and legal needs.

Each inter-jurisdictional arrangement is discussed below.

Smart Corridor/TMC coordination

During program planning agencies tended to view coordination as part of a progression of steps. For example, L.A. DOT staff expected that cooperation with Caltrans and other agencies in the Smart Corridor project would start with information sharing and then move toward sharing of control over surveillance cameras, control of traffic signals and variable message signs.

The Smart Corridor project did not move further into sharing operational control for essentially two reasons. First, the agencies felt there were too many risks involved with shared control. These risks are operational, legal and political.

Operationally, staff feel that shared control would require an unattainable level of understanding of other agency's facilities. In order for Caltrans to effectively change arterial signal timings for example, its staff would need to understand not only how altered timings would help relieve traffic from a freeway incident, but also the impacts on other arterials, effects of any ongoing construction on surface roads, special events, etc. Likewise, for L.A. DOT to change ramp-metering settings would require an areawide understanding of freeway conditions. Each agency feels that everyone is best off focusing on its own facilities. There are too many risks of inadvertently choosing a "cure" that is worse than the "disease." Thus, shared control of facilities is avoided for both potential operational problems, and to avoid the legal liabilities that might result.

In addition, and closely related, agency staff feel that they need to be clearly responsible for operation of their own facilities. Shared control would compromise their responsibility.

There are two notable exceptions to the "sharing-only" practice. First, L.A. DOT and Caltrans share control over the operation of surveillance cameras. Each agency can zoom, pan and tilt cameras to obtain the best view of traffic conditions throughout the highway and roadway network. This exception proves the rule, however; shared camera control does not involve signalization, message signs or other traffic-control responsibilities.

Culver City vs Beverly Hills

Coordination and information sharing is illustrated by two separate arrangements between L.A. DOT and adjacent cities: Culver City and Beverly Hills. L.A. DOT reached an agreement with Culver City where Culver City would construct the signal coordination system to L.A. DOT specifications and then turn over the system to L.A. DOT. L.A. DOT operates traffic signals in Culver City and is thus able to coordinate signals timings on major arterials running through both cities. Culver City maintains the signal equipment. There is an agreement on the computerized signal changes in response to changing traffic patterns. L.A. DOT does not intervene in these patterns without contacting Culver City except to respond to a major incident.

The Culver City-L.A. DOT arrangement is aided by financial and staff circumstances. L.A. DOT has pledged 100 hours of free support a year to Culver City, a level that has not been exceeded. The cooperative arrangement is facilitated by the fact that the chief traffic engineer in Culver City is a retired L.A. DOT traffic management center employee.

Beverly Hills' approach contrasts with that of Culver City. Beverly Hills is virtually surrounded by the City of Los Angeles. Several major arteries run east-west from L.A. through Beverly Hills and back into L.A. Beverly Hills operates its own traffic signals while sharing information and coordinating with Los Angeles. About one-half of Beverly Hills' 98 signals are controlled centrally; the status of these signals can be shown on ATSAC terminals. Likewise, Beverly Hills' traffic control center computers show the status of L.A. traffic signals. Staff from the two cities coordinate by phone on signal timings. At one time L.A. DOT had an agreement with Beverly Hills to operate signals on Olympic Boulevard but Beverly Hills took back control.

Beverly Hills retains operational control for several reasons. The city wants to be sensitive to residents' concerns, particularly pertaining to cross-street traffic and pedestrian needs. City staff are also expected to provide same-day response to citizen or City Hall questions, which might be difficult if L.A. controlled the signals. There seems to be an issue of the symbolism if L.A. took over control of a Beverly Hills traffic function.

West Hollywood

L.A. DOT is hoping that a recent agreement with West Hollywood will set a model for future agreements. In response to a proposed major development in West Hollywood and the concerns raised by the city on the impact of the development on traffic, there was an agreement that the developer would upgrade the signals on Sunset Boulevard to ATSAC specifications. It was also agreed that L.A. DOT would take control of traffic signal operation on Sunset Blvd.

Bus priority

In the bus priority project, information on bus locations, bus schedules and signal timings is shared between L.A. DOT and MTA on the Ventura Boulevard and Wilshire/Whittier Boulevard corridors.

As with the Smart Corridor project, the agencies involved share information and coordinate their responses, but each maintains control of their own operations. Occasions for bus priority are carefully defined; the MTA control center requests bus priority when the bus is running late and either holding a green light or giving an early green would be help get the bus back on schedule. L.A. DOT's system evaluates each request in real time, taking into account the need for pedestrian walk time and cross-street traffic volumes.

Countywide Signal Synchronization

This effort is focused on sharing information and coordinating traffic operations, beginning with a showcase program involving nine municipalities in the southeast part of the county, L.A. County, the MTA and Caltrans.

The program does not involve sharing or altering control of traffic signals, ramp meters or other facilities. MTA and County staff note that the various agencies involved do not want to take on the responsibility of understanding other agencies' environments, similar to the point made by L.A. DOT and Caltrans staff.

(4) How were the projects funded? How was public, political and institutional support for traffic management systems built?

Capital funding for these projects has come from federal and state transportation funds, and local funds generated by Prop. A and Prop. C. The Smart Corridor project was built with federal transportation funds.

Capital funding is channeled through SCAG (the MPO) and the MTA, which is responsible for transit and highway planning and funding allocations in L.A. County. The MTA estimates that it has allocated $300 million in funding for traffic management projects. L.A. DOT estimates it has spent $150 million in capital funds on its ATSAC system, broadly defined. This includes $2 million planning grant from the MTA for development of its adaptive traffic control system.

Developers are another source of capital financing. Developers have used ATSAC system expansion and improvements as mitigation measures to offset the increased traffic from office and retail development. Developers are allowed a traffic capacity credit of 7% improvement for funding of hook-ups between ATSAC and traffic signals in a defined geographic area. Funding must be for a defined geographic area, on the basis that the traffic system must be improved in order to realize traffic improvements, not simply for specific intersections or development sites. Developer payments have totaled approximately $10-15 million.

Municipalities fund all operating and maintenance costs. L.A. DOT's ATSAC budget is $1 million annually. Although federal rules allow some federal funds to be allocated to operations, MTA's policy disallows it.

Earmarked federal funding is also important for developing coordination. The SMART Corridor project was initiated with federal funding. Funding for the 9-city showcase

program came from the designation of southern California as a priority corridor in the ISTEA legislation.

(5) What were the main costs and benefits of coordination?

The traffic management system in Los Angeles has documented speed improvements. Agency staff believe that inter-jurisdictional coordination extends these benefits across the city's boundaries and between highway and arterial systems. Benefits were particularly evident during the 1984 Olympics and the aftermath of the 1994 Northridge Earthquake. Calamitous traffic tie-ups that were feared for the Olympics never occurred; the traffic management system was given a share of the credit for this happy outcome. The 1994 earthquake toppled a section of I-10 in the heart of the Smart Corridor. Smart Corridor technology was invaluable in moving re-routed traffic on the adjacent arterials.

Financial costs were noted earlier. Agency staff did not cite any non-financial costs.

(6) What were the catalysts to inter-jurisdictional traffic management? What role did bodies with regional jurisdiction play? Was there a champion who played a critical role? Were funding requirements important? If so, who set the requirements and why? Did the demands of traffic management for special events play a catalytic role?

Champions, funding requirements and special events all played catalytic roles in the development of the traffic management system and inter-jurisdictional cooperation.

In the late 1970s and early 1980s, the L.A. DOT General Manager, Edwin Rowe, championed the ATSAC system. His unremitting efforts over a period of years was critical to bringing ATSAC into existence. Availability of non-city capital funds played a critical role as well; the fact that City General Funds were not used for the initial cost helped ease city approval.

A champion of a very different type was key to development of the Adaptive Traffic Control System (ATCS). ATCS is a PC-based networked system. An ATSAC engineer at home initially developed the software on his own time and initiative. At the outset it was not formally commissioned. The City eventually paid him for the software, copyrighted the code and continued development.

As noted earlier, capital funding from federal, state and regional sources was essential to construction of the traffic management system. MTA funding requirements were critical to coordination between neighboring municipalities. For example, the MTA required that Beverly Hills adopt technology that is compatible with the ATSAC system. The MTA is also funding the Countywide Signal Synchronization program that will enable nine municipalities in southern L.A. County to coordinate their traffic systems.

The important role of special events was discussed earlier.

(7) To what extent was coordination a product of planning processes? What was the nature and extent of the planning processes? Who was involved? To what extent did coordination proceed incrementally? What was the experience with each approach used?

Traffic management programs and the subsequent coordination between jurisdictions came about primarily as a response to a widely perceived need to improve traffic conditions. In the Smart Corridor and bus priority projects, coordination arose because agencies identified particular opportunities to work together. These steps were then incorporated into regional transportation plans, which then made is possible for additional funding to be secured. It seems fair to say that while coordination was not directly a product of planning processes, it has been supported and furthered by regional plans.

Somewhat by contrast, the Countywide Signal Synchronization program originated in the Southern California Priority Corridor project. USDOT designated a 6-county region around Los Angeles as a priority corridor in 1994. Its objective is to bring local agencies up to speed on ITS and integrate the many individual projects into an overall system.

(8) How was trust built between agencies?

The two keys to trust building have been expertise and experience. Effective coordination requires that each agency possess comparable levels of staff expertise in addition to equipment with the necessary capabilities. In contemplating coordination arrangements, staff at each agency wanted to be sure that neither agency was too far "ahead" or "behind" the level of staff expertise and capability at the other agency or agencies. This is important to an effective, satisfactory peer relationship.

As the coordination proceeded, staff at different agencies became more familiar and comfortable with each other and more expert is dealing with traffic events. In Smart Corridor, rather than necessarily wait for the expert system to diagnose a problem and recommend responses, staff often took action first, collaborating between agencies as necessary. In this way, informal coordination often supplanted the formal response plans that had been agreed upon in a painstaking process.

(9) How were control issues addressed?

As discussed earlier for each project, the basic approach to control issues has been to let each agency retain control over its own facilities while sharing information and coordinating incidence response and traffic management. By itself, however, this basic approach is not necessarily sufficient. Two other ingredients seem to be critical to successful coordination. One concerns mutual respect for staff expertise, also discussed earlier. The other is that agencies have been careful to avoid letting their traffic management actions negatively affect other agencies' facilities. For example, Caltrans does not divert traffic from freeways to local streets no matter how bad the freeway congestion may be. Variable message signs are used to advise motorists to avoid a given freeway or take an alternate freeway route but not to get off the freeway onto an arterial.

In operating ramp meters Caltrans ensures that traffic does not spill back into intersections adjacent to the on-ramp. "Q loops" at the start of the on-ramp detects when the ramp is full and ramp meters are adjusted accordingly.

(10)How were issues of compatibility of communications systems, data formats, etc. dealt with? Was this an important issue? At what point was it resolved?

We observed two distinct approaches to this issue—ensuring compatibility in system design, and designing systems using different technologies to work with each other. Compatibility in system design was a MTA requirement for funding of Beverly Hills' traffic signal upgrades and traffic management system equipment. The Countywide Signal Synchronization program takes the opposite tact. Information is to be shared between systems using different technologies by use of a "kernel" that translates between the "language" of each system and the "language" used by the kernel. Participating cities, the county and MTA need not have compatible software but can communicate using this translation software. This approach was felt to be the most practical given the diversity of current technology in use and the reality that procurement procedures prevents jurisdictions from necessarily choosing standardized equipment.

(11)Use of private partners, particularly of interest if traffic information has commercial value.

Los Angeles' approach is to provide traffic information to the media at no charge. Officials view this as the most convenient conduit to the public, and the most effective since the media can be responsible for tailoring the information to the needs of different audiences.

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6. HOUSTON TRANSTAR CASE STUDY

PROJECT OVERVIEW

TranStar is the name given to a consortium founded in 1994. The members of the consortium are the City of Houston, Harris County, the Metropolitan Transit Authority of Harris County (Metro) and the Texas Department of Transportation (TxDOT). TranStar has two main functions—Transportation Management and Emergency Management. The TranStar building, which opened in 1996, houses these two functions and has representatives of the four consortium members as well as other organizations working within the same building.

TranStar has a small staff of 5 people to guide and administer the various programs. Representatives of the various agencies perform the rest of the functions. In the event of a major emergency, TranStar is equipped to be self-sufficient for up to 10 days and has a control room for the major elected officials and their staffs.

TranStar has 3 levels of management. All decisions are made on a consensus basis.

1. Executive Committee that sets policy and decides fiscal matters. The representatives are the District Engineer of TxDOT, General Manager of METRO, Director of Engineering, Harris County and the Director of Public Works, City of Houston.

2. Leadership Team administers agency staff assigned to Houston TranStar. Representatives include traffic managers from the four agencies as well as the Chief of Police, Metro; Emergency Management Coordinator, Harris County; Executive Liaison, Harris County, and Emergency Management Coordinator, City of Houston. Recently the Director of the 8 County MPO (Houston Galveston Council) was added to this group since the 8 county region is developing an ITS architecture for the whole region.

3. Agency Managers Committee, comprised of on-site managers of the transportation and emergency management groups, oversees daily operations.

The history of TranStar can be traced to two factors. The first factor was that starting in 1991, the agencies began to work cooperatively on the establishment of a 103-mile network of high-occupancy lanes (HOV) as one of the primary transportation strategies for the area. This shared common vision and the positive experience of working together led to the TranStar agreement in 1994. The second factor was the presence of a strong champion for both the HOV concept and for TranStar in the person of Mr. Robert Lanier. He had the unique experience of having held leadership positions in three of the member agencies, serving as a member of the Texas State Transportation Commission, Chairman of Metro and Mayor of the City of Houston during the formation of TranStar. Not to be discounted was the role of the head of TranStar, Doug Weirsig, in directing the early development, funding and implementation of TranStar.

Another success factor in the establishment and functioning of TranStar is the structure and responsibilities of Metro. In addition to the normal responsibilities of a transit

authority to run the transit operations, Metro is also responsible for the operation and maintenance of the HOV lanes. Metro builds local roads, provides police for the HOV lanes, administers the Motorist Assistance Program (MAP) and is the recipient of 1 cent of the local sales tax, 75% of which is for transit programs and the remaining 25% is for mobility projects including ITS.

Probably the best way to describe the functioning of TranStar is to use phrases from some of the people interviewed for this case study. TranStar was described as:

> ”a loose umbrella for the coordination of activities”
>
> “ working separately together”
>
> “ like brothers and sisters, we fight a lot but don’t talk bad about any one of us or we will defend each other”
>
> “ creates a level playing field to solve problems”
>
> “ TranStar is no better than any one of its agencies”
>
> “ its not my traffic, it’s everyone’s traffic”

Projects coordinated under the TranStar umbrella can best be described by going around the room in the traffic management center and describing the activity at each agency’s work station.

(1) Metro’s bus transit operations- dispatch, operations and maintenance functions of 1200 buses

(2) Metro’s traffic management police officers- operate the HOV lanes, manage incidents and control the Motorist assistance Program (MAP)

(3) City of Houston Police dispatcher- controls incidents on freeways

(4) Texas DOT freeway management system- variable message signs, ramp metering, highway advisory radio, camera surveillance, dispatch of maintenance equipment during an incident, and dispatch of a heavy vehicle clearing contractor to remove heavy vehicles involved in an incident.

(5) Metro Traffic- a private company that disseminates traffic information to the various media outlets.

(6) City and County Emergency Management Agencies activate an emergency management center in the event of an emergency, monitor current conditions including flood gauges on expressways.

(7) Texas Transportation Institute Automated Vehicle Identification (AVI) system that uses toll tag vehicles as traffic probes to determine levels of congestion.

In the future, TranStar will also be the home for the control center for the new light rail system, which is currently under construction, and the city, and county Regional Traffic Control Signal Systems (RTCSS).

The Harris County Toll Authority that operates two major toll facilities within the county is not part of TranStar. Communication and coordination of incidents are done over the phone.

Projects of particular note for Large Cities Transportation Departments are:

1. The use of toll tags as traffic probes under the AVI program. There are more than 1/2 million tags in circulation in the Houston area. Texas Transportation Institute (TTI) developed the program and administers it under contract to TxDOT. A map of congestion is available in the transportation center for use by all agencies and the public. TRANSCOM has a similar research project underway.

2. The Motorist Assistance Program (MAP) is an interesting partnership. It was originally a state initiative but now the program includes the county sheriff deputies as MAP vehicle drivers and motorist assistants. The motorist assistants' salaries are paid for by Metro, TxDOT provides the dispatcher, Houston Cellular donates a cell number and the Houston Area Auto Association donates the vans on a four year replacement cycle.

3. The agencies are creating a Regional Traffic Control Signal System (RTCSS). RTCSS will provide for surveillance, interconnection, and synchronization of some 3200 signals in the area, 2300 within the City of Houston. It provides a state-of-the art traffic signal/communication system capable of regional transportation management. Signals in the city will be operated and maintained by the City of Houston. The county will own and operate the signals outside of the city and off the state system. In the City on state routes, the state contracts the maintenance and operations with the city. Outside the city, the state owns and operates the signals on the state system. All systems will connect to TranStar eventually. All will use the same software (Gardner systems) and will have compatible hardware. On transit routes, Metro will fund the signal upgrades using federal transit funds and local mobility funds. The agencies are developing a maintenance system (Signal Shop) which will detect signal malfunctions or receive calls on signal failures and transmit the information to the responsible agency. Another software program ICON will automatically report malfunctions and change signal timing for synchronized operation with adjacent controllers.

In addition to these day-to-day functions, TranStar has some $20 million of federal priority corridor projects in various states of implementation (see attached list)

MAIN LESSONS LEARNED/USEFUL IDEAS FOR LARGE CITY TRANSPORTATION OFFICIALS

1. The importance of face-to-face communications. Each person interviewed stressed that having each agency located in the same building and in most cases in the same control room yielded numerous benefits in terms of building trust, joint approaches to solving problems, having exposure to lots of different functions carried out by other agencies, and developing new ways to work together which were not foreseen when TranStar was originally designed. Each agency is immediately made aware of the impact of their actions on other agencies. The ability to "shout over to another agency traffic controller" during an incident was viewed as a major benefit. It seems to be a paradox that in a high-tech atmosphere with the latest communications devices, the benefit most prized by the participants was the ability to interact face-to-face on a day-to-day basis.

2. The importance of technically competent, highly motivated employees. While TranStar is widely viewed as a success, there is a concern on the part of several individuals that the application of new technologies has hit a plateau. One statement was that, "it took ten years of HOV coordination to get TranStar, it will take another 10 years to get to the next level of cooperative operations." Member agencies are struggling with accomplishing the day-to-day primary mission of their agencies and are having difficulty keeping up with the explosion of new ideas and applications coming out of the synergy created by TranStar. This is recognized as a nationwide problem. Nationally, transportation agencies are trying to make the transition from construction-based activities to systems operations-based organizations. There is a shortage of engineers trained in the use of technology for systems operations. And the overall policy of reducing the size of government is impacting traffic management operations. Even with the technological expertise of the member agencies of TranStar, they have still experienced false starts and delays in the development of some programs. All participants stressed the importance of in-house expertise before undertaking large technology-driven projects.

3. A coalition such as TranStar provides the opportunity to use the strengths of each organization in a partnership arrangement. For example, in the design and construction of the TranStar facility, the State let the construction contracts, Metro did the communications systems, the City handled the finances and the County maintains the building. There were many other examples given where the strengths of individual agencies were combined to accomplish a project.

4. The combination of emergency management with traffic management is viewed as bringing benefits to both functions. When TranStar was designed, the emergency management function was not part of the original plan. Now that the functions are combined, the participants have developed many new ways to cooperate not only in times of an emergency but in preparation for an emergency and in dealing with day-to-day incidents.

5. The combination of all agencies involved in incident management into TranStar has proven to be beneficial. The Metro Police have the lead for coordinating incident management. They have created a Freeway Incident Management Plan and Procedures Manual in conjunction with all the other agencies. Combining enforcement personnel with traffic operations staff has provided additional benefits. The combination of emergency management and incident management with traffic operations provides political support for the entire operation since emergency and incident management are highly visible public activities while traffic control tends to be a background operation.

6. When developing inter-agency agreements dealing with technology issues, the agreement should be as general as possible since technology is rapidly changing and future technology cannot be predicted. The tendency in government agreements is to anticipate all possible situations and to incorporate language to handle these contingencies. Experience at TranStar has shown that past agreements could not have anticipated the impact of new technologies and that the time spent in worrying about past contingencies was wasted.

7. The importance of a shared vision (a network of HOV facilities) and a strong champion (Robert Lanier) facilitated the working relationships that led up to TranStar. TranStar has been able to transition from the departure of the Mayor who was the champion of the operation and the hiring of a new Metro General Manager who has a new proposal for transit in the area. Both the new Mayor and new General Manager have become strong supporters of TranStar.

8. The agencies need to have a strategic plan for considering the operations and maintenance costs of not only the individual components of the traffic management systems but also the combinations of new services that are possible when the systems are operational. There are many opportunities for cost savings by joint actions as opposed to each agency doing its own thing. Operations and maintenance considerations may become the limiting factor on how many new areas and programs are incorporated into TranStar.

9. While thinking regionally is important, each agency must also take care of their local constituencies and not ignore the local problems. Cooperation does not discharge local responsibility. Local officials stressed that they must still be aware of and responsive to local constituencies and elected officials regarding day-to-day concerns.

10. The inclusion of a private sector media outlet within TranStar, Metro Traffic, has relieved the agencies of a major responsibility for disseminating traffic information to the public. The information is made available to the private sector without compensation. The feeling is that the dissemination of information to the public has a value that offsets any compensation.

11. Building mutual trust among agencies is a must. This can often be accomplished by starting with small projects with a high likelihood of success and then building off that success with more complex projects. One agency with technical competence in a

particular area can take the lead and set the parameters and specifications for other agencies. In this case, Harris County took the lead in designing the specifications and software requirements for RTCSS. Competition among agencies is not necessarily bad since it increases technical competence and forces other agencies to increase their competence in order to compete.

12. Texas state law gives incident management agencies the ability to quickly clear the traffic lanes on state highways without incurring any liability in subsequent accident proceedings. While this is very useful and used extensively for clearing vehicles, this power is rarely used when there is a fatality or serious injury.

13. The state put out for bid a contract for a heavy vehicle wrecker to quickly clear accidents involving trucks and other heavy equipment. The final bid was $1 since the wrecker figured that they could make their money from insurance companies. This has proven to true and the second time the contract was bid, all the bids were for $1.

14. When writing procedures for handling incidents, knowing who is in charge is important but the plan should also determine "who is in charge of what and at what time" since multiple agencies have responsibilities. The overall goal of TranStar incident management is "to minimize the impact of incidents on traffic congestion and to reduce the probability of secondary incidents."

15. The planning and funding of multi-agency projects takes considerable lead time since the four agencies all have different budget cycles. It normally takes two years to get a project budgeted by all parties.

DISCUSSION OF KEY ISSUES

(1) What agencies were involved at the start of the TMC inter-jurisdictional process? Why were they selected? What was the role of direct inter-agency relationships vs. multi-agency coordinating committees and the like? How were these relationships structured? Was there a lead agency, and if so, who was it? What were the functions and responsibilities of each agency?

Why were they selected? What was the role of direct inter-agency relationships vs multi-agency coordinating committees and the like? How were these relationships structured? Was there a lead agency and if so, who was it? What were the functions and responsibilities of each agency?

TranStar was discussed in the opening section of this report. Several key points are worth repeating. TranStar owes its initial success to a working relationship that was established before TranStar (the implementation of a network of HOV lanes) and the presence of a champion (Robert Lanier). The success has brought other agencies into the process (incident management, emergency management) and this has strengthened the political and technical base of TranStar. Under the TranStar arrangement and committee structure, different agencies take the lead for different projects based on technical expertise and time availability.

(2) Why did the agencies participate in this effort? What was the role of need to improve traffic flows? Of a regional vision? Of political forces?

Initially the availability of a commonly shared vision of a network of HOV lanes and a bus network was the unifying factor. This vision had strong political support and local and federal funding support as well. The TranStar structure has continued even though elements of the vision have changed over time.

(3) What was shared—information, facilities, equipment, communications networks? What was coordinated—incident response, traffic signal control, variable message signs, emergency response? Why did coordination take the form that it did? What tradeoffs were involved? Would additional benefits be achieved with additional sharing or coordination arrangements?

In its 1998 annual report, TranStar estimated travel time savings of more than 4 million vehicle hours, a reduction in time and operational costs of $69.219 million and a reduction in fuel consumption of 6.501 million gallons and the accompanying exhaust emissions for a benefit/cost ratio of 3.9.

The expertise and the availability of time by the technical experts within a particular agency has been a key toward technology development. Cases in point were the county taking the lead in developing the standards and software requirements for the RTCSS and the role of Metro in the establishment of a shared fiber optics system.

(4) How were the projects funded? How was public, political and institutional support for traffic management systems built?

TranStar is funded from a number of sources. The building that cost $13.6M was a combination of federal and local funding. The small TranStar staff is funded by the four agencies on a 30%/30%/30%/10% share basis with the county being the 10%. Interestingly a large share of the RTCSS is funded with “New Starts” - federal transit funds matched with local sales tax funds through Metro. The rationale is that the bus network is their “new start” and that transit routes need signal coordination and priority. Many projects are funded from the 25% mobility funding program from the local sales tax administered by Metro. CMAQ funds are being used by the county for the county portion of RTCSS. Some signals are funded from developer mitigation procedures but in Houston the developers want to put in and fund more signals than the city feels is warranted. TranStar was also selected as one of the Federal Priority Corridor projects and has received about $20 million under that program. The consensus of those interviewed is that capital money is not a constraint at this time. In fact not all appropriated funds are obligated. The constraint is operations and maintenance funding and the availability of trained technical personnel. Operations and maintenance costs are paid by the member agencies directly. Federal funds are not used for O&M.

(5) What were the main costs and benefits of coordination?

See question 3 for the quantified benefits and costs. However, the participants stress that the primary benefits are the ability to work and resolve problems face-to-face.

(6) What were the catalysts to inter-jurisdictional traffic management? What role did bodies with regional jurisdiction play? Was there a champion who played a critical role? Were funding requirements important? If so, who set the requirements and why? Did the demands of traffic management for special events play a catalytic role?

Special events did not play a significant role in the establishment of TranStar but the TranStar structure is used extensively for special events. One Priority Corridor funded project was the installation of a TV surveillance system for transportation management of Astrodome sporting, rodeo and special events.

(7) To what extent was coordination a product of planning processes? What was the nature and extent of the planning processes? Who was involved? To what extent did coordination proceed incrementally? What was the experience with each approach used?

The evidence of the planning process is only in the shared vision of a system of HOV lanes and a strong bus network. The planning process (MPO) is currently working to create an 8 county ITS architecture. The role of TranStar as a regional center or the development of a series of interconnected centers will be discussed during this development process.

(8) How was trust built between agencies?

Trust was built in two ways. The first is through day-to-day, face-to-face working arrangements and developing the ability to solve problems. Secondly trust was developed by successfully accomplishing joint projects through a partnership arrangement where each agency participates within the level and area of their expertise. All of this operates under the umbrella of the policy committee where top level managers set the tone for trust and cooperation.

(9) How were control issues addressed?

At the current time, each agency retains the control of the facilities under their jurisdiction.

(10)How were issues of compatibility of communications systems, data formats, etc. dealt with? Was this an important issue? At what point was it resolved?

Compatibility problems are worked out through the committee structure in place at TranStar and through coordination and partnerships in advancing the various projects

(11)Use of private partners, particularly of interest if traffic information has commercial value.

The TranStar Motorist Assistance Program has several private partners who have donated equipment to the program. TranStar allows a private media firm to operate out of the facility to disseminate traffic information to the public. The arrangement is a "no revenue-no cost" type of arrangement. TranStar does not get any revenue from the private operator but feels that the private operator is providing a service, which otherwise would need to be provided by TranStar, at no cost to TranStar.

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7. NEW YORK CITY AREA CASE STUDY

PROJECT OVERVIEW

Inter-jurisdictional coordination in the New York-northern New Jersey-Connecticut region began with the establishment of TRANSCOM in 1986 under the aegis of the Port Authority of New York and New Jersey. TRANSCOM is a coalition of 16 highway, transit and public safety agencies that are responsible for the safe and efficient movement of people and goods in the tri-state region. TRANSCOM acts as a multi-agency coordinating committee with respect to construction coordination, incident management and testing ITS technology.

The 16 member agencies of TRANSCOM are the Connecticut DOT, Metropolitan Transportation Authority, MTA Bridges and Tunnels, MTA New York City Transit, New Jersey DOT, New Jersey Highway Authority, New Jersey Transit, New Jersey Turnpike Authority, New York City DOT, New York State DOT, New York State Police, New York State Thruway Authority, Palisades Interstate Park Commission, Port Authority of New York and New Jersey, Port Authority Trans-Hudson (PATH) and the NYS Bridge Authority.

In addition to the central-coordinating model provided by TRANSCOM, major transportation, police and emergency response agencies have developed close agency-to-agency relationships. Most notable are intracity coordination among New York City's transportation, police and emergency services agencies and inter-jurisdictional coordination between the City and State DOTs. Other direct interagency relationships are developing. For example, N.Y.C. DOT, New York City Transit (operator of the city bus and subway system) and MTA Bridges and Tunnels (operator of water crossings between boroughs within the city) recently obtained federal funding for cooperative fiber network with video and other information sharing.

TRANSCOM projects

Construction coordination

TRANSCOM assembles construction plans from its member agencies, identifies conflicts (e.g., closures on parallel routes), analyzes potential impacts and provides a forum for mediating the conflicts.

Incident management

TRANSCOM gathers incident information from member agencies in the tri-state region and transmits it back to these agencies. TRANSCOM also obtains information from the I-95 Corridor Coalition and makes it available to member agencies. Agencies can then take a variety of helpful steps. For example, highway traffic can be redirected around trouble spots, often from one or two states away. Agencies may also pull construction work to free up more capacity on a route parallel to the incident.

Implemented in the mid-80s, TRANSCOM currently uses a combination of alphanumeric pagers, fax and phone. TRANSCOM is setting up a system called the TRANSCOM Regional Architecture in which incident information will be shown in map form on computer screens. Users will be able to zoom in on a particular area and click on icons representing particular incidents to see additional detail.

Technology testing

TRANSCOM acts as the lead agency to test new technologies that can then be adopted by other regional agencies. A current example is use of EZ-Pass tags as speed probes on major highways, currently scheduled for completion on 220 miles of highways by the end of 2000.

Model Deployment Initiative

TRANSCOM is the lead agency in this federally-funded project to provide traveler information and personalized trip services.

Direct inter-agency coordination

Direct coordination and sharing among operating agencies takes a number of forms. The two most relevant programs are:

Emergency response within New York City

Several New York City agencies including the City DOT, Police Department, Fire Department, Sanitation Department and Office of Emergency Management are involved in responding to a variety of incidents ranging from traffic accidents to fires, building collapses and chemical spills. At least as far as DOT is concerned, the Police Department is the lead agency for emergency response.

Video sharing.

New York City DOT has obtained a federal grant to construct a fiber optic network connecting City DOT, New York City Transit and MTA Bridges and Tunnels. The fiber network will carry video feeds and data generated by the three agencies.

MAIN LESSONS LEARNED/USEFUL IDEAS FOR LARGE CITY TRANSPORTATION OFFICIALS

1. Begin with projects that are win-win for all agencies involved and produce clear and highly visible benefits. As an early example, TRANSCOM's construction coordination got off the ground after several well-publicized traffic tie-ups. These experiences showed the price of not cooperating and built support among agencies, the public and elected officials for TRANSCOM coordination. Coordination between N.Y.C. DOT and the NYPD has produced clear benefits for both agencies ranging from better traffic management to enforcement of the terms of construction permits.

2. Expertise is important to developing comfort and trust among agencies. Trust is built on respect for the technical competence of other agencies. The NYPD has grown to appreciate the expertise and abilities of traffic agents (now under their control) and of DOT traffic engineers in traffic management and traffic planning. A police sergeant commented that the traffic agents solved a problem of controlling PD, Fire, EMS and other vehicles clogging accident scenes after studies of the problem did not yield a solution. TRANSCOM staff felt that their ability to perform capacity analyses showing the impact of construction conflicts was vital to member agencies accepting their coordination role.

3. High-level champions are important. A senior official at the Port Authority of New York and New Jersey, Lou Gambaccini, championed TRANSCOM's creation nearly two decades ago. Senator Lautenberg of New Jersey was critical to obtaining earmark funding of TRANSCOM's technology program. Bringing new money to the region enabled TRANSCOM to embark on new programs and also gave the organization credibility. Leadership of the N.Y.C. DOT commissioner and a high-level commissioner in the NYPD were critical to setting up a NYPD operations center adjacent to the DOT traffic center in Long Island City.

4. Programs have legs. Successful institutional cooperation in one area spawns cooperation of other operations. For example, coordination of incident management between the NYPD and N.Y.C. DOT led to joint efforts to plan and evaluate signal adjustments in complex intersections such as Herald Square. Coordination also gives rise to the opportunity to put to use for other purposes information generated for one purpose. For example, TRANSCOM's incident detection grew into a highway advisory service utilizing incident information and will be used for travel information services. TRANSCOM also uses congestion data gained from the EZ-Pass speed probes in construction management to reduce lane closures when delays surpass thresholds defined by member agencies.

5. Face-to-face communications greatly enhance agencies' response to major incidents and enrich the possibilities for broader operational coordination. NYPD staff commented that the ability to talk one-on-one with DOT staff helped give staff from both agencies a good feel for what each other could and could not do. The closeness has produced an appreciation for what incident response really entails for each agency and an appreciation of the benefits of cooperation.

6. Current technology facilitates web-like rather than spoke-and-hub relationships between agencies. In the mid-1980s when TRANSCOM was started, incident notification required there to be a central agency to collect and distribute information across a broad collection of agencies. Fiber optic networks, such as the one being undertaken by N.Y.C. DOT, N.Y.C. Transit and MTA B&T, enables each agency to instantly communicate with every other agency in the network without a need to go through a central hub.

7. Funding and designation of a lead agency for funding purposes drive the process. Examples are TRANSCOM funding that added money to the region in the 1980s, and the federal grant to N.Y.C. DOT for video coordination.

8. Access to video feeds has spurred cooperation among New York City agencies. Agencies ranging from NYPD to Sanitation value the video camera coverage of major incidents as the most effective way to decide what type of response to mount. Video gives operations staff the opportunity to look at the problem and dispatch appropriate equipment without having to wait for a field supervisor to arrive at the scene.

Several lessons are specific to setting up and managing a regional coordinating organization:

9. Avoid threatening agencies' autonomy to prioritize and manage capital projects. TRANSCOM staff say that it was vital to their organization's success that member agencies realized that TRANSCOM was not proposing to be a super MPO or capital planning agency. TRANSCOM focused on scheduling and coordination, not capital planning. Member agencies had to agree to schedule changes; these could not be forced on them.

10. Help each member agency focus on management and operations of its own facilities. Provide construction and incident information that helps the agency plan and manage its construction and operations more effectively.

11. Take away barriers to agencies' participation. TRANSCOM went to 24/7 operation after initially being open only during rush hour in order to win the respect of police departments. TRANSCOM provided police departments with pagers when they were not able to purchase pagers on their own, and provided a toll-free 800 number because agencies could not call long-distance (mid-1980s).

DISCUSSION OF KEY ISSUES

(1) What agencies were involved at the start of the TMC inter-jurisdictional process? Why were they selected? What was the role of direct inter-agency relationships vs. multi-agency coordinating committees and the like? How were these relationships structured? Was there a lead agency, and if so, who was it? What were the functions and responsibilities of each agency?

As noted above, agencies that were responsible for highway, bridge and street construction became TRANSCOM members in order to coordinate construction schedules. These same agencies, with the addition of the New York State Police, also coordinated incident management. Other agencies such as numerous law enforcement and emergency services agencies participate in TRANSCOM activities because of the benefits of sharing incident information.

New York City agencies such as DOT, Police, Fire and Emergency Management coordinate on a peer-to-peer basis with the proviso that the Police Department takes the lead in managing the scene.

(2) Why did the agencies participate in this effort? What was the role of need to improve traffic flows? Of a regional vision? Of political forces?

Agency participation in construction coordination and incident management was a response to clear public problems.

With the pick-up of transportation rebuilding programs in the New York area in the early 1980s, agencies unwittingly scheduled construction closures on parallel facilities. These closures combined with growing traffic to create several highly-publicized traffic tie-ups and bad press. The Port Authority created TRANSCOM to avoid parallel closures by identifying potential conflicts and mediating changes to construction schedules by member agencies.

Similarly, the need for incident management was clear from several traffic incidents that resulted in avoidably severe traffic tie-ups.

Coordination among city agencies grew as the Police Department played an increasingly important role in incident management. A key development was the PD taking over traffic enforcement agents from DOT in 1996. Though still considered civilians, traffic agents are under the direct control of the police command and integrated with police operations. Having the police take over this function empowered both the police and the traffic agents. For example, traffic agents can be called to the scene of a fire, water main break or other major incident in a matter of minutes, in time to direct Police, Fire, EMS and other vehicles as they respond to the scene. Traffic agents prove to be much more effective at controlling these vehicles and directing traffic than did police officers themselves.

Another example concerns construction permits. Traffic agents had historically found it difficult to enforce the terms of construction permits, which often limit construction to certain times of the day and limit sidewalk and lane closures. As the PD center next to DOT's traffic center came into being, the PD became more closely involved with enforcement of construction permits. DOT now trains traffic safety officers (one to three per precinct) on how to read the permits. The officers are able to effectively check construction sites and can shut down and summons companies that violate their permits. Fines range up to $8,000. These steps have greatly reduced problems with traffic blockages from construction permit violators.

(3) What was shared—information, facilities, equipment, communications networks? What was coordinated—incident response, traffic signal control, variable message signs, emergency response? Why did coordination take the form that it did? What tradeoffs were involved? Would additional benefits be achieved with additional sharing or coordination arrangements?

Sharing and coordination has occurred in a wide variety of areas as noted above. Coordination began with high-visibility problems and over time broadened to less-visible, day-to-day operational issues such as enforcement of construction permits.

(4) What were the main costs and benefits of coordination?

Each agency feels that the benefits to that agency well outweigh costs, although formal cost/benefit analysis has not been undertaken.

(5) How were the projects funded? How was public, political and institutional support for traffic management systems built?

Projects have been funded by both regular federal-aid programs and by special ITS funding, either from grants to agencies from the ITS program or from Congressional earmarks in federal legislation. N.Y.S. DOT has adopted a policy of installing the ITS infrastructure as part of reconstruction projects and using the ITS capability as part of the maintenance and protection of the traffic component of the project. The area is using federal funds for traffic operations purposes. The programs are basically under the political radar screen with the exception of EZ-PASS which withstood a significant public and political challenge.

(6) What were the catalysts to inter-jurisdictional traffic management? What role did bodies with regional jurisdiction play? Was there a champion who played a critical role? Were funding requirements important? If so, who set the requirements and why? Did the demands of traffic management for special events play a catalytic role?

Highly-visible problems, champions and funding have all been important catalysts. Special event planning has not played a major role in germinating inter-jurisdictional cooperation.

(7) To what extent was coordination a product of planning processes? What was the nature and extent of the planning processes? Who was involved? To what extent did coordination proceed incrementally? What was the experience with each approach used?

Coordination proceeded incrementally although the players had a clear vision of the purposes and direction of the overall effort.

(8) How was trust built between agencies?

Trust was built from recognition of other agencies' expertise, from staff working together across agency lines and from seeing successes of that cooperation.

(9) How were control issues addressed?

With few exceptions each agency maintained control of their own facilities and equipment. One notable exception is that N.Y.C. DOT puts NYPD messages on variable message signs during major incidents. DOT staff explain that the PD has clear responsibility for

incident response should anything occur and on that basis DOT is comfortable with giving over control of message content. (Note that DOT does screen nonemergency messages and has disallowed information such as concert cancellations.)

(10)How were issues of compatibility of communications systems, data formats, etc. dealt with? Was this an important issue? At what point was it resolved?

Compatibility was a very important issue in setting up TRANSCOM information sharing. The TRANSCOM Regional Architecture enables communications among agency systems.

Agencies are currently coordinating technology as they expand fiber optic networks and video and data sharing.

(11)Use of private partners, particularly of interest if traffic information has commercial value.

TRANSCOM has begun using private partners that would distribute travel and traffic information. To date, however, information has been distributed to radio stations and other news outlets at no charge.

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CHAPTER 2

Interagency Sharing

Of Fiber Optic Systems

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1. INTRODUCTION

Interagency fiber optic sharing is closely linked to the previous chapter on Inter-Jurisdictional Coordination For Traffic Management. One of the most important features of a Traffic Management Center (TMC) is the communications network which links cameras, variable message signs, ramp meters, advanced signal control systems, and other real time travel information to one or more TMCs. The communications system "puts the intelligence in an intelligent transportation system." There are a variety of wireline and wireless media available for performing the responsibilities of the communications network; copper twisted-pair, coaxial cable, digital microwave, digital pocket radio, cellular and fiber systems. All have advantages and disadvantages. Fiber-based communications networks, however, provide high bandwidth and high data-transmission rates and for these reasons are increasingly being used in the establishment of ITS.

The private sector use of fiber optics systems for a variety of purposes has been well documented. State and local agencies have a long history of franchising or accommodating fiber optic systems on public or private rights-of-way.

Other public agencies, state and local, also have a need for high-speed, high bandwidth communications to carry out their mission and to satisfy the growing public need to communicate with the public and private industry through the electronic media.

The combination of these three areas of need for fiber optics systems (ITS, private sector and other governmental agencies) has created opportunities for large cities to enter into multi-agency sharing arrangements for installation and use of fiber optic systems. While other types of sharing arrangements have received considerable attention,[1] relatively little has been written about fiber sharing among public agencies in large cities. What approaches have been successful? How can large cities best take advantage of opportunities for fiber optic sharing?

[1] One focus has been on public-private sharing of highway rights-of-way. See American Association of State Highway and Transportation Officials, *Guidance on Sharing of Freeway and Highway Rights-of-Way for Telecommunications*, 1996; and ITS America, *Shared Resource Projects: An Action Guide,* 1997.

2. ISSUES

The institutional issues regarding the sharing of fiber optic systems can be separated into four basic issues. These issues and the different approaches taken by various cities are outlined in this section.

1. What agencies are involved in fiber optic sharing arrangements; whether sharing arrangements span distinct missions or all relate to transportation activities.

In many instances fiber optic sharing takes place among transportation agencies that need to communicate to accomplish their missions. Fiber optic sharing is an extension of traffic management coordination, as discussed in the first chapter, and typically developed as part of an ITS project or program. Fiber sharing benefits the mission of each agency not only in terms of increased communications capacity, but also increased sharing of information among the participants and greater operational coordination.

Another approach is for fiber sharing to take place among agencies with diverse missions—e.g., transportation, schools, welfare agencies, etc. The benefit to agencies is primarily, if not entirely, in increased communications capacity and/or reduced communications costs from shared facilities. Fiber sharing in these instances does not typically bring greater coordination in the operations of the member agencies.

Finally, cities may build fiber optic telecommunications systems primarily to attract business and develop high technology employment.[2]

2. Type of relationship(s) between agencies.

Relationships can be more formal or less formal. Agencies may negotiate and sign formal memorandums of understanding specifying what is to be shared and responsibilities of each party. MOUs may be negotiated bilaterally or among several agencies. In some cases, MOUs have created a "virtual" agency that serves as the vehicle to coordinate construction, cost sharing and decision-making among the member agencies.

Conversely, staff from participating agencies may share fiber capacity without completing formal interagency agreements. For example, two transportation agencies may exchange access to fiber optic systems in order to share access to video camera feeds and other data.

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[2] There has been much attention to the importance of telecommunications and high tech to city economic development. See United States Council of Mayors, *America's Cities and the New Economy*, June 2000. Bloomington, Indiana is an example of a city building telecommunications capacity to attract business. See Jill Rosen, *Bloomington lays 'digital underground,'* civic.com, May 12, 2000.

3. Methods used to build the fiber optic system.

There is a range of options, from building fiber optic systems based on a comprehensive plan to phased or incremental approaches. The differences relate to the type of planning conducted, sources of funding and timetable for construction.

Comprehensive approaches involve a greater degree of upfront planning, identification of funding and more expeditious construction. Comprehensive ITS projects that include fiber optic construction are a prime example of this approach. Multi-purpose, multi-agency systems are a second example of the approach.

Incremental approaches take a number of forms. Many cities have obtained conduit capacity under city streets through requirements that telecommunications companies provide capacity to the city when digging in the city right of way. Transportation agencies (city and state) have obtained fiber capacity by including conduit construction as part of highway, bridge and transit construction/reconstruction projects.

4. What is shared.

Another core issue involves what to share when sharing fiber optic networks. Fiber optic sharing arrangements can encompass any number of the following:

Sharing of physical facilities

Fiber optics systems either run though conduits underground or are suspended above the street on poles. Sharing arrangements include sharing conduit space, sharing fibers in a multi-fiber cable or sharing pole space. In addition there is the possibility of sharing the same fiber strand using wavelength division multiplexing (WDM). As the private sector is encountering capacity problems on their fiber optics systems, WDM is employed to multiply the potential capacity of each fiber by filling it with many wavelengths of light, each capable of carrying a separate signal. Carrying 16 wavelengths per fiber has become routine and the literature talks about up to 128 wavelengths per fiber.

Sharing of software

Agencies are finding that adopting the same software packages for transmitting information between agencies facilitates the exchange of information. Some areas have developed software that will “convert” information from one TMC into compatible formats for reception and use by other TMCs. However, when starting a new system of sharing, the development of common software that can be used by all participating agencies can be preferable provided that it can be done consistent with agency procurement procedures. Common software can also be employed to manage and troubleshoot the fiber system.

Sharing of expertise

Telecommunications systems can be very complicated in technical terms; all agencies participating in a sharing arrangement cannot be expected to have telecommunications

specialists on staff. Successful sharing arrangements have each agency sharing their unique expertise, be it technical, purchasing, maintenance, construction, etc.

Sharing of operations and maintenance responsibilities

For a shared telecommunications system to operate for all parties, there must be an arrangement for operating and maintaining the entire system over a long period of time. These responsibilities can be shared through a central city agency or through a "virtual" agency created by a memorandum of understanding involving a myriad of city, state and other entities. Alternatively, responsibilities can remain with the agency that owns each part of the fiber system.

Some agencies have a more "mission critical" need for real time information. Therefore, shared operations and maintenance must take into consideration individual agency needs.

Sharing of costs and financing

Fiber optics systems are not cheap. Installing fiber optics systems through franchising agreements and as parts of larger construction projects are ways to reduce the cost of the ultimate fiber system. Multi-agency sharing in the cost of implementing critical links reduces the individual agency cost.

3. FIBER OPTIC CASE STUDY FINDINGS

CASE STUDY CITIES

Information on the experiences of seven cities was gathered to gain an understanding of the range of approaches to fiber optic sharing. The project team visited Portland, Oregon, which has a particularly extensive fiber-sharing program. The project team also explored fiber-sharing arrangements during site visits to New York City and Houston that also looked at traffic management coordination. In the other cities key staff were contacted for telephone interviews and to obtain written materials.

Fiber-sharing arrangements in these cities can be classified into two categories:

- Sharing arrangements dedicated to transportation purposes as part of an ITS program;
- Multipurpose sharing arrangements among transportation and non-transportation agencies. Most often this is combined with separate (though interconnected) fiber systems devoted to transportation uses.

ITS Fiber Sharing

In Houston and San Jose, transportation agencies have developed sharing arrangements in conjunction with the implementation of regionwide Intelligent Transportation Systems (ITS).

Houston is developing a backbone communications system using components of facilities from each major agency included in TranStar. The sharing arrangement is basically sharing of physical systems, x fibers for you, y fibers for me. The participants are evaluating the use of wavelength division multiplexing to overcome some capacity issues.

San Jose. The fiber optic network was developed as part of the Silicon Valley ITS project using federal Smart Corridor funding.

Multipurpose and/or ITS Fiber Sharing

Portland, Oregon. Transportation agencies began the sharing arrangements while implementing the ITS infrastructure for the region. The City of Portland was attempting to link all city agencies with a high-capacity communications system. The result is a multi-purpose, multi-agency sharing arrangement that uses all five types of sharing arrangements (physical, software, expertise, O&M and costs).

Austin, Texas. Like Portland, Austin has taken both ITS and non-ITS approaches. Seven governmental entities including city, county and state agencies and the local school district have formed a consortium, the Greater Austin Area Telecommunications Network (GAATN), that connects 275 sites throughout the Austin area. In addition, City and State DOTs have or are building fiber optic systems for transportation purposes.

New York City. The agencies in the New York area are in the early stages of sharing fiber optics systems to facilitate the exchange of information and to reduce the cost of the overall ITS communications system. The city also has an essentially separate network for multipurpose, multi-agency sharing.

Denver. The local and state transportation and transit agencies have developed sharing arrangements to link management centers and field equipment. While this system is primarily targeted to transportation purposes, it also involves access for non-transportation agencies such as Police and Fire and various city/county buildings

Boston's "shadow conduit" program requires that telecommunications and electronics firms install conduit for City use whenever they dig beneath streets for their own purposes. Private companies must not only provide the conduit; they must also maintain it. Fiber optic cable that will be installed in this conduit will be used by a variety of City agencies.

Table 2 summarizes the characteristics of fiber-sharing activities in each of these cities.

LESSONS LEARNED

Sharing can involve at least five types of arrangements: physical facilities, software, expertise, O&M and costs. There are examples of successful arrangements in each of these categories.

A key lesson from the cities examined is that successful sharing arrangements can take a variety of forms and that "more" sharing is not necessarily "better."

Relatively "loose" sharing arrangements in which transportation agencies interconnect their fiber optic networks to share data while each agency builds, operates and maintains its own fiber facilities have worked quite well. Examples of this are found in New York, Austin, Houston and Denver. These arrangements tend to involve only two or three agencies, all of which have substantial bandwidth needs, fiber capacity and in-house expertise. Sharing arrangements are relatively informal and further core agency missions.

The most extensive sharing arrangements are seen in multipurpose, multi-agency consortiums. In these cases, sharing may encompass operations, maintenance and financing. The most extensive examples are found in Austin and Portland. These consortiums tend to involve a half-dozen or more agencies, some of which possess no fiber system of their own and little or no expertise. Agencies' bandwidth needs are sufficiently modest that the overall system can accommodate the total need. For many consortium members, building their own system would be cost-prohibitive. Consortium membership is the lowest-cost path even if reaching agreement on MOUs is time consuming.

Agency expertise and software standards are shared in most cases. Sharing levies no direct or tangible costs and mutually beneficial relationships can be established informally.

Transportation uses such as video camera feeds create bandwidth demands that currently tend to exceed the capacity of multi-agency fiber optic networks.

Austin, New York City and Portland each have fiber optic systems dedicated to transportation needs in addition to multipurpose, multi-agency efforts. Transportation agencies' bandwidth needs necessitated the dual approach—the multi-agency systems cannot allocate sufficient bandwidth for transportation purposes—in particular, the bandwidth needed to connect video cameras to traffic centers. (It should be noted that multipurpose and transportation systems are usually linked so that agencies on both systems can communicate if desired.)

As fiber cable has become cheaper and with wavelength division multiplexing further reducing costs per megabyte, it may be possible for multipurpose systems to meet the voracious bandwidth needs of transportation agencies.

Fiber optic technology continues to advance and there are some new opportunities for sharing including wavelength division multiplexing (WDM). Sharing arrangements should be flexible enough to accommodate changing technology.

Using franchising agreements in conjunction with an overall fiber optics plan or vision is a very cost-effective method to develop a fiber optics communication system.

Franchising agreements offer cities the opportunity to obtain fiber capacity at no cost or for only the incremental cost of adding conduit for city purposes. Even the incremental cost is much less expensive than a dedicated installation. This approach is much more effective, however, if the city first prepares a plan detailing its fiber optic needs by location and capacity. Such plans enable City staff to quickly evaluate whether to piggyback on a given private construction project.

The decision to utilize a privately owned and operated fiber system as opposed to a public system for public purposes is a critical decision point. Cities may face political opposition to the notion of creating a public communications system. In that case, sound cost information on the benefits of a public system is required.

Houston is a prime example where private companies sought to provide telecommunications services. Although the system was built by public agencies, private sector interest was taken very seriously in the political process and caused a two-year delay in the project.

Other cities have not faced this problem, apparently for a variety of reasons. ITS systems dedicated to transportation uses seem to be less of a target if they are not on routes desirable to private companies. In some cases, incremental development has presented less of a target for private development interests. In other cities, officials were baffled by lack of private sector opposition to a city-built network.

Technical expertise in at least one of the agencies is necessary to deal with the complex issues and to interact meaningfully with the private sector.

As with traffic management, technical expertise is critical to planning, procuring and managing a fiber optic network. Multipurpose, multi-agency sharing in Austin, Portland and Denver utilized substantial in-house staffing.

Long term funding commitments to operations and maintenance are necessary for a successful sharing arrangement. Multi-purpose fiber sharing can foster greater local support for adequate funding.

O&M funding has been a particular challenge to transportation agencies operating ITS systems built with federal funds. Multipurpose systems appear to have had less difficulty obtaining adequate local funding, presumably because their multiagency constituency provides a broader base of political support.

The implementation of a shared ITS can facilitate a program of wider fiber optics sharing.

As with traffic management inter-jurisdictional cooperation, fiber optic sharing can be built in a building-block manner. In Portland, the initial sharing was among transportation agencies. When the transportation agencies needed access to city streets, the multi-agency, multi-purpose sharing benefits became evident and the agencies were able to build on the success of the initial sharing among transportation agencies.

Documentation of the sharing arrangement is necessary for the future but flexibility is necessary to handle unforeseen events.

In Portland, the participants in the sharing arrangement recognize that a part of their success is due to the interpersonal relationships that have developed as part of the process. However, they also recognize that people move on to different jobs or positions, so there is a need to document the informal arrangements so that successor participants know who agreed to what and to set a base for future arrangements. Both Portland and Houston stress that the agreements should be flexible enough to accommodate changes in technology as well as unforeseen needs, i.e., the addition of a light rail system to the Houston transportation network.

NEAT IDEAS FOR LARGE CITIES

This section summarizes several innovations that proved successful in developing shared fiber systems and appear to have particular relevance to large cities.

1. **Fines for fiber cuts.** A major operational and maintenance problem for cities involves preventing and repairing cable cuts in the fiber system. Cuts in the network are expensive to repair and can disrupt operations while the system is down. Santa Clara County recently enacted an ordinance that levies $1500 per day fines on contractors for unrepaired fiber cuts. These fines have substantially reduced this problem.

2. **Piggybacking through purchase orders.** The City and County of Denver has used purchase orders to "piggyback" on private telecommunications companies' conduit installation. During the permit process, Denver staff compared the company's plans with City and County of Denver's planned fiber network. The purchase order process is then used to pay for the incremental cost of an additional conduit for Denver's use where advantageous to the city/county's network.

3. **Notification system.** Boston has introduced a procedure whereby telecommunications and electronics companies must notify one another when they plan to dig beneath the streets. Anyone planning to install conduit beneath the same streets must become a "participating" company with the lead firm. This prevents repeatedly digging up the same streets.

4. **Establishment of a Technical Coordinating Committee.** The Portland area established the Cooperative Telecommunications Infrastructure Committee (CTIC) to facilitate the development of a multi-agency, multi-purpose fiber optics network. The CTIC has a statement of purpose and an agreement signed by all parties. It meets monthly and is a decision body as well as serving as a communications device.

5. **Use of "Enterprise Funding."** The Portland Bureau of General Services, Communications and Network Services (ComNet) operates as an enterprise fund. Their funding comes from fees charged to other city agencies for the telecommunications services that are provided. There is a general feeling within the Portland government that operating under an enterprise fund concept creates an "entrepreneurial" atmosphere within a governmental structure that promotes the exploration of new ways to conduct business. The creation of the internal communications system in Portland (IRNE) is attributed in part to the enterprise fund structure of ComNet.

6. **Peer Reviews and State of the Practice Scans.** In implementing the city agency sharing arrangement, the City of Portland hired a consultant to analyze the state of the practice in other areas both as an internal check for their plan and also as a selling document to the city council. They also extensively engaged in peer reviews with other cities before going forward.

Table 2. Summary of Features for Fiber Optic Sharing.

	Portland	Austin		Houston	San Jose	Denver	New York*	Boston
		GAATN	Traffic signal					
Part of ITS program	✓		✓	✓	✓	✓	✓	
Multipurpose sharing	✓	✓				✓		✓
Formal MOU	✓	✓		✓	✓	✓	✓	
Sharing involves								
Conduit	✓	✓		✓	✓	✓		✓
Fiber strands	✓				✓	✓		
M&O costs	✓	✓		✓	✓	✓		
Expertise	✓	✓	✓	✓	✓	✓	✓	
Obtaining capacity								
Part of h'wy/bridge/-arena/transit construction	✓			✓		✓	✓	
Piggyback on private sector installations	✓		✓	✓		✓	✓	✓
Built specifically for project	✓	✓	✓	✓	✓	✓	✓	

*Transportation agency sharing.

4. CITY OF PORTLAND/PORTLAND AREA FIBER OPTICS SHARING AND COOPERATIVE AGREEMENTS

PROJECT OVERVIEW

Governmental agencies within the City of Portland and in the greater Portland area have come together to create a fiber optics backbone system by sharing fiber optics cables, conduits, related infrastructure, operating software and maintenance and operations. Based on our research this arrangement and the resulting communication systems can be described as a " best practice" in the country. The best practices include:

a) The blending of network assets; physical, technical, financial and operational

b) The partnering of multiple agencies and leveraging of many applications onto a planned high-capacity architecture

c) Open access to the Internet

The sharing arrangements serve different programmatic objectives of the participating agencies. In each instance the participating agency has made the judgment that entering into a sharing arrangement meets two important tests:

- The sharing arrangement provides benefits to the agency objectives
- The sharing arrangement is in the overall public interest of the residents in the Portland area.

The sharing arrangements in the Portland area can be viewed from two major programmatic objectives. The first is the implementation of a multi-agency Intelligent Transportation System (ITS) for the area with a focus on traffic management, incident response and traveler information. The second program objective is the development of an Integrated Regional Network Enterprise (IRNE) within the City of Portland to interconnect all city agencies and partner locations with a high capacity communications system for voice, video and data communications.

The development of the fiber optics backbone system is facilitated through the Cooperative Telecommunications Infrastructure Committee (CTIC). The committee meets monthly to discuss and resolve issues, monitor the progress of the fiber optics system and ensure that the resulting system is compatible for all participants. Subcommittees meet more frequently on technical matters. "CTIC was formed to share the region's publicly owned telecommunications assets- fiber optic plant, conduit, cable, I-NET, wireless voice and data plant and other assets. Rather than overbuild each other, creating expensive single application networks, the partners opted to pool their resources." The current members of CTIC are the Oregon Department of Transportation represented by Dennis Mitchell, the Traffic Engineer of the Portland region office (ODOT); TRI-MET, the region public transportation provider, represented by Ron White, the Network and Systems Manager; The City of Portland Department of Transportation,

represented by Rich Johnson, the Signals Division Communications Engineer and the City of Portland Bureau of General Services, Communication and Networking Services Division Director of ComNet, Nancy Jesuale. CTIC is looking to expand its membership and scope to include the State of Oregon statewide communications system and several education and public safety related systems.

The Portland area is known nationally as an area of progressive and cooperative government. The Smart Growth initiatives and the joint concern for environmental issues have been well cataloged in national publications. The area has a metropolitan government, METRO, which is responsible for many planning activities and regionwide services. METRO also serves as the MPO for the area. It is against this backdrop of generally cooperative government activities that the fiber optics sharing program can be described.

HISTORY AND AGENCY PERSPECTIVE

The fiber optics system sharing arrangement can best be understood by presenting the history and perspective of this arrangement from the viewpoint of each participating agency.

Oregon Department of Transportation (ODOT)

The ODOT is broken into 5 region offices and a number of districts within each region. The culture of the organization is to decentralize decision-making as much as possible to the region offices. It is against this backdrop that the Portland Region Office of ODOT started to implement a freeway surveillance ITS program as part of a regionwide ATMS (Advanced Transportation Management System) program in 1993. The ITS program for the region, TRANSPORT, is fairly standard with traffic management, incident management and traveler information components and thus will not be reported here in detail.

While ODOT had some conduit in place along the freeways, ODOT found that there was a need to utilize city streets in order to connect the freeway system to their control center. Thus, they began to develop a joint arrangement with the Portland DOT. Under the initial agreement, the state would put in the fiber and the city would give the state access to reserved pole space above the city streets. The state would then give the fiber to the city to maintain and the fiber would be shared for both city and state purposes. ODOT also discovered that in one corridor TRI-MET already had fiber optics cable along an adjacent transit corridor and that it was more cost effective to utilize excess TRI-Met capacity than to build their own. Thus the initial notion for sharing fiber systems came from coordinating with Portland DOT and TRI-MET on these two relatively isolated gaps in implementing the freeway surveillance ITS. As will be described later, the success of these activities led to a wider review of sharing opportunities.

a) From the perspective of the ODOT region office, the sharing arrangement:

b) Facilitates implementing the ATMS plan

c) Provides redundant paths in the event that one of their fiber cables is inoperable

d) Gives access to information on arterials

e) Is overall cost-effective and in the public interest

TRI-MET

TRI-MET developed a communications plan which would link all of their operations with a high capacity SONET system. When ODOT came to them on sharing fiber capacity in one corridor they were able to accommodate the request. Furthermore, TRI-MET saw the opportunity for a regionwide approach to sharing that would facilitate the implementations of their communications plan. TRI-MET convened the first meeting of the group that is now CTIC. From their viewpoint the sharing arrangement:

a) Allows them to implement their communications plan more cost effectively by utilizing existing conduit of other agencies and trading off excess capacity in their own system

b) Provides redundant paths in the event that one of their cables is inoperable

c) Is in the public interest

City of Portland

There are actually four agencies within the city structure involved in the sharing arrangement as well as the City Council.

1. Office of Cable and Franchise Management. Many companies have come to the City requesting access to city streets for either underground conduits or for air space for overhead cables. In exchange for access to city streets the companies were required to place two conduits for city use for underground facilities or reserve three feet of pole space for the city for overhead cable applications. At that time there was no plan for utilizing this capacity except for the notion that eventually the city would have a need for an internal communications system. Therefore, when the sharing concept was first discussed, there was a significant unused asset available to the group: the reserved infrastructure put in place through the franchising process.

2. Portland Department of Transportation (PDOT). PDOT began working on the implementation of the ATMS in 1992/93 following the results of an early deployment planning process. The City maintains and operates 958 traffic signals, has 8 video cameras and several count stations for monitoring traffic flows. Two thirds of the signals are connected to a central traffic signal system. The city has a small traffic control center for the coordinated signal program. The city has the responsibility for traffic control on city streets and for state arterials within the city. While the county owns the bridges across the river in the city, the city also has traffic operations control for the bridges.

The original fiber optics sharing agreement was between the PDOT and ODOT as reported previously. Today, PDOT is a member of the CTIC and utilizes the shared fiber network as part of implementing the citywide signal coordination/ATMS program. In addition, PDOT has a communications engineer on staff who provides technical services to all members of the CTIC.

3. Bureau of General Services (BGS). The Communications and Network Services Division (ComNet) of BGS is responsible for providing external communications capabilities (voice, video and data.) for all city agencies including communications between city agencies and communications for city agencies with external groups or individuals. BGS operates as an enterprise fund; that is, they receive no city general fund budget support, rather they generate operating and maintenance funds by providing services to city agencies and charging the agencies for their services. While still under the overview of the City Council, the agency has more independence and incentive to try new ideas. In the past BGS was a "reseller" of services provided by private companies. For example, BGS had negotiated a citywide contract for "centrex phone service" with a private telecommunications company and then resold the service to the individual agencies.

A new director of ComNet, Nancy Jesuale, was appointed 4 years ago and saw the opportunity to link several existing activities into a coordinated system, IRNE, which would provide better communications capability to city agencies as well as provide a lower overall cost to city agencies. The sequence of activities which were linked were:

a) Mapping the existing available conduits and pole space obtained over the years from the city cable and franchise management

b) Overlaying the city conduits and pole space network on the ODOT/TRI-MET/PDOT ITS fiber optics systems to create an areawide shared fiber Optics network,

c) Determining the future data and voice communications requirements of the various city agencies.

d) Developing a citywide funding program to meet the needs of the city agencies.

By adding interagency voice communications to the shared fiber network, BGS determined that the net communications cost could be reduced. In essence, BGS could finance a citywide wide area network to meet the future needs of the city agencies for video, data and voice communications with the funds which were currently being expended to provide voice communications through a private communications company. The City would take over the responsibility for voice communications through IRNE and eliminate the need for the private company. A large part of the cost savings is achieved by participating in the development of the shared fiber optics system through CTIC. The total fiber network for the citywide area network will be about 50 miles. About 30 miles of fiber will come from shared arrangements (other agencies fibers) under CTIC. A significant portion of the remaining fiber will come from a franchise agreement where in lieu of providing new conduit space, the franchisee will lay new cable for the coordinated

fiber network. City agencies will be getting the same voice communication service and the video and data transmissions through the wide area network will be free. The system will also provide agencies with a telecommunications infrastructure to promote e-commerce and open Internet access for citizens.

BGS estimates that they have spent a total of $250,000 to get IRNE to the stage of Commission approval. The total budget for the project is $8 Million and the target completion date is April 2002. The city will borrow to finance the initial cost of the system. The current citywide agency cost for internal telephone service is about $2.3m/yr. These revenues will now be redirected to finance the IRNE capital cost, pay for maintenance and operation and in addition create a depreciation fund that is projected to be sufficient in 14 years to change the system over to the next future technology platform.

BGS is also a seller of services to other governments, universities, schools, counties etc. The continuation and expansion of these services under IRNE are also part of the cost equation. In addition the staff will pursue other coordination efforts with the statewide state government communications network and other similar public sector communications programs.

A short technical summary of IRNE is included in the appendix. There are many technical issues regarding IRNE that are also covered in an accompanying document. Technical issues will not be described in this report since the scope of this report is really on institutional arrangements for sharing fiber networks.

4. Bureau of Information Technology (BIT). This bureau is responsible for developing and maintaining local area networks (LANs) within the buildings of city agencies. The Bureau of General Services coordinates with BIT to connect the LANs into the wide area network.

The role of the City Council should also be noted. The City of Portland is a central city with a population of roughly 575,000 in a metro area of nearly 2 million. The City of Portland is run by a commission form of government. Four Commissioners and the Mayor serve as both the City legislative body (The Council) and as administrators of city departments, individually overseeing bureaus and carrying out policies approved by the Council while wearing its legislative hat. The assignment of departments and bureaus is determined by the Mayor and may be changed at his/her discretion. The Mayor, four commissioners and the Auditor comprise the City's six elected officials. All are elected at-large on a non-partisan basis and serve four-year terms. The terms are staggered on a two-year cycle with the Mayor and two commissioners elected on one cycle and the other two commissioners elected two years later. Three of the commissioners oversee the four agencies involved in IRNE, which ensures a majority of the commission support for the project if all three commissioners support the concept.

MAIN LESSONS LEARNED/ IDEAS FOR LARGE CITIES TO IMPLEMENT

1. Communications network sharing is more than six fibers for you and six for me. The members of CTIC, in their memo of agreement (attached), quickly recognized that

sharing was much more than counting fibers. Sharing has also included the sharing of the unique technical expertise which exists in each agency, sharing of software programs so that all agencies have the capability to readily share information and jointly creating the capability to incorporate advanced technologies such as Wave Length Division Multiplexing on a coordinated basis. The agencies will be able to share video output from any of the surveillance systems including the ability to position other agencies camera.

2. The spirit of the cooperative effort was to operate as a mid-level technical activity, below the political radar screen, and to accomplish as many joint activities as possible within each agencies programmatic responsibilities. Political sanctioning was sought after a substantial coordination effort was already in place and the group was ready to go to the next level (IRNE). Members of the CTIC continued to use the two tests: good for the agency and good for the general public. Their advice to other cities is:

    - To create a vision,
    - Recognize that all agencies have the same customers,
    - Start small and build on successes,
    - Keep the initial applications simple but also preserve future options, and
    - Have some technical expertise in communications systems available at the agency level.

3. The group does not keep a balance sheet, for example, the cost of fibers donated or received by each agency. Since the sharing involves more than fiber strands, keeping a balance sheet of technical expertise or software sharing would be difficult and perhaps counter productive to the spirit of the cooperative effort. The CTIC uses group dynamics more than formal agreements to ensure that any one agency doesn't try to take advantage of the cooperative effort.

4. To a person the participants credit the success of this effort to the personalities involved in the exercise and to the level of technical expertise represented at the table. All members consider each other as friends and say that they look forward to each meeting as their "most productive" meeting on their calendar. They all feel that what they are doing is good for their agency and is "what the public would expect of governmental agencies." The group has developed a high level of trust and respect for each other and for the respective programs of each agency. They recognize that there will be thorny issues ahead as new participants come into the process and as technology advances but they feel confident that they can cooperatively work these issues out.

5. The members recognize that the personalities will change over time and are now going through a process of documenting the sharing arrangements so that if one or more of the key participants leaves, there is a record and continuity to the process. To

the extent possible the agreements are technical in nature and do not require legal review.

6. The group has adopted a philosophy of "doing it if it makes sense" rather than asking permission first and then doing. While other areas have cited federal transportation requirements as impediments (some of the fiber systems were paid for with federal transportation funds) the CTIC feels that since the initial cost was fully justified for transportation purposes, that the additional use for public information sharing, including public safety purposes, is consistent with federal requirements.

7. One of the keys is to tie the city franchising of cable and telecommunications systems to the overall vision for a fiber network, especially during the creation of the ITS backbone communications system. Portland did not do this initially but was fortunate to have required the installation of conduit and the reservation of pole space in previous franchising. Now that they have a vision and a program they are proactively using the franchising process to help achieve the vision. The members of CTIC felt that they should have started the sharing process years ago, but even starting at this late date has created many new opportunities.

8. One of the current constraints is the unavailability of fiber cables. The CTIC estimates that there is a one-year backlog of orders for fiber cable. Current production is committed to large long distance companies.

9. The ability to deal with the political power of the private providers is important for any city attempting to establish a government owned network. Cities need to understand and anticipate political pressure. The CTIC has been able to agree that the fiber optics network is one system with common standards, common software and a common management system. This common coordinated approach has allowed the group to fend off attempts by the private sector to divide and conquer. The Portland network is accessible only for government purposes so one of their arguments is that they are not competing with the private sector for private customers.

10. New members to the shared network must have both a long range plan as well as a long term funding commitment. The CTIC will only add new members if the new members have a long range plan and long term funding to sustain the plan. Several organizations have approached the CTIC with one-time grants in hand but without a long-term commitment or funding. While CTIC will cooperate with these efforts, without a long-term commitment, future maintenance and operation responsibilities would fall on CTIC members if the agency grants are not renewed. As an example, METRO received grant funds to create a regional government information network. The network operated for several years but when the grant funding was not renewed METRO turned off the switch leaving some municipalities and agencies without connections.

11. Political leaders in Portland attribute the success of CTIC and IRNE to a government culture that is willing to try new things, encourages taking calculated risks and which can tap into the latent entrepreneurial spirit of some city agencies. There are a

number of enterprise funds in city government in addition to BGS. While there is always political tension among the different levels of government, this effort is under the political radar and is generally accepted as a good government activity.

12. Documenting the physical network, the components of the network and the responsibilities for each component is important. The CTIC is developing a fiber optic route agreement or standard operating procedure where:

    - Each fiber optic segment will have a unique descriptor.
    - The owner, and thus the agency responsible for maintenance, will be noted.
    - The number of fibers allocated to each agency within the segment, color coded to that agency, and an asset manager identified from that agency.
    - A description of the physical assets including conduits, street poles, patch panels, fiber optic cables, inner duct, duct banks, pull boxes, communications cabinets, etc.
    - One or more fibers will be designated as maintenance fibers to allow any agency to "shoot the system" (test the system)

Once this agreement or procedure is completely filled in, it will serve as the "as built" plan of the network. Eventually this information will be incorporated into the software that is being jointly purchased which will manage the entire system. The details and format will be worked out in the next months.

The CTIC memo of agreement, City Council resolution to implement IRNE and a technical summary of IRNE can be found at the end of this chapter.

DISCUSSION OF KEY ISSUES

1. How are bandwidth and other fiber resources allocated?

Fiber allocation is determined by the CTIC through a cooperative discussion process. The principle to date is to allocate fibers based on agency need. At this point there is excess capacity in the fiber systems but the group feels that multiplexing can enhance future capacity.

2. What is the arrangement for O&M Responsibilities?

Final arrangements for O&M are still being developed. There is agreement that the financial responsibility for maintaining the system remains with the owner who built the system. There is also an agreement to use the same contractor for first response restoration. CTIC may use PDOT for preventative and routine maintenance and the contractor for emergency restoration. The city is creating software that will monitor the entire system and will hire a consultant to monitor the operation of the system, to detect problems and then notify the owning agency to initiate maintenance procedures.

3. How are costs allocated? What is the cost for tapping into the system?

Within the CTIC cost sharing is worked out informally depending on the needs of each agency, what each agency can bring to the table, (i.e. existing conduit, technical expertise, etc.) and the maintenance and operations rules adopted by the agencies. Within the city administration, each agency is required to utilize IRNE by direction of the City Council (Copy of resolution attached). As noted previously any new agencies wanting to be part of the system must come with a long-term plan and long term funding. The group is talking to several perspective new members but no new members have been added.

4. How are the capacity needs determined?

The CTIC has set a 48-fiber cable standard for laying new cable for use by CTIC members. The allocation of the fibers to agencies is based on needs of the agency. Future capacity will be allocated in the same manner.

5. How are demarcation lines (firewalls) established between agencies and the backbone?

The agreements now being drafted will show the color-coded networks of each agency within the cable. Agencies have the ability to create "firewalls" for their system. Sharing the same fiber by use of multiplexing has not been discussed although that option is reserved for the future as well.

6. How have the agencies used franchise arrangements? What is the impact of utility deregulation?

Utility deregulation has made this sharing arrangement possible. With deregulation have come many applications for companies to install fiber and other communications systems, which in turn presents the opportunity through the franchise process to get something in exchange for access to rights-of-way. The key is having a vision of what government wants and using the franchise process to help achieve that vision.

7. Are there security issues, especially for emergency services?

At this point there are no security issues on the table. Emergency agencies within the City are included in the system. The nature of the design, which includes redundancy and the ability to create firewalls, has satisfied the various interests.

8. How can cities effectively contract with private sector firms in a rapidly changing market?

In this case study, the City of Portland is "uncontracting" with the private sector to create its own government network. They are working cooperatively with private companies on providing access for fiber optics systems including a unique project that will give IRNE a portal to the private "Internet Hotel" in exchange for access to city owned conduit.

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5. HOUSTON CASE STUDY ON FIBER OPTIC SHARING

PROJECT DESCRIPTION

The Houston area provides a case study of the sharing of fiber optics systems among transportation agencies. To fully understand the Houston fiber case study, the reader should first read the Traffic Control Center section of this report and in particular the section on Houston TranStar. The fiber sharing and the transportation projects are under the umbrella of TranStar.

The goal of the participants (Texas DOT, METRO, Harris County and the City of Houston) is to establish a fiber backbone network that will link the TransStar Control Center and the operations offices of the participating agencies with the transportation facility control systems. Previously, several fiber optics systems were developed separately as part of TranStar capital projects, most notably the control systems on TxDOT freeways and the METRO HOV lanes. In the City, utilities were required to string a wire for traffic signal communications as part of fiber optics franchising agreements. The County is building its portion of the Regional Computerized Traffic Signal System (RCTSS), which includes a communications network. METRO is developing a communications system to link its 6 bus facilities and IT data center.

METRO had the lead for developing the RTCSS in the city and had established a budget for the system based on negotiations for a federal grant (Note that the funding arrangement is unique in that the signal system is being upgraded using federal transit funding under the premise that the major goal of the system is to increase bus speeds). One of the goals of RTCSS is to provide video capability as well as data connectivity thus increasing the communications bandwidth requirements. METRO discovered that 20-30% of the proposed $120M budget was needed to provide voice, video and data communications with video being the major component. In addition METRO was developing a system to connect their six service facilities with a fiber system. METRO also serves as the system integrator for the fiber network.

As METRO went to implement the communications component of RTCSS, they received pressure from private communications companies to open the development and construction of the communications network to the private sector. One company initially offered to provide communications for a twenty-year period at a low price. METRO developed a proposal package for a ten-year contract with extension options. After a strong initial response to expressions of interest, the final biding process resulted in only one proposal received at a cost that was much higher than the budget allowed. The participants say that among the factors which led to the high cost were the specific long term requirements (i.e. performance and service standards) which were required to be included as part of getting governmental approval for a procurement project. The result of the attempt to develop a private sector contract was a significant loss of time in implementing RTCSS (2 years), frustration on the part of both sides and a number of lessons learned (see next section).

The fiber optics network being developed under the TranStar umbrella is still evolving. At this point there are no formal agreements but a working agreement on implementation of a fiber optics backbone system. This system includes sharing existing fiber optics cable and sharing future cable that will be installed as part of RTCSS and other transportation projects. The benefits of such arrangements are different among the different agencies but in all cases are described by the participants as win-win. For example, the county RTCSS will connect to the state fiber system to gain access to the TranStar control room while the state will connect to the county system to gain redundancy for their system in the event of a system interruption.

The issues of available bandwidth and capacity limitations are still significant. The state system is limited to 48 fibers. The proposed fiber optics sharing system has created two specific and somewhat opposing viewpoints related to fiber optics systems sharing. Some agencies favor physically separated fiber systems within the same conduit—you get six wires and I get six wires. METRO feels that Wave Length Division Multiplexing, a technique now being used by the private sector to increase system capacity, can solve the capacity issue. These issues continue to be discussed within the umbrella of TranStar.

LESSONS LEARNED

1. There is a need to clearly present the issues regarding accomplishing a master plan for communications systems, budget constraints, specific project needs, and project constraints.

2. Do not underestimate the pressure (technical, political etc.) to consider leased-line options from utilities and other communications providers.

3. There needs to be an understanding of the difference (benefits, costs, risks etc.) of sharing conduits with separate wires vs sharing the same wires (Wave Length Division Multiplexing)

4. Sharing agreements should be as simple as possible because it is impossible to anticipate tomorrow's technology on bandwidth, multiplexing, fiber capacity, etc. Do not allocate bandwidth in advance and keep details out of any agreement. Agreement on general sharing principles with future flexibility are preferable. Using government procurement contracts often limits the amount of flexibility.

5. Agencies value savings in operations costs higher than savings in capital costs. Pay attention to O&M costs upfront.

6. Agency staff in Houston say that there is a constraint on federally financed transportation fiber optics systems projects from sharing the fiber with non-transportation agencies. Yet other areas are sharing with non-transportation users under the general goal of public safety.

7. In-house technical capability is essential to developing a communications system, not only for implementing the various components but also for dealing with private sector

proposals and pressure. Having one agency (METRO) be the system integrator is also important.

DISCUSSION OF KEY ISSUES

1. How are bandwidth and other fiber resources allocated?

At the current time, the agencies are dedicating a certain number of fibers to an agency based on need and capacity. The agencies are discussing Wave Length Division Multiplexing.

2. What is the arrangement for O&M responsibilities?

The current arrangement is that the agency that owns the fiber system is responsible for the maintenance.

3. How are costs allocated?

Costs have not been allocated among agencies. Since the sharing arrangement is under the general umbrella of TranStar, the overall cost sharing arrangement of TranStar is in place.

4. How are capacity needs determined?

The capacity needs are still evolving which emphasizes the need for flexibility. The existing Texas DOT and METRO HOV fiber systems have limited capacity. The RTCSS system is being developed. An example of the need for flexibility arose with plans for a light rail system, supported by the new METRO administration and the new Mayor. The light rail system will need fiber optics communication capability. This option was not on the boards two years ago.

5. How are demarcation lines established between agencies and the backbone?

At this time, each agency has its own fibers.

6. How have agencies used franchise arrangements?

The City has used the franchising process to develop the internal fiber system for RTCSS. Organizations are required, as a condition of the franchise, to install conduit on city streets and to include one cable for RTCSS. In addition, the City is active in reviewing new developments. If additional signals are required, they must be compatible with RTCSS.

7. Are there security issues, especially for emergency services?

Emergency services are integrated into TranStar.

8. How can cities contract with private sector firms in a rapidly changing market?

The experience of METRO in trying to develop a private sector communications system shows the problems associated with the incompatibility of long-term government contracts and the rapidly changing market.

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6. NEW YORK CASE STUDY ON FIBER OPTIC SHARING

PROJECT DESCRIPTION

Transportation agencies in the New York City area have developed and shared fiber optic networks over the past decade. The pattern has been for each agency to install fiber optic capacity on its own right-of-way, followed by connecting fiber of different agencies to link management centers with each other and with field equipment.

The New York State and New York City Departments of Transportation each built fiber capacity starting in the early 1990s to link their respective traffic management centers with field equipment such as closed circuit television (CCTV), traffic detectors and variable message signs. The State's initial development was based on an ITS Early Deployment study. The initial links involved NYSDOT's fiber on the Gowanus Expressway in Brooklyn, installed during highway rehabilitation, and NYCDOT's fiber between its traffic management center in Queens and the Williamsburg Bridge in Brooklyn. The two agencies then connected their fiber, thus linking the Gowanus Expressway and Williamsburg Bridge to each agency's TMC in Long Island City.

The fiber network has been and is being further developed. Several approaches are used. One approach is to include fiber installation or new duct capacity in major capital work. The light rail line running from Jamaica, Queens to Kennedy International Airport, currently under construction by the Port Authority of New York and New Jersey, will have ducts available to NYSDOT. The State is also building conduits during reconstruction of the Long Island Expressway and Route 9A on Manhattan's west side.

Another avenue is taking advantage of the City's control over valuable rights-of-way. The City's franchise agreement with the company owning ducts under streets throughout Manhattan has long provided for free duct access to city agencies. More recently, a revised franchise with Consolidated Edison provided for free duct access, thus opening access to the other boroughs. A franchisee also provided access for the Queensboro Bridge fiber installation.

Fiber will also be installed as part of two recent NYCDOT initiatives. First, the Integrated Incident Management System (IIMS) will use a mix of fiber and other communications technologies to link transportation management systems with the Police Department. This will likely be expanded at a later date to include the Emergency Management and Fire departments.

Second, N.Y.C. DOT, New York City Transit (operator of the city bus and subway system) and MTA Bridges and Tunnels (operator of water crossings between boroughs within the city) recently obtained federal funding for a cooperative fiber network with video and other information sharing. The fiber network will carry video feeds and data generated by the three agencies. The agencies are developing plans to connect the interagency network with fiber running throughout the subway system.

Fiber optic sharing among transportation agencies in New York is separate from other City networks. The N.Y.C. Department of Information Technology and Telecommunications (DOITT) links city buildings with a fiber backbone, cable, T1 and T3 lines. Due to capacity constraints of this system, however, NYCDOT has needed to develop its own fiber network. It should also be noted that City DOT's fiber complements an extensive existing system of coaxial cable and T1 lines that interconnect traffic signals in Manhattan.

LESSONS LEARNED

1. A key to fiber sharing is building excess capacity. The linking and sharing between City and State DOT is made possible because each agency had (and has) available capacity to share with the other agency. Since the major cost is in accessing rights of way and installing ducts, the cost of increasing the number of fiber strands is minimal, particularly in relationship to the benefit of trading capacity with other agencies.

2. Fiber sharing does not necessitate a central coordinating or oversight function but can be accomplished with peer-to-peer interagency cooperation. Notably, these relationships involve a small number of large agencies in New York.

3. Fiber capacity can be developed over time, taking advantage of opportunities that arise with major capital projects and the use of franchisee's right of way.

DISCUSSION OF KEY ISSUES

1. How are bandwidth and other fiber resources allocated?

To date, there has been sufficient bandwidth to accommodate each transportation agency's needs, and thus no need to formally allocate fiber capacity. Lack of capacity has kept City DOT from using the DOITT network, however.

2. What is the arrangement for O&M responsibilities?

Each agency is responsible for maintaining its own fiber. Maintenance is part of the contract during construction. At the conclusion of construction or reconstruction of state highways, the highways will be turned over to City DOT. Ongoing O&M funding will be worked out at that point. Funding mechanisms will be included in a memorandum of understanding being developed between State and City DOTs.

3. How are costs allocated?

Each agency is responsible for costs on its own facilities.

4. How are capacity needs determined?

NYCDOT has sought to install capacity well in excess of current needs. For example, on the Queensboro Bridge, DOT ran 280 fibers, up from 188 fibers for highway installations.

5. How are demarcation lines established between agencies and the backbone?

This question is not relevant to the New York situation since there is no backbone.

6. How have agencies used franchise arrangements?

Franchises have been very important in New York. The City DOT has used duct access rights in utility franchises.

7. Are there security issues, especially for emergency services?

There have not been security issues for the transportation agencies. The IIMS system involving NYPD includes stringent security measures, although these are more important for over-the-air communications.

8. How can cities contract with private sector firms in a rapidly changing market?

Private companies have been used as contractors for construction and franchisee's duct access has been used. No other arrangements have been carried out.

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7. SILICON VALLEY CASE STUDY FIBER OPTIC SHARING

PROJECT DESCRIPTION

Fiber sharing in the Silicon Valley area has occurred as part of the Silicon Valley Smart Corridor project, the first project built by the Silicon Valley-ITS Program, led by the City of San Jose. The communications component of the Smart Corridor project utilizes a variety of technologies including fiber optics, frame relay and leased telephone lines. The fiber component involves 35 miles of fiber optic cable installed to connect six local agency traffic management centers with one another and with field devices. Frame relay is used to provide communication to the Caltrans (State DOT) traffic management center, located in Oakland, about 40 miles north of the corridor.

The Smart Corridor project is a partnership involving ten agencies:

- City of San Jose
- City of Campbell
- City of Milpitas
- City of Santa Clara
- Town of Los Gatos
- County of Santa Clara
- California Department of Transportation (Caltrans)
- Santa Clara Valley Transportation Authority (VTA)
- Metropolitan Transportation Commission (MTC)
- California State Highway Patrol (CHP)

Planning for the Silicon Valley Smart Corridor began in the early 1990s when the "Smart Corridor Statewide Study," prepared for the State DOT, identified I-880 as a prime candidate for an implementation of a "smart corridor." This was followed with a 1994 feasibility study to identify the phasing of projects necessary to deploy a smart corridor. The City of San Jose awarded the design contract in 1996; the County of Santa Clara awarded construction contracts in 1997 for the first three phases of the project. Federal funds totaling $7.5 M were secured to complete this work.

The City of San Jose had previous experience in deploying ITS around its downtown sports arena and had the staffing resources to manage the design contract. The County's regional influence, combined with its expressways serving as key elements of the corridor, made it the appropriate agency to lead the construction management effort.

Two agreements were completed among the ten participating agencies to facilitate design and construction of the Smart Corridor. These include a memorandum of understanding (MOU) outlining the intent of all agencies to work cooperatively on the project and an agreement between San Jose and the County on transfer of funding responsibilities to simplify reimbursements for the construction activities. As the SV-ITS Program has developed during implementation of the project, the partnership is developing a

cooperation agreement detailing the roles and responsibilities of each agency for design and construction; and an operation and maintenance agreement. These agreements will permit the partnership to pursue projects near the airport, northward to the adjacent county, and westward to other Silicon Valley cities.

When capacity permitted, fiber optic cable was installed in existing conduit. However, significant lengths of conduit and cable were installed by trenching and boring into existing roadways. Depending on the location, 12 to 84 fiber strands are in each cable. The project design provided spare "dark" fibers with the anticipation of future ITS needs.

LESSONS LEARNED

1. San Jose and its program partners built a substantial fiber optic network as part of a federally funded ITS project. By making fiber installation part of a much larger transportation project, separate funding did not need to be obtained.

2. O&M costs and arrangements are important issues that are still being worked out. The existence of San Jose's earlier ITS effort ensured that trained staff was in place for new demands.

3. Fiber cuts have been a significant problem. A recent County ordinance leveling a $5,000/day penalty on contractors for unrepaired fiber cuts has significantly hastened the repair process. The partner agencies will be installing markers along the fiber alignment at 500' intervals to reduce the potential for future damage.

4. The replacement of fiber optic cable has become a significant challenge as the demand for the product has grown. Currently, the program has a 52-week wait for replacement fiber delivery.

DISCUSSION OF KEY ISSUES

1. How are bandwidth and other fiber resources allocated?

Bandwidth is allocated by the project committee. The committee has limited the network to transportation uses that benefit the whole group, not just one member. The Smart Corridor's technical approach was based on a peer-to-peer network, the committee functions in a similar manner. All agencies have equal representation regardless of size or role.

2. What is the arrangement for O&M responsibilities?

Each jurisdiction is responsible for maintenance of the portion of the fiber network within its boundaries. The County has repair equipment; it is contemplated that the County will repair fiber breaks throughout the network on a reimbursable basis. The funding for that has not been arranged as yet, however.

3. How are costs allocated?

Capital costs were covered by federal transportation funds. Each agency is responsible for its own operating costs and for O&M of fiber within their jurisdiction.

4. How are capacity needs determined?

Capacity needs were assessed in the 1994 feasibility study for the Smart Corridor project. Capacity was intentionally overbuilt; however, multiplexing will be necessary on a project basis to meet growing bandwidth needs.

5. How are demarcation lines established between agencies and the backbone?

Smart Corridor is designed as an integrated communications system among the agencies.

6. How have agencies used franchise arrangements?

The Silicon Valley project used available conduit when practical. In all circumstances, the conduit was serving the signal and streetlight systems so it was already under the control of traffic management agencies. Project staff did not approach private sector or outside agencies for use of conduit, or rely on franchise terms.

7. Are there security issues, especially for emergency services?

Security was designed into the system to a level the agencies are comfortable with. The inclusion of emergency services will occur with future projects – the existing Smart Corridor is predominantly a traffic management effort.

8. How can cities contract with private sector firms in a rapidly changing market?

TravInfo, a regional data disseminator, is a key program partner. Data from the corridor is sent to TravInfo via frame relay. The agency gathers that data and makes it available to public and private sector entities to provide commuter services.

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8. AUSTIN CASE STUDY ON FIBER OPTIC SHARING

PROJECT DESCRIPTION

The Austin area is home to a pioneering multi-agency fiber network called the Greater Austin Area Telecommunications Network (GAATN, pronounced Gat-in). The network connects about 275 sites for the seven GAATN members:

- Austin Independent School District
- Austin Community College District
- County of Travis
- City of Austin
- Lower Colorado River Authority
- State General Services Commission
- University of Texas.

In addition to the GAATN network, Texas DOT has an extensive fiber network to transmit highway video feeds. The City of Austin is building a fiber network to connect traffic signals with the city's signal shop. These three fiber systems—GAATN, the City's traffic signal control system and the TxDOT highway system—will be interconnected, allowing agencies to communicate with each other.

GAATN

In the late 1980s, the Austin Independent School District (AISD) initiated plans for a 250-mile fiber network for voice, data and video transmission. During the design phase, the City of Austin, Travis County and Austin Community College approached the District to be included in the design. The parties recognized that a joint effort would be less expensive than separate networks. An interlocal agreement was executed in May 1991, followed by bidding out construction of the network. The other GAATN members later joined the original four partners of the consortium.

The network consists of about 300 miles of fiber arranged in eight rings and two super rings. This design provides redundancy, maintaining communications despite fiber breaks. Most of the network is pole mounted although there is some underground conduit. Four-inch conduit is used with subducts for four fiber runs.

Consortium members jointly own and maintain the sheathing, pole attachments, in-line electronics and similar items. One entity acts as the managing partner. Maintenance costs are allocated based on each participant's percentage interest in the network. Each fiber strand, however, is individually owned by one of the participants. The City of Austin provided access to pole attachments at no cost and received 12 strands in-kind everywhere the network goes.

Highway and Traffic Signal Fiber Networks

The City of Austin is in the early stages of building a fiber system for traffic signal control and video monitoring. The plan is to install 180 miles of fiber and connect all 700 traffic signals in Austin. The network will also carry video images from 80-100 intersections back to the central signals shop. The video system is quite sophisticated; in addition to simply showing intersection conditions it is designed to conduct traffic counts and to follow individual cars as probes through the street system.

Existing conduit that has been used for copper wire is being used where possible. The City is also encouraging joint installations with utilities and telecommunications companies that are also installing fiber. There is no legal requirement that utilities or telecommunications companies share duct access with the City, however.

The City is also constructing an emergency operations center. The center will centralize the City's emergency operations center, Police, Fire and Capital Metro (transit agency) dispatch operations. The county emergency operations center may also join this "combined center." The center will receive video feeds from the City's intersection video cameras and TxDOT's highway video cameras. The center is scheduled to open in 2002.

LESSONS LEARNED

1. Capacity and locational needs have driven the development of separate transportation and inter-agency fiber networks. The networks are interconnected, however. This creates redundancy and makes it possible for agencies to communicate with all other agencies on either network.

2. Austin focused on sharing the most expensive part of the network—installation of capacity—while each participant in the GAATN network is responsible for its own fiber within the system. This has seemed to be a convenient and workable division of shared and individual ownership.

3. In-house expertise and a major commitment of city staff resources are necessary for operation and maintenance of GAATN and traffic signal fiber networks.

DISCUSSION OF KEY ISSUES

1. How are bandwidth and other fiber resources allocated?

Fiber capacity is not allocated among different agencies. Each agency controls its own fiber in the GAATN system. The City's fiber system for its signal system and TxDOT's highway fiber are controlled by the respective agencies.

2. What is the arrangement for O&M responsibilities?

The GAATN consortium contracts for operations and maintenance of the network. The City Public Works Department and TxDOT foot the bill for O&M of their fiber.

3. How are costs allocated?

O&M responsibilities are shared on the GAATN network through the consortium, as spelled out in an interlocal agreement. The City Public Works Department and TxDOT are responsible for O&M costs.

4. How are capacity needs determined?

Each agency determines its capacity needs.

5. How are demarcation lines established between agencies and the backbone?

Not applicable; each agency owns its own fiber.

6. How have agencies used franchise arrangements?

Franchise arrangements have not been utilized. There is no requirement for city access to franchisee's fiber installations.

7. Are there security issues, especially for emergency services?

Security issues are addressed in design of the networks.

8. How can cities contract with private sector firms in a rapidly changing market?

Contracts have been used for installation of the system.

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9. DENVER CASE STUDY ON FIBER OPTIC SHARING

PROJECT DESCRIPTION

The City and County of Denver is constructing a fiber optic network through a combination of formal and informal arrangements with transportation and other agencies in the Denver area. Agencies involved are:

- City and County of Denver Public Works Department (Traffic Operations) and General Services Department (Information Services)
- Colorado Department of Transportation (CDOT)
- Regional Transit District (RTD)
- City of Lakewood

Through the Information Services Division, various other departments of the City and County of Denver (CCD), including the Police and Fire Departments and various city buildings, are connected to the fiber network. Over 90% of the fiber network is underground. Both federal and local funds have been used.

Most of the CCD's fiber capacity was acquired from telecommunications companies that were installing their own fiber capacity. The City and County of Denver Public Works Department (DPW) paid these companies for the incremental cost of installing an additional conduit along streets that CCD has planned to include in its fiber network. In some cases, DPW made the transaction on a purchase order basis when the telecommunications provider applied for a permit to install conduit. DPW has been able to justify the purchases as a very cost-effective way to gain fiber capacity. DPW has used federal Congestion Management and Air Quality (CMAQ) funds allocated to the traffic signal system for this purpose.

DPW shares fiber with other agencies as the opportunity arises. For example, DPW and CDOT extended fiber conduit along a major arterial street to connect the light rail system and CDOT communications center into the DPW fiber network, thus connecting the three agencies (DPW, CDOT and RTD). CCD has also connected its fiber network to the City of Lakewood's network which is leased from a private telecommunications provider. This link enables Lakewood to connect its traffic signals to the CDOT traffic management center.

DPW has also obtained fiber capacity in conjunction with various governmentally sponsored construction projects. For example, DPW entered into a development agreement with the Metropolitan Football Stadium District under which the District installed conduit and fiber around the new football stadium. This fiber was used to connect traffic signals around the stadium to the traffic signal control system, enabling traffic-responsive control of traffic signals.

When the Pepsi Center was opened a year ago, ITS features such as dynamic message signs and video cameras were installed. In this case, DPW installed and paid for fiber in the area.

CCD also has an agreement with the Regional Transit District to share fiber on RTD's new light rail line. CCD and CDOT have an umbrella agreement, currently in draft, to share fiber where possible.

LESSONS LEARNED

1. The City and County of Denver has spent "pennies on the dollar" for fiber capacity by piggybacking on private fiber construction projects. This has required CCD to have a plan as to where it wants fiber capacity and flexibility to purchase and pay for the incremental costs as the opportunities arise.

2. Fiber sharing has depended on each agency having "extra" capacity to share with other agencies.

3. Fiber sharing has come about through both formal and informal arrangements made possible by a shared vision of the efficiency and utility of building a shared network.

4. The two agencies' going hand in hand to the City Council with a joint funding request from DPW and Information Services was critical to Council approval of funding for fiber capacity. The fact that the network would benefit the Police and Fire Departments was also important to gaining support.

DISCUSSION OF KEY ISSUES

1. How are bandwidth and other fiber resources allocated?

Capacity is allocated by the agency that puts it in. Normally, each agency installs sufficient fiber to share a bundle of at least six strands. The fiber is color-coded to facilitate identification and splicing at jurisdictional boundaries.

2. What is the arrangement for O&M responsibilities?

Each agency maintains the fiber in its own right-of-way. Other agencies need to live with whatever delays there may be in repairs. As the network grows, there will be redundancy so that communications traffic can be re-routed around a break.

3. How are costs allocated?

Each agency maintains its own segments of fiber.

4. How are capacity needs determined?

Initially, DPW made a judgment to install 12 multimode and 18 single mode fiber strands. That has since been doubled at a small additional cost. DPW has been using

wave division multiplexing to accommodate multiple devices including video camera feeds.

5. How are demarcation lines established between agencies and the backbone?

Not applicable; there is no backbone.

6. How have agencies used franchise arrangements?

DPW has used a CCD franchise with the power company to install segments of the fiber network (e.g., at the football stadium), taking advantage of low installation costs in the franchise agreement.

7. Are there security issues, especially for emergency services?

None were mentioned.

8. How can cities contract with private sector firms in a rapidly changing market?

CCD has taken advantage of telecommunications companies' need for local permits to install fiber networks.

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10. BOSTON'S SHADOW CONDUIT PROGRAM

PROJECT DESCRIPTION

Boston's "shadow conduit" program has created an infrastructure of conduit available for City use, reduced the frequency with which private contractors dig up city streets, and produced revenue for the City of Boston.

Boston's policy requires that telecommunications and electronics companies notify other firms of their intention to dig beneath the city's streets. Other firms that need to install conduit then become "participating" companies in the lead company's project. The street is then dug up once instead of multiple times. Any telecommunications company that fails to participate is precluded from digging in the same location for a period of time.

Projects are cleared through the Public Improvement Committee, which is composed of agencies with responsibilities from one curb to the other. The committee is chaired by the Public Works Commissioner. Instead of paying a fee to the City, telecommunications and electronics companies are required to install for City use a 4-inch pipe with four interducts. Companies must give the conduit to the City and maintain it as well. (Companies also maintain conduits for the other "participating" companies.)

Thus far, the City has obtained about 25-30 miles of conduit through the shadow program. The primary use to date is to rent interduct space to other private entities. One interduct is saved for future City use. The intent is to connect various City agencies including schools, Fire and Police. Fiber for City use has been installed in about two miles of conduit thus far. The Public Improvement Commission will centrally coordinate pulling fiber in the shadow conduit and allocating costs and bandwidth.

LESSONS LEARNED

1. City control of the right-of-way on City streets can be used to leverage a significant amount of conduit for use by City agencies.

2. The eventual network does not need to be fully planned out before the City begins to develop conduit capacity for eventual installations.

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CHAPTER 3

Planning For Pedestrians

In Large Urban Centers

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1. INTRODUCTION

Since the onset of the automobile revolution people, jobs and commerce have gradually migrated away from the urban core. As the exodus progressed many of our cities were retrofitted to accommodate the automobile with little consideration for the effects of those changes on the original mode of travel – walking. Now that attention has refocused on our nation's large cities, we want people to come back. But cities face the same limitations they have in any age – space for maneuverability and storage is at a premium. They also face new limitations – those on the amount of pollution they can allow vehicles to pour into the air. Because automobile congestion and parking demands already threaten to overwhelm city streets, it would be best for cities if people traveled by transit - and on foot.

A pedestrian-friendly environment means better access to transit and bus stops, modes that help ease automobile congestion. Busy sidewalks provide customers for shops, groceries, restaurants, art galleries and visitor attractions. A "walking city" beckons tourists and conventioneers who contribute to urban economic development. An active street (and sidewalk) life affirms that cities are attractive and interesting.

Because of design and land use choices made by the generations that preceded the automobile, people *can* walk from place to place in cities. But many choose not to, and scant literature addresses how urban centers can best encourage more walking and accommodate those who do venture out on unsafe or overcrowded streets. Research and how-to guides tend to focus on residential areas where traffic calming measures slow traffic, reduce noise, and promise a more "livable" neighborhood, while high speeds and fatality rates draw attention to large suburban arterials. The landmark Americans with Disabilities Act required cities to retrofit their streets to meet the needs of pedestrians that travel by wheelchair or are otherwise challenged, and a lot of recent literature aims to help engineers meet those challenges. A surprising volume of literature is dedicated to the needs of the elderly, children, or the alcohol-impaired who are most at risk for collisions and most vulnerable to serious injuries.

That material is extremely helpful to engineers and other city officials responsible for transportation planning, but does not address ways to generate more and safer walking activity by the general population in our large cities.

This guide focuses specifically on strategies applicable in urban centers with a high concentration of pedestrians (and potential pedestrians). The goal is to integrate the needs of all users into an organic, urban whole rather than recommending piecemeal solutions to conflicts between users.

Pedestrian Activity and the Vitality of the Urban Core

Many cities have experienced the benefits of a more pedestrian-friendly urban environment and the increased walking activity that comes with it. Baltimore's Inner Harbor is a testament to "build it and they will come." The festival-marketplace atmosphere draws enough people to support multi-level Harbor Place, featuring upscale

retail, food stands and smaller shops. The pedestrian-oriented design creates a bustling, indoor-outdoor tourist center at the harbor's edge, with ample open space for strolling and street performers. When San Francisco dismantled its Embarcadero Expressway and replaced it with an urban waterfront boulevard, the pedestrian-scaled improvements sparked a revitalization that included renovation of a historic ferry building, a new light rail line and views of the water and the Bay Bridge that hadn't been seen in 40 years.

Smaller cities have had similar success. West Palm Beach was determined to generate pedestrian activity in the depressed Climatis Street area, and recognized that high speeds on the wide multi-lane road and unfriendly streetscape were key barriers. The city removed traffic lights, installed roundabouts, widened sidewalks and put in landscaping. Pedestrians promptly reappeared and the city's initial investment of $10 million was parlayed into $300 million in private investments.

The Right Mix of Ingredients for a Healthy Pedestrian Environment

The good news for cities is that urban cores generally enjoy a compact layout and a street grid that is conducive to walking and other non-motorized transportation modes. In some cities, motorists are already the minority users of the street network. According to the 1990 Census, in New York City over 64% of the city's eight million residents do not drive to work, and only 44% of its households own or have access to an automobile. A survey completed in the New York & northern New Jersey metropolitan area found that walking accounts for 18% of social/recreational trips and 10% of work trips. In dense urban neighborhoods like Manhattan, one-third of all residents' trips are by transit; cars are used for fewer than 20% of trips; and walking accounts for 40% of all trips.[1]

So what makes a city *walkable*? Safety is a primary issue. People avoid walking where they fear getting hurt. In most examples of successful streetscape redesigns, the elimination of safety hazards and other discomforts brought pedestrians back.

The statistics in Table 3 highlight an important relationship between speed and safety across communities. According to the report's ranking of metropolitan areas, the older compact communities around Boston have a very high percentage of people who walk. They also have the lowest score among large cities on the pedestrian fatality index. Since Boston's narrow streets and high traffic volume keep vehicle speeds low, we observe a correlation between vehicle speeds and the incidence of fatalities. Reading upward in the ranking, the most dangerous metropolitan areas tend to be newer, sprawling, southern and western communities, whose wide roadways have been designed to accommodate automobiles traveling at high speeds.

But continuing with the Boston example, while fatality rates in Boston proper are low at only 22 per year, the injury rate among pedestrians is quite high. Each year over 1,100

[1] *Travel in the New York-New Jersey Metropolitan Area: A Summary of Results from the 1997/98 Regional Travel-Household Interview Survey*, April 2000. New York Metropolitan Transportation Council and the North Jersey Transportation Planning Authority.

pedestrians are injured seriously enough to require ambulance transport to the hospital. The mayor's press office in November 1999 blamed the high rate on "poor pedestrian habits, such as jaywalking, crossing outside of the crosswalk and crossing with the DON'T WALK signal". Also blamed were "driver behaviors such as speeding, running red lights and stop signs, failure to yield to pedestrians and alcohol-impaired driving".

High average speed then is not the only threat on city streets. This handbook identifies elements that discourage poor habits among road users to create safer and more attractive city streets.

Organization of this Guide

Based on an extensive literature review and interviews with transportation engineers, city officials, pedestrian advocacy groups and transportation consultants, this guide covers techniques that facilitate high-pedestrian activity in urban environments.

The following section outlines four primary strategies for creating a safer and more inviting pedestrian environment. Section II introduces the common challenges and constraints faced by transportation engineers and planners who try to implement those strategies. Section III outlines a guide to funding sources that are available for pedestrian-related projects. Section IV is a reference guide to forty-five applied measures along with positive and/or negative feedback from cities in the form of case studies.

Table 3. Pedestrian Walking Rates Compared to Fatality Rates in Metropolitan Areas

Rank	Metro Area	Total Pedestrian Deaths* (1997-1998)	Percentage of Commuters Walking to Work**	Pedestrian Danger Index***	1995-1996 Ranking
1	Tampa-St. Petersburg-Clearwater, FL	192	2.27%	91	1
2	Atlanta, GA	185	1.45%	83	4
3	Miami-Fort Lauderdale, FL	274	2.25%	81	2
4	Orlando, FL	139	3.46%	65	7
5	Jacksonville, FL	71	2.57%	64	11
6	Phoenix, AZ	190	2.65%	60	5
7	West Palm Beach-Boca Raton, FL	49	1.99%	58	3
8	Memphis, TN-AR-MS	70	2.96%	52	15
9	Dallas-Fort Worth, TX	192	1.86%	52	8
10	New Orleans, LA	88	3.09%	52	12
11	Houston-Galveston-Brazoria, TX	205	2.26%	50	9
12	Salt Lake City-Ogden, UT	60	2.32%	49	17
13	Charlotte-Gastonia-Rock Hill, NC-SC	56	2.07%	48	18
14	Greensboro-Winston-Salem, NC	51	2.29%	46	13
15	Nashville, TN	42	1.94%	45	14
16	Las Vegas, NV	86	3.67%	44	6
17	St. Louis, MO-IL	98	2.15%	43	25
18	Oklahoma City, OK	36	2.11%	40	10
19	Los Angeles-Riverside-Orange Co., CA	737	2.94%	39	16
20	Kansas City, MO-KS	52	1.89%	38	19
21	Detroit-Ann Arbor-Flint, MI	209	2.41%	38	20
22	Sacramento-Yolo, CA	71	2.68%	38	21
23	Raleigh-Durham-Chapel Hill, NC	52	3.12%	38	28
24	San Antonio, TX	81	3.58%	36	26
25	Austin-San Marcos, TX	46	2.86%	36	23
26	Denver-Boulder-Greeley, CO	94	3.28%	29	29
27	Portland-Salem, OR-WA	79	3.27%	27	24
28	San Francisco-Oakland-San Jose, CA	268	3.63%	26	31
29	San Diego, CA	134	4.53%	26	35

30	Indianapolis, IN	35	2.17%	26	22
31	Washington-Balt., DC-MD-VA-WV	279	3.87%	24	30
32	Grand Rapids-Muskegon-Holland, MI	28	2.76%	24	27
33	Chicago-Gary-Kenosha, IL-IN-WI	333	4.01%	23	33
34	Hartford, CT	34	3.40%	22	34
35	Seattle-Tacoma-Bremerton, WA	104	3.53%	21	36
36	Norfolk-Virginia Beach-Newport News, VA	46	3.67%	20	37
37	Cincinnati-Hamilton, OH-KY-IN	47	2.99%	19	45
38	Minneapolis-St. Paul, MN-WI	70	3.22%	19	40
39	Columbus, OH	34	3.25%	17	42
40	New-York-No. New Jersey-Long Island, NY-NJ-CT-PA	869	6.31%	17	41
41	Cleveland-Akron, OH	8	2.98%	16	43
42	Buffalo-Niagara Falls, NY	2	4.38%	15	32
43	Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	197	5.26%	15	38
44	Milwaukee-Racine, WI	38	3.95%	14	39
45	Rochester, NY	24	4.34%	12	44
46	Boston, MA-NH	147	5.12%	12	47
47	Pittsburgh, PA	52	5.08%	10	46

From *Mean Streets 2000*, Environmental Working Group/The Tides Center and the Surface Transportation Policy Project, June 2000.

* From the Fatal Accident Reporting System (FARS), maintained by the National Highway Traffic Safety Administration, contains approximately 2.5 million records or every fatal traffic-related accident in the United States since 1986.

* 1990 U.S. census data.

*** The pedestrian fatality index was calculated by dividing the overall fatality rate (per 100,000 people) by the percentage of people walking to work. The results were then normalized on a scale of 1 to 100, with 1 being the safest and 100 the most dangerous.

2. STRATEGIES

Strategy 1: Reduce vehicle speeds

Lower speeds on urban roadways enhance pedestrian safety and comfort. Persons who drive at or below 20 mph are better able to see pedestrians in time to stop at intersections. At impact speeds of less than 30mph, injuries can more likely be survived.

Transportation officials report that motorist compliance with posted speed limits below 30 mph is so poor that trying to enforce it does not work. Therefore reducing the posted limit must be done in conjunction with calming devices that physically slow motorists. New York State passed legislation in 1999 to allow speeds to be reduced from 30 to as low as 15 mph when done in conjunction with physical calming measures.[2]

Vehicle Speed	Risk of Pedestrian Fatality in Collision
20 mph	5%
30 mph	45%
40 mph	85%

Source: *U.K. Department of Transportation.*

Measures that reduce vehicle speeds:

- Narrow roadways to keep vehicles in more compact formation, increasing predictability of movement and encouraging slower speeds. Of particular danger are streets whose widths fluctuate from point to point – usually where part of a roadway was widened during reconstruction. This creates a series of choke points and speedways.
- Time traffic signals to reward compliant motorists with sequential green lights.
- Enforce slow turning speeds with neck downs, which create tighter turning radii.

Strategy 2: Shorten & Simplify Crossings

Crossings should be short in both time and distance to minimize pedestrian exposure to vehicular traffic. Reduce pedestrian delay to reduce the pedestrians' motive to cross against the light and therefore improve compliance with pedestrian controls. Unclear controls confuse pedestrians who then behave unpredictably at crossings. Signs, signals and markings should be readily understood and simple to obey.

Measures that shorten crossings:

- Break a wide roadway into shorter crossing segments with landscaped pedestrian islands.
- Extend the curb to shorten total crossing distances.

[2] Former N.Y.C. DOT Director of Traffic Calming Michael King points out that most fatal injuries in New York City occur at high-speed, wide crossings like those along Coney Island Avenue in Brooklyn. The Mayor's Office and the Streets Department in Philadelphia reached the same conclusion in a 1997 report. Wide streets with high pedestrian and auto volumes such as Broad Street accounted for the greatest number of accidents.

- Mark crosswalks along paths that pedestrians naturally prefer since they are very sensitive to out-of-the-way travel and seek the shortest route rather than the one provided for them.
- Use stop signs and concurrently-timed signals for more frequent periods of pedestrian right-of-way.
- Program pushbuttons to respond in no more than 30 seconds.
- Provide a WALK/DON'T WALK signal head at complex intersections and where traffic signals are not visible or don't provide adequate information.
- Tell pedestrians how much time remains before cross-traffic is released with the countdown walk signal.
- Encourage looking behavior among pedestrians with signage.
- Eliminate the permissive right-turn-on-red in urban centers.

Strategy 3: Communicate Pedestrian Presence

Motorists on the roadway tend to watch for other motorists – because automobiles pose a threat to them while pedestrians do not receive equal attention. To make matters worse pedestrians are hard for motorists to see, often obscured by other cars, streetlights, trash receptacles, and mailboxes.

Measures that improve visibility:

- Make sure motorists and pedestrians see each other by moving stop lines back from the crosswalk
- Restrict parking at corners.
- Build curb extensions that project pedestrians into the roadway where motorists will see them.
- Integrate a leading pedestrian interval into the WALK signal phase to allow pedestrians to get off the curb and be seen by motorists before they begin turning into the pedestrian path.
- Encourage motorists to scan for pedestrians with stop signs in place of traffic signals.
- Provide sufficient lighting so pedestrians are visible to motorists.
- To maximize the visibility of YIELD TO PEDESTRIAN IN CROSSWALK signage, place the signs on stationary traffic cones in the middle of crosswalks.
- Install pedestrian sensors to automatically activate a warning signal when a pedestrian enters the crosswalk.

Strategy 4: Expand and Enhance the Pedestrian Domain

Safe and convenient walking paths reduce the disincentives to walking. Enhancements to a street provide the incentives that really draw pedestrians. Wide, clear sidewalks suggest that people are not only permitted but encouraged to walk. So does informational and directional signage oriented to sidewalk users. Urban plazas and parks draw people with a place to sit and enjoy a bubbling fountain or contemplate public art. These amenities are what define good cities as well as good pedestrian spaces.

Measures that enhance streetscapes:

- Most importantly, increase sidewalk space.
- Remove or consolidate parking meters, news boxes, etc. that act as obstacles to safe walking (and block motorists' view of pedestrians).
- Provide amenities and art. City transportation departments and departments of public works can work jointly with parks departments or private organizations to landscape, create seating, and install public art.
- Work with the city to reduce horn honking and vehicle exhaust, which are especially noxious to pedestrians. These and other nuisances, like construction sites that force pedestrians off their path, can reduce a traveler's incentive to walk.

3. CHALLENGES

A few key issues were repeatedly cited by transportation officials as barriers to effective implementation of plans to benefit pedestrian activity.

FEDERAL AND STATE STANDARDS INAPPROPRIATE TO CITIES

There is constant conflict perceived by local officials between smart pedestrian planning and the guidelines in the American Association of State and Highway Transportation Officials (AASHTO) Green Book and the Manual of Uniform Traffic Control Devices (MUTCD) for such things as road widths and signage. The departments fear legal liability over non-compliant measures which often inhibits the best designs.

An Atlanta Department of Traffic official notes that American Association of State Highway and Transportation Officials (AASHTO) guidelines are based on criteria developed in the 1930s. For example, stopping distances and horizontal and vertical curves are based on outdated automotive technology. The ability of cars to corner and stop has come a long way in half a century. Deceleration lanes, he points out, are unnecessary in cities. They encourage high speeds and increase the distance pedestrians must cross. A 90-degree angled intersection is more appropriate in most instances. Atlanta officials report that Georgia DOT has recognized that and no longer requires acceleration lanes after five years of urging from the city.

Another problem in Atlanta is the freeway-style ramps that exit into urban areas. Despite limits on road expansions, in air quality non-attainment areas many road projects are getting pushed through as *safety improvements*, and are aimed at reducing the incidence of rear-end collisions. Pedestrian advocates feel that the resulting ramps amount to road expansion and don't take pedestrians into account at all. The state continues to push through projects such as new turn lanes and deceleration lanes in the name of safety.

Philadelphia faces a different problem with respect to inappropriate safety guidelines. Pennsylvania DOT does not recognize non-reportable accidents when defining traffic signal warrants. Reportable accidents are limited to those after which a vehicle can't move and must be towed, or an injury or death has occurred. Police officers at the scene record many collisions that can't be considered in decision-making. Meanwhile federal and state funding is based on meeting specific criteria defined by those warrants.

USE OF FEDERAL FUNDS

Federal and state funding guidelines provide one more example of insensitivity to city needs. Funding for new or improved roads is based on both minimum lane width and the demonstrated consideration of a bike lane during reconstruction, yet there are no pedestrian requirements. In order to achieve narrower lanes and wider sidewalks, a waiver is required.

Similarly, officials in Boston note that federal and state money is available for arterials, not residential streets, so traffic calming is implemented on arterials. Because narrow

arterials in older cities are ill suited to further calming efforts, the result is a tendency among frustrated motorists to choose other routes. Traffic is therefore diverted onto residential streets.

CONSISTENCY, PREDICTABILITY, AND MAKING CHANGES

Many officials point out the dangers inherent in making changes to the street network. Localized changes affect the predictability of the network for regular users, creating inconsistency from street to street or intersection to intersection.

The planning division of the Boston Transportation Department reports a history of ad hoc intersection planning. For example, pushbuttons are not required to activate the walk phase during peak hours. They *are* required at other times yet no information alerts the pedestrian that they must push the button in off-peak hours. Perhaps that is why pedestrians there have made Boston the "jaywalking capital."

Engineering and signal changes along a pedestrian's usual routes can be problematic. Officials find that implementing changes "in a bunch" is the best approach. Otherwise the changes create more hazards than they fix, and may be undone by protests and resulting concerns over liability.

In the spirit of "better safe than sorry," New York City DOT officials say they have placed pedestrian crossing signals at 85% of signalized intersections, regardless of warranted demand. Therefore there are numerous pedestrian WALK/DON'T WALK indications even in simple intersections where the vehicular threat comes from only one direction. This is done primarily due to liability concerns. Yet one result of this approach is an increase in calls for maintenance when cities are already overwhelmed by daily demands.

The key to a successful strategy may be the manner of a plan's implementation. The best way to avoid inconsistent application of treatments is to attempt area-wide implementation rather than spot-fixes. It is important that the area of focus be easily defined and readily identifiable to the community. People should be kept informed about the plans and therefore expect them. If the community expects the changes they are less likely to resist them for being unfamiliar. Ideally, the treatment should be integrated with a larger plan – in conjunction with a general traffic calming effort, or with a larger municipal project as in the case of Houston's new Enron Field.

Pedestrian advocates at Walk Boston feel that changes (e.g. from exclusive to concurrent signal phasing) should be accompanied by a public relations campaign and additional signage. Slow turning movements should be enforced through physical adjustments to street design, through signage like "Vehicles Turning" aimed at pedestrians and "Yield to Pedestrians" aimed at drivers. Radio advertising along with press releases would ideally accompany the change, says the group.

In New York City, the Downtown Brooklyn Traffic Calming Project has involved a series of newsletters that kept the community informed from the outset of the project.

Newsletters included definitions of traffic calming, information on open houses, and a reply card for specific community feedback.

"HIGHWAY MENTALITY"

"Traffic engineer's mentality" has become a derogatory label now that many in the field recognize that traffic engineering has been focused primarily on the movement of automobiles for the last fifty years to the detriment of other modes.

The formal education of engineers does not yet reflect the new interest in a balanced transportation system – not based on the observations of some longtime transportation professionals. Most of the officials consulted for this guide expressed a willingness to be sensitive to the pedestrian. But most admitted that single-mindedness was still entrenched at many levels within city departments. Efforts have been made to educate engineers through conferences and workshops. Response is mixed regarding the effort to educate transportation engineers. One official doesn't feel that the effects are lasting – much like enforcement efforts on jaywalking.

The City of West Palm Beach, Florida has taken a proactive stance to combat the old-school thinking. In November 1996 the City released its *Transportation Language Policy*, a guide to removing auto-biased language from the planners' and engineers' lexicon. All department directors and division heads were instructed to adopt the new, objective language and use it in all correspondences, resolutions, ordinances, plans, and in meetings. Terms like "improvement" or "increase in capacity" are stricken in favor of terms clearly stipulating WHO benefits from a proposal and how other modes will be affected by it.[3]

PLANNING FOR VEHICLE AND PEDESTRIAN NEEDS

Other barriers to implementation include contradicting views on what constitutes "traffic delay." Who should be given priority within limited space and time constraints—motorized vehicles or pedestrians? How long should either user have to wait to cross an intersection? Of course the goal should be to minimize delay for all users. Some pedestrian advocates suggest using person-delay, rather than vehicle delay, where signal timing can be adjusted to reflect changing volumes of vehicles and pedestrians.

A level of service measures for pedestrian traffic is also recommended.

GAINING POLITICAL SUPPORT

The interests of public and elected officials clearly lie in being immediately responsive to their voting constituency on a case-by-case basis across scattered areas. A healthy transportation network, in contrast, is better achieved by area-wide planning. But an

[3]The 7pp document is available from the Rudin Center. For more information, please contact the West Palm Beach Transportation Division at (561) 659-8031. Ian Lockwood, Principal Engineer.

area-wide perspective is hard to maintain. After a pedestrian fatality, for example, the community and elected officials may insist on a quick fix such as the installation of a traffic signal to "solve" the problem.

On the other hand, the burden of proof is rightly on planners to defend their solutions. Their explanations should reflect long-term observations by city agencies. But because planning departments seldom have dedicated pedestrian staffers, little data has been compiled about pedestrian traffic. With few before-and-after studies of implemented devices, planners can't back up a campaign of good ideas that would get people and politicians on board. Not surprisingly, transportation officials feel that long-term planning is a luxury with their limited resources. Most of the staff, they report, is kept busy with crisis management – for instance fielding complaints from citizens who call to report a signal malfunction or to request a change in signal timing.

Furthermore, transportation departments are constantly barraged with problems and "ideas" coming down the pike from various sectors like the city council, grass roots community groups, the mayor's office, and utility companies. "Maybe 5 out of 100 ideas are good," reported one official, but all must be given consideration by departments with limited resources. It is difficult to be proactive in this environment. In some cases though, transportation officials report having established a relationship with elected officials by being truthful with them, and felt they had gained their trust and respect. While they couldn't win every battle and had to grant favors now and again, they felt that they were listened to.

DEFINING DEPARTMENTAL RESPONSIBILITY FOR PEDESTRIAN PLANNING

Most transportation departments do not have a dedicated pedestrian or bicycle planner. The U.S.DOT *Bicycling and Walking Study (Final Report)* recommends a full-time local pedestrian/bicycle coordinator to carry out program planning, policy development, facility design, accident analysis, coordination among agencies, etc. The study also recommends that the staffers develop coalitions with local advocacy groups. As of 1991, almost half of all local program coordinators were positioned within planning departments and a quarter were located in engineering or public works departments.

Currently, the Boston Transportation Department incorporates input from advocacy groups like "Walk Boston." They would like to have a budget and time for a staffer to dedicate part-time to planning rather than to full-time crisis management (e.g. answering complaints regarding signal timing). Currently, pedestrian studies and planning only arise at the time a road is undergoing reconstruction. The exception is problem areas where an incident or a high number of complaints draw attention.

Some officials do not feel that the U.S.DOT recommendation for dedicated coordinators is a good idea. A better solution, they say, is to have senior engineering staff "on board with pedestrian concerns."

4. FINANCING

In recent years, the Federal Highway Administration (FHWA) has been developing a new, expanded statement of policy regarding the non-motorized modes of transportation – walking and bicycling. Most significantly, in the congressionally mandated *National Bicycling and Walking Study*, the FHWA has taken the position that bicycling and walking for transportation have too long been the "forgotten modes" and that this should change. The report laid out an action plan to achieve the report's goals of doubling the current percentage (from 7.9% to 15.8%) of total trips made by bicycling and walking and to simultaneously reduce by ten percent the number of bicyclists and pedestrians killed or injured in traffic crashes[4].

Federal resources available for pedestrian and bike facilities increased significantly in 1991, when Congress passed the Intermodal Surface Transportation Efficiency Act (ISTEA), and continue to be made available through the Transportation Equity Act (TEA-21). Among other programs, TEA-21 explicitly allocates funds to promote transportation safety, a program known as the Surface Transportation Program safety set-aside, or "STP safety funds." About $300 million is available each year for this program and pedestrian safety is an eligible activity.

Yet with pedestrians making up 14% of annual traffic fatalities, the states use less than one percent (0.6%) of all federal transportation dollars to provide pedestrians with better facilities (1997-1998). Local application of federal funds for pedestrian safety has been similarly disproportionate. (See Table 4.)

States have spent other money – over $1 billion – on pedestrians and bicycles through a program known as the Enhancements program. While the program supports development of bike paths and separate pedestrian spaces, it is not rightly considered a safety program.

As outlined below, bicycle and pedestrian projects are broadly eligible for funding from almost all the major Federal-aid highway, transit, safety, and other programs. The following list is taken from the web site for the U.S.DOT/Federal Highway Administration Bicycle and Pedestrian Program, Bicycle and Pedestrian Provisions of the Federal-Aid Program: www.fhwa.dot.gov/environment/bikeped/BP-Broch.htm.

Federal-aid Highway Program

National Highway System funds may be used to construct bicycle transportation facilities and pedestrian walkways on land adjacent to any highway on the National Highway System, including Interstate highways.

[4] Final Report,The National Bicycling and Walking Study: Transportation Choices for a Changing America, FHWA-PD-94-023, 1994.

Table 4: Federal Safety Funding that Goes to Local Pedestrian Safety Projects

Metropolitan Area	Average Annual # of Auto-Related Fatalities	Average Annual # of Auto-related fatalities that are pedestrians	Percentage of Auto-related fatalities that are pedestrians	% of Federal Safety Spending Devoted to Pedestrian Safety (since 1992)*
New York, NY	677	310	46%	0%
San Francisco, CA	136	43	31%	0%
Los Angeles-Long Beach, CA	1099	299	27%	1.2%
Chicago, IL	585	158	27%	0%
Boston, MA	235	58	25%	0%

Source: Environmental Working Group/Surface Transportation Policy Project report, Mean Streets*, 1997.*

* The Financial Management Information System (FMIS) maintained by the Federal Highway Administration, contains over 550,000 records of every federal highway project since 1992. This database was analyzed in a number of different ways, including analyzing total spending, safety spending under the STP safety set-aside programs, and projects that were designed for pedestrian safety. STP safety projects were identified using codes obtained from FHWA. Pedestrian safety projects were identified in two different ways. All projects that were identified by work-type codes as being pedestrian projects were included. However, a 1996 GAO report found that bicycle and pedestrian projects were frequently miscoded in the database (GAO 1996). Thus, in addition to using codes in the database to identify pedestrian projects, researchers included any project whose description identified it as being pedestrian related.

Surface Transportation Program (STP) funds may be used for either the construction of bicycle transportation facilities and pedestrian walkways, or non-construction projects (such as maps, brochures, and public service announcements) related to safe bicycle use and walking. TEA-21 adds "the modification of public sidewalks to comply with the Americans with Disabilities Act" as an activity that is specifically eligible for the use of these funds.

Ten percent of each State's annual STP funds are set aside for **Transportation Enhancement Activities (TEAs)**. The law provides a specific list of activities that are eligible TEAs and this includes "provision of facilities for pedestrians and bicycles, provision of safety and educational activities for pedestrians and bicyclists," and the "preservation of abandoned railway corridors (including the conversion and use thereof for pedestrian and bicycle trails)."

Another 10 percent of each State's STP funds is set-aside for the **Hazard Elimination and Railway-Highway Crossing programs**, which address bicycle and pedestrian safety issues. Each State is required to implement a Hazard Elimination Program to identify and correct locations that may constitute a danger to motorists, bicyclists, and pedestrians. Funds may be used for activities including a survey of hazardous locations and for projects on any publicly owned bicycle or pedestrian pathway or trail, or any safety-related traffic calming measure. Improvements to railway-highway crossings "shall take into account bicycle safety."

Congestion Mitigation and Air Quality Improvement Program funds may be used for either the construction of bicycle transportation facilities and pedestrian walkways, or non-construction projects (such as maps, brochures, and public service announcements) related to safe bicycle use.

Recreational Trails Program funds may be used for all kinds of trail projects. Of the funds apportioned to a State, 30 percent must be used for motorized trail uses, 30 percent for non-motorized trail uses, and 40 percent for diverse trail uses (any combination).

Provisions for pedestrians and bicyclists are eligible under the various categories of the **Federal Lands Highway Program** in conjunction with roads, highways, and parkways. Priority for funding projects is determined by the appropriate Federal Land Agency or Tribal government.

National Scenic Byways Program funds may be used for "construction along a scenic byway of a facility for pedestrians and bicyclists."

Job Access and **Reverse Commute Grants** are available to support projects, including bicycle-related services, designed to transport welfare recipients and eligible low-income individuals to and from employment.

High Priority Projects and **Designated Transportation Enhancement Activities** identified by TEA-21 include numerous bicycle, pedestrian, trail, and traffic calming projects in communities throughout the country.

Federal Transit Program

Title 49 U.S.C. (as amended by TEA-21) allows the **Urbanized Area Formula Grants**, **Capital Investment Grants and Loans**, and **Formula Program for Other than Urbanized Area Transit Funds** to be used for improving bicycle and pedestrian access to transit facilities and vehicles. Eligible activities include investments in "pedestrian and bicycle access to a mass transportation facility" that establishes or enhances coordination between mass transportation and other transportation.

TEA-21 also created a **Transit Enhancement Activity program** with a one percent set-aside of Urbanized Area Formula Grant funds designated for, among other things, pedestrian access and walkways, and "bicycle access, including bicycle storage facilities and installing equipment for transporting bicycles on mass transportation vehicles."

Highway Safety Programs

Pedestrian and bicyclist safety remain priority areas for **State and Community Highway Safety Grants** funded by the Section 402 formula grant program. A State is eligible for these grants by submitting a Performance plan (establishing goals and performance measures for improving highway safety) and a Highway Safety Plan (describing activities to achieve those goals).

Research, development, demonstrations and training to improve highway safety

(including bicycle and pedestrian safety) is carried out under the Highway Safety Research and Development (Section 403) program.

Federal/State Matching Requirements

In general, the Federal share of the costs of transportation projects is 80 percent with a 20 percent State or local match. However, there are a number of exceptions to this rule.

- Federal Lands Highway projects and Section 402 Highway Safety funds are 100 percent federally funded.
- Bicycle-related Transit Enhancement Activities are 95 percent Federally funded.
- Hazard elimination projects are 90 percent Federally funded. Bicycle-related transit projects (other than Transit Enhancement Activities) may be up to 90 percent Federally funded.
- Individual Transportation Enhancement Activity projects under the STP can have a match higher or lower than 80 percent. However, the overall Federal share of each State's Transportation Enhancement Program must be 80 percent.
- States with higher percentages of Federal Lands have higher Federal shares calculated in proportion to their percentage of Federal lands.
- The State and/or local funds used to match Federal-aid highway projects may include in-kind contributions (such as donations). Funds from other Federal programs may also be used to match Transportation Enhancement, Scenic Byways, and Recreational Trails program funds. A Federal agency project sponsor may provide matching funds to Recreational Trails funds provided the Federal share does not exceed 95 percent.

5. DEVICES – TRAFFIC SIGNAL CONTROL

STOP SIGNS IN PLACE OF TRAFFIC SIGNALS

Where volumes are sufficient traffic signals are required to create gaps in vehicular traffic so waiting pedestrians can cross. However, signals should only be installed after a case-by-case review because in certain circumstances stop signs are the better alternative.

Traffic signals help reduce pedestrian accidents where there is both high-volume pedestrian (3,500+ daily) and high-volume motor traffic (27,500+ daily) (Zegeer et al, 1985). However, removal of traffic signals and replacement with multi-way stop signs has been shown to reduce pedestrian accidents under certain low volume traffic conditions.

Philadelphia Beginning in 1978, the Department of Streets undertook a signal removal program in strict adherence to the Pennsylvania DOT's traffic signal guidelines.[5] There was no publicity about the change at the time and no reported resistance from the community.

A study of the converted sites has found a reduction in all crash types of 24%, scaling for levels of severity, light conditions, and impact types. Collisions resulting in pedestrian injuries declined by 18%. Furthermore, the conversion resulted in less severe crashes when they did occur – 54% for pedestrians and 62% for motorists (Hauer et al).

By the early 1990s, with the city in a recession and looking for cost-cutting measures, the city's motives for conversion came under scrutiny. Streets Department engineers attended city council meetings to argue the merits of continuing the conversion program by asking the council to consider the "dynamics of the driver" by visualizing their own behavior behind the wheel. A motorist who approaches a green signal tends to focus attention on the signal, accelerating in order to "make the green." In contrast, a motorist approaching a stop sign removes his foot from the accelerator and scans for other motorists and pedestrians to determine whether he may roll through the intersection. Statistics support the argument that this cautious behavior is actually safer for the pedestrian, with fewer collisions and less severe injuries when collisions do occur.

New York City The buildings that make up New York University are spread out across a 40-block area of the Greenwich Village neighborhood, set on a pre-existing urban grid of primarily one-way streets. The institution sought in the 1960s to create a more campus-like setting, despite its non-traditional location. Appeals to the N.Y.C. DOT resulted in the installation of multi-way stop signs at many intersections. Additionally, large painted

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[5] Guidelines meant that signals at intersections with annual average daily traffic (ADT) of less than 9,000 on the major street or less than 2,500 on the minor street were superfluous. Often, the signal was placed in flashing mode for 1 month prior to removal. Site inspection indicated that removals were typically at low volume intersections of one-way non-arterial streets, where signals tended to be pre-timed and on short cycle lengths of the order of 60 seconds. Typically, the approaches had parking on both sides and one lane.

lettering in the road before crosswalks read STOP. Rudin Center staff observed that eye contact is frequent between waiting pedestrians and motorists, each nodding to indicate the other may proceed.

EXCLUSIVE VERSUS CONCURRENTLY TIMED PEDESTRIAN INTERVAL

The exclusive pedestrian interval (sometimes called "all red" or "scramble") stops vehicular traffic in all directions while pedestrians cross without conflict. Exclusive phasing offers maximum protection for the pedestrian, but also maximum delay. Concurrent timing reduces delay for all users because there are fewer phases to each cycle.

Zegeer (1985) conducted studies of various signal alternatives in 15 cities. Exclusive timing was associated with a fifty-percent reduction in pedestrian accidents for downtown locations with heavy pedestrian volumes and low vehicle speeds and volumes compared to signalized intersections with concurrent signal timing or with no pedestrian signals. However, at intersections with fewer than 1,200 pedestrians per day, no significant difference in pedestrian accidents was found in comparisons with exclusive signal phasing, concurrent phasing, and no pedestrian signals (Zegeer et al, 1985).

A significant downside to exclusive phasing is that delay is increased for both pedestrians and motorists. Critics note that most pedestrians cross against the light while traffic still has the right-of-way, leaving motorists to wait unnecessarily during the all-red. For *most* pedestrians the concurrent signal may be just fine – they treat every signal as if it's concurrent anyway. Unfortunately this creates the "little old lady" problem in the minds of many transportation engineers who fear the all-red phase remains only to serve that minority of pedestrians who have the greatest need for a pedestrian-protected phase.

Boston Exclusive signals are used at most crossings except a few dense areas in the financial district and along Massachusetts Avenue. Out of 750 signaled intersections, only 75 have concurrent timing. Officials would prefer to implement more concurrent signals and are slowly doing so, but are restrained by the difficulties of implementation and community response.

During a Rudin Center visit, staff members observed two intersections with pedestrian-exclusive phasing. The jaywalkers there were bold even by New York standards. And little wonder, when compliance meant waiting one and one-half minutes at times for the WALK signal to appear. On some cycles staffers didn't observe a WALK signal at all unless the pushbutton was activated. This was in the middle of a weekday.

Conversion at one location circa 1980 on Massachusetts Avenue was accompanied by a before-and-after study. WATCH FOR TURNING VEHICLES signage was placed at the intersection to inform pedestrians of the transition. The result was fewer accidents.

A Boston engineer stressed that there should never be a case where pedestrians have exclusive protection at certain times of the day but not others. It is reasonable to vary the timing or activation method of signals, but never the phasing. That inconsistency places pedestrians in danger.

SUFFICIENT PEDESTRIAN CROSSING TIMES

While the standard designed walking speed is 1.0 meter or 4-feet per second, it is generally recognized that older pedestrians and large pedestrian volumes require longer crossing times. The forthcoming AASHTO Pedestrian Guide will recommend use of a standard 3.5 foot per second rather than four.

New York City N.Y.C. DOT officials report that walk periods are lengthened during non-peak hours, when the priority is shifted from rush-hour motorists to pedestrians.

Philadelphia A Department of Streets engineer stresses that Philadelphia is a "walking city" and should remain that way. The department therefore provides minimum green time beyond standard recommendations. Where some cities will provide only 4 or 5 seconds of a solid walk signal, Center City Philadelphia provides 7 seconds or more. They use the 4-foot per second standard walking speed in signal timing, and the 3-foot per second near designated schools and senior facilities.

RIGHT TURN ON RED (RTOR) RESTRICTIONS

The permissive right-turn-on-red (RTOR) allows motorists to make a right turn at a red light after coming to a complete stop. Where the law was adopted between 1974 and 1977, crashes increased dramatically in states that adopted the law compared to those that did not. Despite safety concerns the practice continues because of benefits in reduced energy consumption, positive environmental impacts and reduced operational delays.

After adoption of a permissive right-turn-on-red, pedestrian crashes involving right turn maneuvers increased by 79% in urban areas, compared to 57% for all areas. A 110% increase was found for elderly persons (Zador et al. 1982). Motorist disobedience is high at RTOR intersections, with a 1985 study showing that 57% of motorists failed to make a full stop before turning right on red (Cynecki and Zegeer). ITE recommends that where pedestrian volumes are high (3,500+ daily), this turn should be prohibited, either full- or part time (ITE Toolbox). Most pedestrian advocacy groups and many transportation officials strongly assert that all urban areas should restrict right turn on red. It should be noted that a blind person, in particular, is at a disadvantage where right turn on red is allowed.

Where pedestrian volumes are high, some cities prohibit RTOR with a NO TURN ON RED sign (or the more effective NO TURN ON RED sign with a red ball in the center). For areas where a right turn would be acceptable during certain times, a variable message NO TURN ON RED/blank out sign is recommended (ITE Toolbox p192). The forthcoming AASHTO Pedestrian Guide will recommend the prohibition of free flowing right-turn-on-red in all urban areas.

Philadelphia The city prohibits RTOR throughout its Center City. Restrictions are divided between the 6am - 6pm signs and the full-time restrictions. Officials do not feel there has been confusion among motorists over the part-time indications. In general, the

restriction has been eased since its inception as the community and city officials become more comfortable with the RTOR movement.

New York City Right-turn-on-red is prohibited throughout the city.

Atlanta RTOR is prohibited at downtown locations and those with line-of-sight restrictions. The Department of Public Works suggests trying a sign that reads “Right Turn on Red AFTER Stop” since he sees a high incidence of rolling stops at the permissive right turn.

6. DEVICES – PEDESTRIAN SIGNAL CONTROL

PEDESTRIAN SIGNAL INDICATORS (WALK/DON'T WALK)

Pedestrian signal heads are widely used in urbanized areas because they remove ambiguity for users, clearly establishing the right of way. Yet confusion over the meaning of the signal phases is well documented, and studies have not proven any benefits to pedestrian safety. Meanwhile, transportation departments use up valuable resources to maintain the signals.

The MUTCD recommends the use of pedestrian signal indicators in instances where:

- traffic signals are installed based on meeting minimum pedestrian volume (4C-4);
- an exclusive pedestrian interval is provided;
- vehicle signals are not visible to pedestrians;
- the crossing is within a school zone.
- The signal heads are also encouraged where multiphase traffic signals may be confusing for pedestrians, or pedestrian push buttons are in use.

Observational studies of more than 4300 pedestrians found that pedestrian crossing behavior appears to be more affected by the presence or absence of traffic than it is by signal indication. If pedestrians can safely cross, they will do so regardless of the signal (ITE, *Plaques*).

A 1985 study of pedestrian crashes at 1300 signalized intersections in 15 U.S. cities provides a valuable database for comparing signal treatments. No significant differences in pedestrian crash rates were found between intersections with no pedestrian signals versus intersections with concurrent pedestrian signals (Zeeger et al, 1985). In the conclusion to his study Zegeer wrote:

> The results of these analyses, while raising questions about the effectiveness of current pedestrian signalization practice are not believed to justify the widespread elimination of pedestrian signals. It is recommended, however, that city and state agencies take a closer look before indiscriminately installing pedestrian signals at all traffic-signalized locations. Pedestrian signals are expensive to install and maintain and they may not be justified at many locations (Zegeer, 1985, p44).

A major criticism of the signal heads is that pedestrians do not understand the meaning of the signal indications, particularly the flashing DON'T WALK/raised hand (Robertson, 1977). Only 12% to 28% of pedestrians interviewed in a 1995 FHWA study understood the meaning of the flashing DON'T WALK and only 24% to 29% of all signal cycles observed had full compliance with the flashing DON'T WALK indication (Knoblauch, 1995).

New York City Of the city's 11,000 traffic signals, 85% have pedestrian indicators. The Department of Transportation explains that this high proportion grew out of concerns over liability.

Philadelphia The Department of Streets provides side-mounted red, green and yellow

ball signals visible to pedestrians at every controlled intersection. The department does not feel pressured, in general, to provide the indicators. They install them in downtown at departmental discretion – usually where pedestrians number 100 per hour for four hours and the crossing width is greater than 20 feet.

Washington DC At some intersections in the Dupont Circle area, signal phases are coordinated meaningfully with the motorist signal phase. The walk signal lasts the length of the leading pedestrian indicator when all traffic has the red; the flashing DON'T WALK means turning traffic should be watched for; the solid DON'T WALK means that cross traffic is being released.

Atlanta The community expects the signals and that they are routinely provided.

COUNTDOWN WALK SIGNAL

A new indicator, added to conventional pedestrian signal heads, counts down the seconds (e.g. 12-11-10) remaining to clear the intersection, beginning at either the WALK indication or with the flashing DONT WALK indication. The steady DONT WALK appears as the countdown signal reaches zero.

The countdown device addresses confusion among pedestrians about the standard flashing "DON'T WALK" or raised hand that prompts pedestrians to clear the crosswalk. Surveys in Hampton, VA revealed that 88% of pedestrians felt that the countdown signals were clearer than the conventional displays and 82% felt that the new heads were an improvement.

A number of negative predictions about the signals have not been realized at a limited sample of sites. Pedestrians in Boulder, for instance, better understand the clearance interval phase and are making informed choices rather than dashing into the crosswalk.[6]

Still, there is limited experience with the new devices. Some officials express concern that pedestrians will misjudge the time needed to cross and will step off the curb in the final seconds. Others argue against the increased equipment needs and maintenance requirements.

Boston Installation of the countdown signals at two different mid-block crossings teach a valuable lesson about successful placement. While both the Congress Street and Hyde Park Avenue signals resulted in overall positive effects on pedestrian compliance, one works better than the other.

Both arterials carry two lanes of traffic in either direction, but the Congress Street location has a median, and pedestrians still rely on the gaps in traffic. In comparison, the Hyde Park location has no median and a much more complex traffic situation. A heavily used commuter parking facility plus an adjacent bus loop entrance creates a complex situation where pedestrians rely more on the countdown signal in making their decision to

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[6] Joe Paulson, traffic division engineer for Boulder's public works department.

cross.

Both locations feature additional signage that cautions drivers to watch for pedestrians. Officials stress that signals are not visible to cross-street motorists for fear motorists will anticipate the green and rush the intersection as the timer reaches zero.

Advocates at Walk Boston are supportive of the countdown signal. They claim that it provides needed information to the user – much better than the ambiguous flashing DON'T WALK signal.

See photos, details, suppliers: http://www.walkinginfo.org/pedsmart/count.htm

LEADING PEDESTRIAN INTERVAL PHASE (LPI)

The LPI permits pedestrians to assert themselves in the crosswalk several seconds before the release of potentially conflicting vehicles. Typically, a red signal is prolonged for traffic traveling parallel to pedestrians, giving pedestrians the opportunity to begin crossing the street before cars turn into the crosswalk. This pedestrian "head start" is primarily used where there is a heavy concentration of turning vehicles.

Protected pedestrian intervals are associated with significantly lower pedestrian crash rates than locations with only concurrently timed signals. Crash rates decline at LPI-equipped intersections regardless of pedestrian volumes. A study at three urban intersections in St. Petersburg, FL showed that a three-second LPI decreased pedestrian conflicts from the baseline of 3.0, 2.1 and 3.3 per one hundred to 0.1, 0.1 and 0.2 per one hundred (Van Houten).

The LPI is an inexpensive solution. The negative effect is the reciprocal loss of green time for vehicles.

New York City Results of a N.Y.C. DOT study at four Manhattan intersections with heavy turning movements showed the positive effects of LPI use. Vehicle-pedestrian crashes were reduced by an average of 69% and by 1,483% when factored for the severity of the crash. (King)

Philadelphia In a city with a large proportion of one-way streets and heavy pedestrian volumes, the LPI is used primarily at intersections with right-turning movements, as well as for some left-turning movements, as at a T-intersection.

Baltimore Traffic engineers use 5-to-7-second intervals at eight locations near the Inner Harbor that experience heavy volumes of turning traffic (i.e. double turning lanes). Officials feel the motorist volumes "can't afford an exclusive pedestrian phase which would hold traffic back". LPI phasing is timed to allow pedestrians to walk half way or more into the roadway in order to be visible to turning motorists.

Atlanta After two years of use, the LPI timing has proven highly effective, particularly for the elderly, who need ample time to assert themselves in the roadway. The timing is in use at approximately 10 locations, mainly those with heavy left-turn movements.

7. DEVICES – CROSSWALKS

A WORD ON CROSSWALKS

The results in Table 3 show that walking tends to be most dangerous in newer Southern and Western metro areas. Pedestrians may be forced to walk alongside high-speed roads without any sidewalks and often must contend with crossing wide, busy streets with no median and few safe crossing- points. Intersections are often designed with wide, sweeping curves that allow cars to keep moving at high speed but increase the crossing distance and danger for pedestrians. Zoning codes typically require businesses to be fronted by a large parking lot, forcing pedestrians to thread their way through a maze of parked cars to reach their destinations.

In such sprawling environments, the combination of wide roads without pedestrian facilities and high-speed traffic can prove deadly. The national data show that walking is most dangerous in places without a basic network of pedestrian facilities – in other words, sidewalks and crosswalks.

English-style crosswalk description and photos: *(Research, Development, and Implementation of Pedestrian Safety Facilities in the United Kingdom* Publication no. FHWA-RD-99-089 December 1999). http://www.fhwa.dot.gov/tfhrc/safety/pubs/99089/intro.htm
The National Center of Bicycling and Walking: http://www.bikewalk.org/crosswalks.htm/

MARKED VERSUS UNMARKED CROSSWALKS

Can the presence of a crosswalk actually be detrimental to pedestrian safety? The issue of marked versus unmarked crosswalks is often debated.

Several studies have been completed over the past 25 years on the subject. Some have concluded that motorists are more likely to stop for pedestrians in marked crosswalks, rather than unmarked, and that marked crosswalks are safer and more preferred by both pedestrians and motorists than unmarked crosswalks under most conditions.

Other studies have concluded that marked crosswalks give pedestrians a false sense of security when crossing the street. Inadequate scanning and heavy reliance on California's crosswalk law was reported in San Francisco in 1983 (Liebermann). B.F. Herms' five-year study in San Diego generated controversy by showing that pedestrian collision rates at marked crosswalks were twice that of unmarked crosswalks. Those results were questioned when it was noted that the most vulnerable users, the young and old, prefer to cross at marked crosswalks.

The effectiveness and utility of marked crosswalks has been reaffirmed in surveys of both users and traffic officials in numerous studies (Zegeer and Zegeer).

Los Angeles Marked crosswalks are periodically reviewed and some are not reinstalled if there is no compelling reason to identify a preferred crossing point (active retail area, bus stops, far from signal, etc.) A major study by the City of Los Angeles Department of

Transportation indicates that pedestrian accidents have been reduced by 61% as a result of selective removal. (Pedestrian accidents throughout the city are down 30% over 10 years and 20% in the last 5 years, despite an increase in the number of pedestrians walking). The L.A. DOT's 20-point pedestrian safety program (1999) includes a helpful explanation of the study that prompted the crosswalk policy:

> The Los Angeles Marked Crosswalk Study analyzed 104 unsignalized locations along arterial streets where marked crosswalks were either removed or not re-installed after resurfacing. The 104 marked crosswalks were removed between December 1982 and February 1991. The before and after study periods were identical in duration at each location, with an average of 7.3 years.
>
> The results show that when only the legs of the intersections that previously had the marked crosswalks are considered, pedestrian accidents declined from 116 to 31, a reduction of 73%. The results also show that when both legs (previously marked and unmarked) of the intersections are considered, pedestrian accidents declined from 129 to 50, a reduction of 61%.
>
> At 72 of the 104 locations, at least one of the adjacent intersections is signalized. Thus, crosswalks were removed in many cases to encourage pedestrians to cross at the nearby signal. At the other 32 of the 104 locations, where neither of the adjacent intersections is signalized, pedestrian accidents declined from 47 to 14, a reduction of 70.2%. At the adjacent 64 unsignalized intersections, pedestrian accidents were 24 in the "before" period and 21 in the "after" period. Thus, there was no increase at the adjacent locations.
>
> Where marked crosswalks are installed, controls that exceed state and national guidelines are installed to maximize the visibility of the crossing and the pedestrian. The controls include pavement markings, warning signs, and red curb. (L.A. DOT, 1999)

Atlanta Safety at transit stops is one of the biggest problems in the metro area. Seven-lane roads with center turn lanes were built in the 1970s. Many had signals placed a half mile to one mile apart. No provision was made for pedestrians trying to cross to bus stops. Many of the stops lie along suburban arterials where many poorer residents do not own cars and are forced to walk the unfriendly road. A recent consultant study recommended an English-style treatment with center medians and signaled crossings with vehicle detectors.

Officials at the Department of Public Works feels it will take a citizen task force or an elected official to draw attention to the problem and implement the recommendations, but says that money would be available from the State DOT Safety Fund.

Philadelphia Continental (a.k.a. zebra) markings are provided in all business corridor districts, at adjoining intersections in school and playground zones, and at any point where transit connections are made. While all controlled streets are marked with crosswalks, uncontrolled streets in the same intersection are not.

MID-BLOCK CROSSWALKS

Like the marked versus unmarked crosswalk debate, the mid-block crossing has both advocates and detractors. While some cities are paving over mid-block crosswalks altogether others are enforcing them with signals. Advocates of mid-block crossings hold that they offer greater safety over intersection locations, and that pedestrians should not have to walk great distances out of their way to cross the street. Arguments against them cite both interference with vehicle traffic and decreased safety for the pedestrian.

Results of a user's survey completed by pedestrians who regularly crossed a 1-km long divided urban boulevard in downtown East Lansing, Michigan found that pedestrians preferred mid-block crosswalks. It was also evident that the crosswalk location relative to the origin and destination of the pedestrian was the most influential in determining crossing locations (Akin). The fact that pedestrians are inclined to cross at points most convenient to them may support the installation of crosswalks to protect them at those points.

Los Angeles Mid-block crosswalks have been present for seventy years in Los Angeles and number about 40 in the downtown. Installations are mainly at high pedestrian activity centers with long blocks (660+ feet). In the last 30 years, the city has begun signalizing most of the mid-block crossings.

Philadelphia The compact city has blocks of just 500 feet in length, and the Streets Department discourages mid-block crosswalks, reasoning that a 250 foot walk to the corner is not a hardship that requires installation of a mid-block crossing. While there are some signaled crossings in downtown the department has fought the Park Service over crossings in the historic district of Independence Mall where Streets feels that building entrances and thus pedestrian flow should be oriented toward corners.

Baltimore The city tries to avoid mid-block crossings, both for safety of pedestrians and traffic flow considerations.

Atlanta The city considers its 400-foot blocks too short to warrant mid-block crosswalks so current policy is to pave over the markings where they exist.

CROSSWALK DESIGN

Crosswalk markings are meant to alert oncoming motorists that pedestrians may be entering the roadway. They also highlight for pedestrians the recommended (and presumably safest) crossing locations. But their presence is more than a safety device. The markings signal street users that walking is expected and even encouraged. As with roadways that don't have sidewalks, a person can walk where there are no crosswalk markings, but will they want too?

Pedestrian advocate Michael King feels that the style of pavement markings is irrelevant because the striping does not provide enough of a visual cue to change motorists' likelihood of yielding. That faction feels that only the more prominent indicators (e.g. standing bollards) work.

Officials at the Department of Public Works in Atlanta also finds the design irrelevant in city centers where speeds are of or below 30 mph, but for a different reason. At those speeds the cars aren't going fast enough to require more than the double stripe crosswalk marking.

New York City. Higher-visibility markings (zebra stripes for instance) are currently installed at higher volume crossings like Times Square. N.Y.C. DOT is unconvinced that the markings are having the desired effect on motorists, but they do know that crosswalks improve a community's perception that their needs are being met.

Los Angeles. Special ladder-style markings are increasingly used in hopes of improving poor yielding behavior among motorists. According to L.A. DOT's John Fisher current studies show that 30% to 50% of motorists do not yield to the pedestrian when given the opportunity.

RECESSED STOP LINE

Moving the white stop bar for drivers farther back from the crosswalk (4 feet or more) gives pedestrians and drivers a better look at each other and more opportunity to avoid conflict.

If met with compliance the recessed stop bar has numerous benefits:

- It can reduce the likelihood of multiple threat crashes where one vehicle has stopped to let a pedestrian cross in a crosswalk and the pedestrian is struck by a trailing vehicle in the adjacent lane.
- It can also mitigate motorists' tendency to overshoot the stop line and invade the crosswalk area - pushing pedestrians out into parallel travel lanes.
- Trucks with limited forward visibility are especially prone to striking pedestrians that they can't see in crosswalks. Pedestrian fatalities in crashes with trucks were more likely than with other vehicles to occur at intersections, at traffic signals, during daylight hours, and to involve older pedestrians. Obstruction of truck driver visibility, caused by the design of truck cabs, appears to be a major contributing factor in crashes at intersections (Retting, 1993).
- A further advantage to the advanced stop lines is that bicyclists can wait in bicycle lanes several meters ahead of other travel lanes. The bicyclist will be much more visible to traffic and can get into the intersection quickly when the light turns green.

Moving the line back somewhat decreases the area available for queuing motorists. Some officials state that they cannot accept the tradeoff. The counterargument is that on an 800-foot block, a 5 or 10-foot setback means a reduction of automobile holding to 795 or 790 feet, an acceptable trade-off for improved visibility.

Atlanta Crosswalks are made twelve to fifteen feet wide in order to mitigate the tendency of motorists to overshoot the crosswalk. Attempts to employ the recessed stop line met with widespread disobedience.

New York City On Park Avenue South, along Union Square, motorist compliance with stop lines is encouraged because the traffic light is placed practically above the stop line. This nearside placement of the signal may work because "what motorist wants to stop beyond the light so that he can't see when to *GO*?"

SENSORED CROSSWALKS

Pedestrian sensor technology can detect pedestrians entering (or leaving) a crosswalk and automatically "call" the Walk signal and/or warning device that alerts motorists to pedestrian presence. No pedestrian action is required, addressing the problem of pedestrians who do not use the push button (51% in one study). These detectors can also extend the clearance interval to allow slower persons to finish crossing.

The sensors complement or replace pushbutton technology at otherwise uncontrolled intersections like mid-block crosswalks. Problems reported with the new technology include false and missed calls, but adjustments often improve operations. Two types of sensors have been used – microwave radar (similar to those used in supermarkets) and pressure sensitive tiles.

Where pedestrian crossings are frequent but do not justify a full traffic signal, the sensors are one-quarter the cost of a full signal.

Los Angeles. "Smart Crosswalks" with microwave radar detectors have been placed in about seven locations. The program is popular, and initial results indicate that the sensors and alerts significantly improve the percentage of motorists yielding to pedestrians.

See photos, details, suppliers: http://www.walkinginfo.org/pedsmart/nookit.htm

CROSSWALK ALERT SIGNALS

A variety of unique measures are being tried by some localities to reinforce pedestrian right-of-way at crossings. The special signals can be activated by active (push button) or passive (sensor technology) activation.

Flashing Overhead lights

Flashing yellow lights are a common sight at mid-block and especially school crossings. Criticisms include the fact that lights are *yellow* rather than *red*, usually meaning to slow down rather than stop. Many transportation officials indicated that positive controls that explicitly state the right-of-way are preferable.

In-Pavement Lighting

A flashing row of lights is embedded in the pavement on both sides of the crosswalk. Activated by either a push-button or through pedestrian detection by an automated device, the lights increase the distance at which motorists become aware of the crosswalk.

They then automatically shut off after the time required for a pedestrian to safely cross the street.

Los Angeles. L.A. DOT rejected in-pavement lighting which had been tested with positive results in Santa Rosa. L.A. DOT reasons that the low-lying in-pavement lighting is only apparent to the first motorist in the platoon. Therefore, the lighting would be effective only on lonely highways where gaps were already sufficient to make pedestrian crossings. The DOT has chosen flashing lights above the roadway instead.

See photos, details, suppliers: http://www.walkinginfo.org/pedsmart/tlite.htm

8. DEVICES – ENCOURAGING PEDESTRIAN COMPLIANCE

SIGNS TO ENCOURAGE PEDESTRIAN COMPLIANCE TO SIGNALS

Pedestrians often do not understand the meaning of pedestrian signal indications (see Pedestrian Indicators above) that may result in poor compliance with signals. Pedestrian behaviors like crossing against the signal are involved in about half of pedestrian injuries, (Zegeer 1985, p11). Informational signage explains the meaning of signal indicators or gives a "heads up" to pedestrians, reminding them to be responsible for their own safety.

Educational placards describing the pedestrian signal phases are commonly incorporated into instructional signs for pushbutton activation.

ITE completed a report in 1997 that evaluated various educational plaques, relying largely on a 1995 FHWA observational study conducted in Virginia, Maryland and New York (ITE, *Pedestrian Information Plaques*). The study found no change in pedestrian signal compliance once the plaque was present. However, it was noted that less than one-third of the pedestrians interviewed actually saw the placard at the intersections. A follow up survey found that exposure to the placard in print resulted in a significant increase in understanding of the phases of the pedestrian signal.

In its summary, ITE concluded:

> Special pedestrian information plaques appear to be more a response to a problem of public understanding than one of safety. The effectiveness of special information plaques appears very limited, but, at the very least, it provides the traffic engineer with a public relations tool, an opportunity to do something in response to complaints. (ITE, p 6)

Boston Part of a Boston Pedestrian Protection Program launched in 1999 includes compelling signage and sidewalk art throughout the city, designed to reach people at some of the high-traffic locations throughout Boston. BTD was involved along with other agencies, but no data is available to measure their effectiveness. Sample language used in the signs included: "YOU DON'T COME WITH AN AIRBAG. PRESS THE BUTTON", and "CRUNCH. THWACK. THUD. SOUNDS LIKE A GOOD IDEA NOT TO DART INTO TRAFFIC."

The signs were in response to results of a one-year observational study at a dozen of the city's most dangerous roadway intersections:

- Only 12% of pedestrians crossed at the crosswalk with the "Walk" signal.
- One-third of pedestrians were clearly jaywalking (crossing at least five feet from crosswalk).
- While nearly 95% of drivers yielded to pedestrians when pedestrians had the right of way, only 50% of drivers yielded to pedestrians who were crossing against the light. Even fewer slowed down for jaywalkers.

- At five of the 12 sites, at least 20% of drivers were speeding. (11/9/99 Press Release, Mayor's Office).

Philadelphia Within the city signs warn "Pedestrians Must Yield on Full Green" and incorporate a green ball. When the right turn arrow appears, pedestrians are not permitted to cross, but must wait for the full green.

SIGNS TO IMPROVE PEDESTRIAN LOOKING BEHAVIOR

Turning vehicles, especially left-turning vehicles are disproportionately involved in pedestrian crashes at intersections (Zegeer, et al 1985, p18). Several devices encourage pedestrians to scan for turning vehicles before stepping into crosswalk.

Both low- and high-tech measures have been tested and proven to reduce pedestrian conflicts with turning vehicles, at least in the short term. These range from signs and pavement markings to auditory and animated pedestrian signals.

Pedestrian advocates fear that such measures put the burden of safety too much on the pedestrian, blurring the legal requirement for motorists to yield to pedestrians. Most officials expressed concern over liability and effectiveness in the long term, commenting that even a flashing yellow beacon will lose its novelty and effectiveness over time.

Boston The Transportation Department posts WATCH FOR TURNING VEHICLES signs where exclusive pedestrian phasing is converted to concurrent timing. They find the signage helpful to pedestrians during the adjustment period. (Signs are also posted for vehicles that read YIELD TO PEDESTRIANS WHEN TURNING.) The department otherwise posts the signs only in response to complaints, where pedestrians report a threat from aggressive motorists.

Clearwater, FL The new SignalEYES device features a pair of blue eyes that scan from side to side for 2.5 seconds at the start of the WALK indication. The eyes were incorporated as part of the pedestrian signal at two sites in downtown Clearwater, FL. Instances of pedestrians not looking for turning vehicles decreased from 32% to 10% and from 26% to 5%, respectively. Introduction of concurrent SignalEYES display and WALK indication further reduced the percentage to 3%. The introduction of the LED signal head without the SignalEYES display produced no change in pedestrian behavior (VanHouten).

Similar results were found in a study of auditory pedestrian signals.

In **Detroit** and **Milwaukee**, a PEDESTRIANS WATCH FOR TURNING VEHICLES sign was found to be effective at each of the four test sites, particularly relative to right-turn vehicle conflicts. The signs had no proven effect relative to left-turn related conflicts (Zegeer 1985).

One untested concern mentioned by Zegeer is that pavement markings may not be the safest option if they encourage the pedestrian to look down rather than scanning for

potential hazards.

See photos, details, suppliers for SignalEYES: http://www.walkinginfo.org/pedsmart/eyes.htm

AN IMPROVED PUSHBUTTON

The pushbutton suffers from a lack of respect borne of mistrust, non-use and non-compliance. Pedestrians often don't see the button, don't understand which leg of the intersection it controls, don't realize it is working, or have to wait so long for a walk signal following activation that they do not wait, leaving traffic stopped unnecessarily after they have crossed.

A study in Detroit and Ann Arbor found only 51% of crossing pedestrians pushed the button to actuate the pedestrian signal, and 66% of pedestrians were observed starting to cross during the flashing or steady DON'T WALK interval. The violation rate ranged from a low of 34% at one site to a high of 71% at another (Zegeer 1985).

Most pedestrians don't realize they may not get enough time to cross safely if they do not push the button and they rely on the vehicular green to make their crossing. In Boston cross traffic from the minor street is commonly given only seven or eight seconds, while pushbutton activation grants 20 seconds.

In its *Toolbox* ITE recommends that municipalities keep pedestrian waiting time to 30 seconds or less and provide signs designating the street controlled (e.g. PUSH BUTTON TO CROSS MAIN STREET).

See photos, details, suppliers on Red Light Indicator: http://www.walkiz.org/pedsmart/iloom.htm

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Philadelphia Pedestrians at actuated signal locations are given adequate time to cross even when they do not activate the push button.

Boston A new device that addresses pedestrian mistrust has been tried in a number of Canadian cities and in Boston. A red indicator light is added to the push button face to communicate to pedestrians that the device is functioning and their call has been received. Rudin Center staff observed an intersection with the red indicator light on each pushbutton. The light did seem to discourage the need people felt to press the button multiple times, but did not seem to affect crossing behavior. In this case the red light (and button itself) was quite small, and barely noticeable at first glance.

PEDESTRIAN BARRIERS

Pedestrian fences are meant to prohibit pedestrians from crossing at high-risk locations and instead channel them to crossings with the least chance for vehicular conflicts.

Barrier fences have a varied success rate and varied popularity across location. One sure finding is that the barriers achieve compliance only if they extend far enough to insure that the shortest route will be the alternatively designated crosswalk. If the pedestrian can simply walk around the end of a barricade (say 5 feet beyond the entrance to his

desired path) he will do that and proceed, rather than walking to a designated crossing that is farther away. Likewise, a height of about 4 feet is necessary to keep pedestrians from easily stepping over the barriers.

New York City. During the 1997-1998 holiday season the police department installed barriers at 10 midtown intersections to prevent pedestrians from blocking vehicles turning onto one-way avenues. Pedestrians were directed instead to new crosswalks set 30 feet from intersections. Barricades initially confused and inconvenienced pedestrians, particularly the elderly and disabled (*New York Times*, 4/11/98). And the scheme inconvenienced all walkers by forcing pedestrians to cross three times instead of one. Some sidewalk vendors were enraged because the barricades practically eliminated their walk-by business (*New York Times* 4/11/98).

Transportation consultant Charles Komanoff has calculated that it takes 16% longer than it used to (741 seconds, compared with 640, on a typical stroll) to walk the length of the experiment area, from the northwest corner of 50th and Avenue of the Americas to the northeast corner of 50th and Lexington. Even if a car's travel time has been improved as much as 30 percent, Mr. Komanoff said, that savings is far outweighed by the time loss for pedestrians – perhaps by a factor of eight, he said – because walkers vastly outnumber cars (*New York Times* 4/13/98).

The mayor's office came under criticism for sanctioning the barriers and the press warmed to the topic, reporting that the police chief who first came up with the barricade scheme did so while "stuck in traffic, sitting in a left-hand-turn situation" (*New York Times*, 1/7/98).

Two years later though, most of the barricades are still in place, and signals have been added.

Atlanta Prior to 1996, the Streets Department installed French barricades in front of hotels in the downtown area in response to a high accident rate. The barricades extended from corner to corner along each block. Pedestrians complied by crossing at corners, and there was no reported complaint from the hotels nor the convention bureau. The barriers were considered unsightly though and came down in preparation for the Olympics in 1996. More of the barriers have been ordered and the department hopes to re-install them. Future plans include replacing the current design with more attractive wrought-iron fencing.

Los Angeles One barrier located near a university campus has achieved only moderate compliance. The barrier extends along a street dividing dorms from academic buildings to discourage crossings at an unsignalized intersection. Accompanying signs direct pedestrians to a more appropriate corner. However, a barrier only 8 feet long does not deter many in the agile population of students.

9. DEVICES – ENCOURAGING MOTORIST COMPLIANCE

PARKING RESTRICTIONS

Vehicles parked on the street can create a visual screen that prevents motorists and pedestrians from seeing each other – a particular problem at intersection and other crossings. A common response to the problem is to implement parking bans at specific times at high-risk locations near corners, sometimes called daylighting. The downside of such restrictions is lost parking space which affects adjacent businesses. Also, non-compliance among motorists is chronic in many cities.

It is interesting that in a recent ITE handbook the first recommendation under the heading Parking Restrictions is a recommended alternative to parking restrictions: "Where there is parking, curb extensions should be built where pedestrians cross." (*ITE Toolbox*, p. 193)

In fact, curb extensions (neck downs) do solve the problem of visibility by projecting pedestrian space beyond the parking lane into view of travel lanes. The neck down does this without removing valuable parking spaces and offers many other benefits, along with a few problems of its own.

However, most cities implement bans on parking near crosswalks with a variety of signs and other controls. The main challenge is enforcement, with motorists intent on finding a parking or standing space.

Philadelphia The application of a large painted X in a box, marked on the pavement in restricted spaces, has generated motorist compliance greater than what had been achieved with signs. The painted graphic is applied 3 to 5 feet on either side of driveways, and at controlled intersections.

In one case - at an intersection with a main street where visibility was a problem – demand was high from the community for an all-direction control. The X was applied at the problem corner and solved the problem.

Los Angeles Red pavement markings enforce the ban on parking near corners and other crossing points. Compliance has been "generally good." The Department has faced some political difficulty from storeowners, but they are working it out.

New York City Parking is restricted at high-risk locations with historically high accident rates or reported poor visibility. NO STANDING ANYTIME signage is placed in those locations. However, officials agree that enforcement is critical and its effects are short lived.

Baltimore It is very difficult politically to restrict parking in Baltimore. Currently they use only NO STOPPING signage, but with no threat of towing as there is for other rush hour arterial parking restrictions.

PEDESTRIAN LIGHTING

Improving illumination of pedestrians is effective particularly at intersections and at dangerous curves where sight distances are reduced. Lighting also has the most positive cost-benefit ratio compared with other safety improvements such as new traffic signals or median barriers, according to the Insurance Institute for Highway Safety (Status Report, 1998).

In commercial or downtown areas, specialty pedestrian-level lighting may be placed over the sidewalks to improve pedestrian comfort, security, and safety. Mercury vapor or incandescent lighting is often preferred as pedestrian-level lighting. Low-pressure sodium lights are low-energy use lights, but have a high level of color distortion (TRB *Toolbox* p182).

Philadelphia The Streets Department reports that private interests – property owners or business improvement districts, for instance, have responsibility for sidewalk, and thus pedestrian–specific lighting. However, the department is looking at new streetlights that combine the pedestal and mast arm to illuminate the crosswalk. Attractive new "torch lighting" has been installed on sidewalks. The new lighting is brighter and spaced more closely together to aid pedestrian safety and comfort. An ordinance and city approval is required for all such installations, mainly due to the electrical power required.

Atlanta The 1996 Olympics was a catalyst for significant improvements to downtown lighting. Before the upgrade, 6-7 candles were used as the standard for street lighting, and 1-1.5 candles were in use on sidewalks. The 28 – 32 foot lights often rose above the tree canopies, blocking light from illuminating the sidewalk below.

Following the redesign, new lights rise only 12-14 feet from the sidewalk and beneath the tree canopy. While the sidewalk lights are only 1.5 candles the street lights were lowered to 4 candles. Because of the reduced contrast the perception is that the sidewalks are brighter. That effect is heightened because lights are oriented to illuminate the vertical building face. The effect is aesthetically appealing and pedestrians feel safer.

Los Angeles Historic 1920s lighting is maintained for ambience in older areas of the city, but only modern poles and lighting are installed at intersections. The ornamental lighting that directs light upward is interspersed with modern lighting, aimed downward at the street and at pedestrians.

FLUORESCENT STRONG YELLOW-GREEN (SYG) PEDESTRIAN SIGNS

A jolting new color has been tried in a number of cities, exclusively at crosswalks and bicycle crossings. While the yellow-green color has won support in communities, studies conducted by FHWA and state authorities have been inconclusive in determining whether the signs effect any measurable changes in driver behavior. The new color will be included in the 2000 MUTCD for use in pedestrian, handicapped, bicycle, and school crossing signs.

Federal approval for use of the SYG signs was given in June 1998 and by California DOT in December 1998. Traffic engineers recommend limited use of the new color to help

preserve novelty and surprise for motorists. But while the new color is universally more visible according to surveyed respondents, a field evaluation of fluorescent yellow-green pedestrian warning signs found only marginal improvements in perceived safety at the crossing sites and no significant reduction in motor vehicle-pedestrian conflicts (Clark).

New York City The Department of Transportation is placing the new signs at all school crossings, where they do stand out even on an overcast winter day. Rudin Center staff note, however, that they clash with surrounding historic districts such as Stuyvesant Square Park.

Baltimore The signs have been placed at the stadium, and along Pratt in the Inner Harbor, and the program is expanded. They will be used in the suburbs in special instances, such as at roundabouts.

Philadelphia The City does not use the new color. The Department of Streets has opposed use of the signs not only because their benefits are unproven, but because the signs have a shorter life span (5 years versus 7).

Pennsylvania DOT had not yet approved the devices when 3M first marketed them to the city, making it easier to resist. Later, though, the department was charged by the Mayor to explain why it was not implementing the signs. Their defense was a convincing argument for the bottom line, based on the increased expense of the signs. At present the department may in fact find an application for the signs at high-speed mid-block locations along routes like US 1, JFK Boulevard.

Atlanta Based on state requirements the new color is used only in school zones, due mainly to the added expense of the color. Officials at the Department of Public Works doubt the long-term effectiveness of the signs. The local advocacy group, PEDS, which feels that the standard crosswalk symbol is over-used and holds no meaning for motorists, regardless of color, echoes this sentiment.

YIELD TO PEDESTRIANS SIGNS

Left and right-turn movements at signalized intersections have been found to be three to six times more hazardous to pedestrians than through movements mainly because drivers fail to observe or yield the right of way to pedestrians. Studies have found that the signs significantly reduce conflicts involving both left and right turning vehicles, though there are conflicting opinions among city officials and advocacy groups as to whether the devices are effective in practice.

In a study of four intersections in Detroit and Milwaukee the sign was found to be effective in reducing turning conflicts, and in particular, right-turning conflicts. Left-turning vehicles were not significantly affected. The signs were equally effective for low, medium, and high traffic volume levels (Zegeer 1985).

Another study of 12 intersections in two smaller cities found that the sign was significantly more effective in reducing left-turn conflicts, though overall effects were

positive for both turns. Not surprisingly, the incidence of conflicts between pedestrians and turning traffic decreased as the pedestrian group size increased regardless of the presence of the sign (Abdulsattar). Based on the results of that 1996 study, it was recommended that the Turning Traffic Must Yield to Pedestrian signs be considered for inclusion in the *Manual on Uniform Traffic Control Devices*.

Philadelphia Signs are placed at entry points around the periphery to Center City warning "State Law – Yield to Pedestrians." The purpose is to sensitize motorists as they enter the area to watch for and take care with those on foot.

Boston The Transportation Department found that the use of the "Yield to Pedestrians in Crosswalk" signs were effective at unsignaled crosswalks, but not at crosswalks where a signal exists. One engineer described pedestrians as "less cautious" in signed crosswalks where they feel more empowered to walk against the light.

Atlanta The signs are used primarily to enforce pedestrians' priority at permissive right-turn-on-red locations.

SUPPLEMENTARY PEDESTRIAN CROSSING CHANNELING DEVICE (SPCCD)

SPCCDs are traffic safety cones with no metallic parts, secured in the middle of the road at a crosswalk. The cones incorporate a graphic panel which reads with some variation of "YIELD TO PEDESTRIANS IN CROSSWALK".

The device, sometimes called the "soft sandwich," has met crash test standards and has proven effective at prompting cars to yield. Official feedback to New York State DOT was "positive and favorable" - the only reported complaint being that the devices are expensive (about $125) and they sometimes need to be replaced after a season of use. Agency memos also stipulated that the devices are considered supplementary and should be placed in addition to any other necessary signs and pavement markings required at a crosswalk. New York State DOT, which first developed the device, reports that that some locations had trouble with theft of devices and of motorists vandalizing the devices by trying to run them over.

A number of state MUTCDs permit use of the device, often with stronger language: STATE LAW. YIELD TO PEDESTRIANS IN YOUR HALF OF THE ROAD. New York, New Jersey and Washington states have all implemented the cones. Common placement is at mid-block crosswalks in conjunction with high-visibility striping. Officials interviewed feel they are best used in relatively low-volume arterials. Pedestrian advocacy group Walk Boston feels that SPCCDs placed mid block have been successful in the Boston area, especially at transit stops where people rush across to catch bus or light rail. Populous city and town retail strips which generate heavy crossing activity by pedestrians are good locations, as are school areas.

U.S.DOT requires that the device's color be traditional orange or the new fluorescent green, except for the graphic panel. A national version of the device will be included in the MUTCD by late 2000.

Philadelphia In 1999, Pennsylvania DOT gave the Philadelphia Health Management Corporation a grant with which they helped the Police Department purchase twenty soft sandwich devices. The signs were distributed, one per police precinct, and the police placed them where they saw fit, often near schools and high accident locations. The accompanying safety campaign ended but the cones are still in place.

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10. DEVICES – ROADWAY DESIGN

ELIMINATE REDUNDANT STREET SPACE

Converting excess space to pedestrian areas or bike lanes helps keep vehicles in more compact and predictable formation, limiting erratic driver behavior, and encouraging slower speeds. Redundant space can range from overly wide lanes to unused parking areas to stretches where wide roadways are essentially wasted because of narrower bottlenecks up the road. Space removed from the roadway can be given back to pedestrians in a form that is much more appealing to all road users.

The forthcoming *AASHTO Pedestrian Guide* will recommend a maximum lane width of 11 feet for urban areas (except where bike lanes and heavy bus use must be accommodated), and parking lanes of seven to eight feet maximum.

New York City There are many locations in Manhattan where redundant street space has been converted into attractive places for pedestrians. The most notable examples are along lower 6th Avenue in Greenwich Village and SOHO, where the roadway used to have a range of widths from 100 feet to as much as 250 feet wide. Beginning in 1974, four plazas were created out of what had been redundant street space. Father Demo Square at Bleecker Street was doubled in size, and trees and seating areas were added. Father Fagan Square at Prince Street was converted to a plaza; a triangle between Broome and Spring Streets was doubled in size, making room for additional landscaping, and a half-acre plaza was created between Canal and Grand Streets.

Sheridan Square in the West Village, once a striped asphalt wasteland, has also been reclaimed. A community association raised about half the funds needed to turn the unused space into a garden. The other half of the funding came from N.Y.C. DOT.

A 1988 report for the Manhattan Borough President's office, *Walking in Manhattan*, commented that "the reclaiming of redundant street space is an area where DOT and the Parks Department continue to display remarkable vision." The report recommends a joint departmental publication titled *Green Streets: Designing Public Spaces while Rebuilding Infrastructure.*

CURB RADII

One goal of intersection design outlined in the Boston Transportation Department's Streetscape Guidelines (7/99) reads as follows: "Curb radii at intersections should be designed to accommodate average turning traffic, without encouraging excessive vehicle speeds."

The TRB *Toolbox*, p. 182 makes the following recommendation:

A wide curb radius typically results in high-speed turning movements by motorists. Reconstructing the turning radius reduces turning speeds, shortens the crossing distance for pedestrians, and improves sight distance between pedestrians and motorists. Ideal curb radii are in many situations tighter than any modern guide would allow.

Older cities frequently have radii of two to five feet, without suffering any detrimental effects. Appropriate radii also depend on whether there is a parking or bicycle lane, in which case the effective radius allows the curb radius to be tighter, say five feet. If those lanes are not present, the radius might be up to about 15 feet and 25 feet for arterials streets with a substantial volume of turning buses, trucks or both. Tighter turning radii are more important where street intersections are not at right angles.

Philadelphia Streets Department officials report the city has predominantly 10 to 15-foot radii at corners, and they discourage anything beyond 20 feet. 30- to 35-foot radii are hugely problematic. Where does one place stop signs, stop lines, etc.

NECK DOWNS (CURB EXTENSIONS)

Neck downs (a.k.a. corner extensions, bulb-outs, bump-outs, side walk expansions) narrow roadways by extending the sidewalk or curb line into the street, reducing pedestrian crossing distance, and improving the ability for motorists and pedestrians to see each other.

Motor vehicles parked at corners present a serious threat to pedestrian safety because they block sight lines, hide pedestrians and other vehicles, and make turning particularly difficult for emergency vehicles and trucks. Neck downs physically enforce parking restrictions.

The restricted street width sends motorists a visual cue, encouraging slower speeds at intersections or mid-block locations with curb extensions. Turning speeds are also reduced with curb extensions (ITE *Toolbox* p185). Neck downs reduce roadway space available for illegal or aggressive motorist actions such as failing to yield to pedestrians, making high-speed turns and passing in the parking lane. It has also been observed that motorists are more inclined to stop behind the crosswalk at a neck down, and that pedestrians are more inclined to wait on the neck down rather than in the street.

One benefit to vehicle movement is that the shorter crossing distances may permit less signal time to be devoted to the pedestrian phase.

Criticisms include problems of restricted turning movements for large trucks and emergency vehicles as well as street cleaning and plowing considerations. However, the fire department in Cambridge, MA much prefers them to the problem of cars parked at corners. Trucks can always go over a curb; not so a parked car. As with pedestrian refuge islands, neck downs can cause concern to cyclists who are forced closer to motor vehicles.

Boston Neck downs have been present and effective in Center Street, West Rockaway in

Boston for ten years. Where there is parking, experience recommends a neck down two feet narrower than the parking lane, extending six feet into the street: less than that is not enough to discourage drivers from parking at the crosswalk. Beyond 6 feet makes snow removal difficult.

Philadelphia Narrow streets are the norm throughout most of downtown. One exception is JFK Boulevard, which runs from the 30th Street train station to City Hall. Neck downs have been installed at key intersections along the route to compensate for a width that is not pedestrian friendly. Other installations include Historic East Market Street, Chestnut Street, Washington Avenue, and Market Street in West Philadelphia.

http://www.bikewalk.org/curb_extensions_and_curb_radii.htm

PEDESTRIAN ISLANDS

Pedestrian islands break up the distance a pedestrian must travel to cross a roadway. Often the islands are integrated with medians dividing two-way travel lanes or provided as triangular spaces between through lanes and designated right-turn lanes.

The effect of refuge islands and medians on pedestrian safety has been studied in the United States and abroad in recent years. A 1993 study for the Federal Highway Administration compared the safety impact of raised curb medians, two-way left-turn lane (TWLT) medians, and undivided crossings in three large metropolitan areas. The study found that in CBD areas streets with raised medians have lower *pedestrian* crash rates compared with streets with painted two-way left-turn lane or undivided streets. The study also noted that the CBD *vehicle* accident rates at raised medians, for both mid block and signalized intersections, are higher than that of TWLT medians and undivided cross sections. However, a greater percentage of raised median vehicle accidents are of lower severity (property damage only) than that of TWLT and undivided cross sections (Bowman).

While raised medians are popularly know as “refuge” islands, pedestrian advocacy groups point out that there is a negative connotation to the term, which suggests that pedestrians should fear and be separated from vehicular traffic. Advocates at Walk Boston are divided over refuge islands. Some see the island as a dangerous, unfriendly place to corral pedestrians. This is especially true when engineers shorten crossing times in conjunction with medians or other refuge spaces in an attempt to stagger pedestrians’ crossing movement. They feel pedestrians must have enough time to make the entire crossing. Others feel that any refuge is good; for those pedestrians who start across too late and for those slower pedestrians who simply need more time.

Baltimore and **Boston** officials mention that some pedestrian islands were lost during a re-paving at a time when political tendency was to follow rigid AASHTO standards. Boston noted an increase in collisions following the removal.

Atlanta The city has quite a few right-turn islands for pedestrians, “some the size of Oahu,” according to officials at the Department of Public Works. Getting pedestrians past

the large turning radii movements is a problem since the state standard demands a 35' radius. Therefore the city often goes with a 35' radius in conjunction with the pedestrian island. The signals do not have split-phased signals to formally separate the two crossing segments.

SLOW TRAFFIC EXITING HIGHWAY OFF-RAMPS INTO URBAN AREAS

Cars hurtle at high speeds off of ramps onto urban roads, even though they are approaching traffic lights or pedestrian crossings. Ideally, engineers should avoid allowing these configurations that dump freeways abruptly onto urban streets. The forthcoming AASHTO Pedestrian Guide will prohibit use of the cloverleaf interchange in all urban areas.

Former Director of Traffic Calming for N.Y.C. DOT Michael King dismisses alert devices such as rippled asphalt and flashing lights in favor of redesign and re-signalization. He recommends conversion of ramps to right angle intersections.

New York City A red strobe light on the red signal head alerts oncoming motorists at locations on the Prospect Expressway and at 48th Street and the FDR Drive that they must stop. The opening of the Park Avenue tunnel on 33rd Street is blocked by jersey barriers and a 'quick curve' to prevent pedestrians from crossing on the north side of 33rd and to prevent vehicles from turning in front of the tunnel mouth.

Baltimore The city currently uses standard two flashing yellow lights, alternating right and left sides of the exit.

Philadelphia In the last 3 years the Streets Department has started to "judiciously" implement red strobe lights at the meeting between ramp and intersection. At some ramps motorists coming off of Highway 95 travel a half mile before getting to an intersection, making it easy to forget they ever left the highway. The idea behind the strobes is to get their attention and remind them that they have.

SUFFICIENTLY WIDE SIDEWALKS

According to ITE's Traffic Safety Toolbox (p.180), a minimum width of five feet for a sidewalk or walkway will allow two people to pass comfortably or to walk side by side. Much wider sidewalks should be installed in heavily traveled downtown areas. A buffer zone of four to six feet is desirable as a separation from the street. In downtown or commercial districts, it is appropriate to include street furniture in the buffer zone.

In congested areas like those around transit stations or other points of interest the sidewalks are so crowded at peak hours that movement becomes painfully slow. Walkers face the choice of stopping altogether or overflowing into the street.

Los Angeles The Planning Commission adopted wider sidewalk standards in 1999 which will increase sidewalk widths by 20% (12 feet versus 10 feet) on Major Highways. In addition, community plans can designate pedestrian-oriented streets where sidewalks are

increased to 17 feet on a selective basis. The Department of City Planning, the Bureau of Engineering, and the Department of Transportation jointly prepared the revised standard street widths.

Philadelphia City streets are typically 12 feet wide from curb to property line. The Streets Department reports they must be constantly vigilant regarding vendors and sidewalk cafes that try to inch their way into pathways that are supposed to remain clear for walking. Another challenge is business owners who demand that sidewalk space be taken to create insets for loading and unloading zones. The Department does its best to recommend alternatives such as signs restricting parking in those areas.

Atlanta The 10-12 foot sidewalks in downtown were retrofitted for the Olympics with added trees and tree grates along with furniture. The result was a sidewalk of only 8 feet, but officials at the Department of Public Works report that pedestrian volumes have not warranted more. They say the cost of taking sidewalk space from travel lanes is very expensive because of restructuring drainage facilities.

SAFE SIDEWALK SURFACES

Engineers aim to create streets with the smoothest possible driving surface for driver comfort and minimum wear and tear on automobiles. At the very least the same degree of effort should go into creating a smooth and safe walking surface for minimum wear and tear on pedestrians.

Attending a Women's City Club meeting in New York, one Rudin Center staff member asked a woman of about 75 her recommendations for a better walking environment. The septuagenarian's first response was immediate and focused – "give us sidewalks in good condition. This is terrible!" she added, gesturing to a stretch of East 21st Street as she walked. This is an active older woman who walks regularly to attend functions required by her many activities. While she doesn't appear feeble, she has slowed down, walks more carefully, and can't rely on her eyesight the way she once did.

SIDEWALK SWEEPING

The *Green Machine* is a new sidewalk vacuum cleaner with two brooms, a powerful vacuum and even a sanitizer. While street sweepers are a common sight, the idea of a machine that specifically cleans sidewalk areas is a new one that is catching on quickly. Unlike conventional street cleaners, the Green Machine can clean uneven surfaces such as brick and cobblestone sidewalks and streets. The machines issue a polite warning: "Caution: Sweeper Approaching."

Chicago At the mayor's request, the city bought nine of the green sweepers in 1998 to clean downtown sidewalks in an area bounded by Oak, Congress, Franklin and Michigan. Streets and Sanitation employees operate the machines on shifts that go around the clock. Each machine picks up an average of 5,000 cigarette butts a day, a result of recent No Smoking ordinances in office buildings.

Local businesses like the green machines. The Berghoff Restaurant and the Greater State Street Council each donated $10,000 toward the purchase. Each sweeper costs about $22,000. The green machines have not replaced the jobs of Streets and Sanitation workers who sweep curbsides clean, usually over a two- to three-block area, which can take them most of the day. One green machine can clean that same area in 20 minutes (*Chicago Sun-Times*, August 10, 1998, NWS pg. 20).

New York City In Times Square, a green machine called "Felix" is programmed with actor Tony Randall doing his Felix Unger character. The machines grind glass bottles and shred aluminum cans for recycling. They also pick up gum, animal waste, cigarette butts and other garbage and shoot it into standard plastic garbage bags. A driver guides the machine, either while sitting in an attached chair or walking behind.

The machines are used in the **Vatican**, **Westminster Abbey**, **San Francisco**, and **Baltimore**.

See photos, details, suppliers: http://www.appliedsweepers.com/

SIDEWALK SNOW REMOVAL

Snow removal efforts in urban areas must consider sidewalks as well as streets. New technology with improved removal methods may offer help to the special challenges posed, but is still on the drawing board at this time (see PennDOT case below).

Streets departments reported a range of compliance among property owners for snow removal on their sidewalks from very poor (Boston) to satisfactory (Philadelphia). Minneapolis and St. Paul were cited by Walk Boston as good examples of owner compliance, even on retail strips.

A bigger concern in compact urban cores has been getting the plows onto smaller side streets, and the mountainous snow banks formed at corners following “successful” plowing of streets. One engineer felt that considering snow removal from a pedestrian aspect was “stretching things a bit.” But with sidewalk sweepers spreading across cities, can sidewalk plows be far behind?

Pennsylvania Department of Transportation (PennDOT) was chosen by FHWA in winter 1996-1997 to lead development of a new snow blower intended to remove snow from congested metro areas.

The Department developed a 31-foot, rear-discharge snow blowing conveyer, resembling a conventional snow blower but placing the snow directly into the bed of a truck following in the same direction and lane as the blower. It was hoped that the new blower could be used on urban streets and bridges where traditional snow blowers are ineffective due to the limited area to blow snow. However, Ray Rugh (717 787-1567) of PADOT reports that the conveyor is too big at 31 feet for urban areas, and that too many trucks and truck maneuvers are required of the device to be effective in compact urban areas. A single truck bed can be filled in 18 seconds.

CONSTRUCTION ZONES

Adequate control for pedestrians should be provided at construction sites. Continuously protected walkways should be provided where pedestrians would expect to walk. When absolutely necessary, pedestrians may be routed to the other side of a street, in which case a safe crossing point must be provided along with sufficient advance notice of the detour.

Just as road work is accompanied by rerouting of motor vehicles, road work and construction projects should take care to accommodate the pedestrian, for whom significant and unexpected detours pose a greater inconvenience.

Boston The advocacy group Walk Boston bestowed their Golden Shoe Award on the Central Artery Business Committee for their excellent work at rerouting pedestrians during an enormously disruptive and lengthy reconstruction project.

Philadelphia All development projects are required to meet first with the Streets Department and the Police Foot Traffic Division. Contractors must agree to provide a protected pedestrian walkway in order to obtain their sidewalk/street use permit. Officials at Streets feel that the relationships built between the city and the finite number of contractors they deal with has benefited pedestrians. Contractors know the expectations, and Streets reports about a 70% compliance rate.

ENHANCEMENTS – LANDSCAPING AND AMENITIES

Urbanist William H. Whyte understood the importance of creating an environment that would draw and nurture the person on foot. His comments on what makes an inviting public plaza are all applicable to streets as well.

Elements of good pedestrian spaces may include:

- **Seating** [either formally with benches and chairs or informally with ledges]
- **Water** [fountains, bridges over waterways, even minor canals and creeks in urban spaces or rivers as in Chicago]
- **Art** [From large sculptures to pavement inlays]
- **Food** [street vendors and outdoor seating at cafés should be encouraged]

Houston. The large scale of the buildings and monotony of the terrain in much of downtown Houston gives a walker the impression that he has covered a very long distance when in fact he's traveled only 2 blocks. There is no street level retail. The only activity, as William H. Whyte noted 25 years ago, seems to be the drive-through windows for parking garages and bank tellers.

There is no parking along the wide avenues, making their great expanses even more daunting to cross. Yet there is extra capacity on in-town streets; all the congestion seems to be out on the freeway. In response to these conditions, or maybe causing them, most Houstonites traverse their downtown through underground tunnels, which protect them from the intense monotony and heat above.

On a downtown street running between several cultural institutions and the new ballpark, restaurants and boutiques have brought life downtown. Property owners immediately requested wider sidewalks. Five lanes were reduced to two; neck downs and angled parking were added. The sidewalks were widened and trees planted. A fountain bubbles. The entire feeling of that eleven-block strip changed for the better. People have come to enjoy walking in Houston under a canopy of trees.

New York City

> Not long ago, the two concrete traffic islands in Midtown, near Macy's, were symbols of a blighted New York. Grandly named Herald Square and Greeley Square, they were cracked slabs with scraggly bushes along the edges and some benches, where homeless people dozed and drug dealers rested between sales. Today, the little triangles - shaped like a bow tie, between 32nd and 34th Streets at Broadway and Sixth Avenue, one of the city's most congested intersections - are another world. Lunchtime on a Friday hundreds of people gather to sit in the sun or in the shade of the honey locust trees, reading, talking, drinking and eating. They set out their lunches on the small tables and have the unusual urban luxury of arranging the light wooden chairs however they wanted - alone, in big groups, or in twos for intimate conversations (New York Times, *Islands in the Stream of Traffic Provide an Escape*, June 4, 2000).

REMOVAL OR CONSOLIDATION OF SIDEWALK HAZARDS

Although collisions with motor vehicles represent serious problems for pedestrians, tripping and falling are also a primary cause of pedestrian injuries, particularly among older pedestrians.

Sidewalks should be kept clear of poles, sign posts, newspaper racks, and other obstacles that could block their paths or become a tripping hazard. Benches, water fountains and other street furniture should be carefully placed to allow for unobstructed paths for pedestrians. (ITE Traffic Safety Toolbox p. 181)

New York City The Department of Transportation has implemented a Geographic Information Systems (GIS) project to document the presence of all objects on corner quadrants. The goal of the database is to aid in conforming to the city's "clear corner" ordinance. The clear zone includes the sidewalk, 10 feet into the block from the building line (from N.Y.C. DOT web site – *Pedestrian Information*).

Philadelphia The city has begun planning for newsstand *corrals* - new structures to be placed away from corners. The highway division has a list of current box locations. A constant battle continues in which newspapers claim 1st Amendment Rights to defend box placement.

Houston and **New York City** are implementing consolidated parking meters. The meters reduce clutter along the curb and are more resistant to coin theft than traditional parking meters.

Boston Several full-scale models of street furniture for the city's new Coordinated Street Furniture Program were available on public display behind City Hall on Congress Street

during March and April. The model included a public pay toilet, a newsstand, and a bus shelter.

According to a press release from the mayor's office, Phase I of the furniture program includes the installation of eight Automatic Public Toilets (APTs) that are self cleaning and flushing; 250 bus shelters; nine information kiosks; and four newsstands. A number of "news condos" will also be installed. Pedestrian traffic, bus routes, community input, sidewalk width and other factors will determine the siting of these amenities. It is expected that the first toilets will be complete by fall 2000.

The manufacturer Wall USA also agreed as part of its contract to build a production and maintenance facility in Boston's Empowerment Zone that will provide about 40-50 people with jobs. It will provide maintenance for Boston's furniture.

In response to the 1998 RFP, companies competed for the right to locate their street furniture products free of charge to the City of Boston, in return for the privilege of deriving revenue from the sale of city approved advertising installed on the products.

GENERAL WAYFINDING SIGNAGE

The November '99 Planning Magazine did a spread on efforts in Dallas, Bethesda, Houston, Newark and Seattle to create wayfinding systems that can bring a large city down to scale by pointing out attractions, adding historical explanations, delineating unique neighborhoods, and locating amenities.

The success of a way-finding system is hard to quantify but the benefit of the signs may be that they not only direct walkers to many important destinations but reinforce safety by directing people to crosswalks and through safe areas.

Philadelphia The *Walk! Philadelphia* sign program is an extension of the popular Direction Philadelphia vehicular signs. The signs are the same as those being installed by the Center City District. They are being installed at locations outside of the CCD within Center City by the Foundation for Architecture so that the entire downtown will be marked with pedestrian signs. The signage is color coded by sub-area and is placed at pedestrian eye level. The traffic unit of the Streets Department funds and coordinates the signs jointly with the Foundation. A future phase of the program will expand the signage to the next level of detail by installing small interpretive signs at places of interest that are already listed on the directional signs.

Atlanta An effort somewhat related to wayfinding is aimed at drivers but may benefit pedestrians as well. The Department of Public Works recently began to place street signs above intersections rather than on corners. The new signs elicited positive response from the community, who appreciated not having to concentrate of looking for hard-to-find street names while behind the wheel. Less distracted drivers must be safer for pedestrians. The city continues to put up about 200 signs yearly, as the budget allows.

Houston Houston's way-finding system incorporates public art to tell the story of Houston and to create an identity for the Uptown section. New charcoal street signs are elliptical in shape and use white letters to evoke a futuristic feeling. Streetlights were retrofitted to make them more aesthetically compatible with the signs. The $10 million project, complete in 1998, created six arches over the crosswalks at major intersections with the intent of encourageing pedestrian activity. A series of mini-parks with public art were also created to enhance the pedestrian experience. The streets are still quite wide and the traffic heavy, however, minimizing the overall improvement of the pedestrian experience.

Seattle The consultant hired to develop a pedestrian way-finding system that integrates bicycle and transit quickly concluded that such a system would be a waste since the vehicular signage here is so out of control. Mayor Paul Schell agreed and ordered that all unnecessary signs be taken down. The city has now compiled a visual inventory of what doesn't belong and a hierarchy of what should stay.

EXCLUSIVE URBAN GREENWAYS FOR NON-MOTORIZED TRAFFIC

While many cities have established greenways as part of a recreational network, there is an opportunity to plan and use these routes as alternative transportation routes as well to serve work, shopping, and social trips.

New York City Hudson River Park on Route 9A provides bike and walking paths that are separate from automobile traffic (opened summer '99). With much less hoopla, a continuous bike and walking path has been pieced together on the east side of Manhattan for access from 20th Street all the way to Battery Park City and continuing north to join the Hudson River Park.

Minneapolis The 29th Street Corridor Project (opened summer '99), also called the Midtown Greenway Project, involved the rehabilitation of a five-mile abandoned rail bed, accomplished with TEA-21 funding. The corridor is 100 feet wide, 5½ miles long, and passes under 40 bridges.

Seattle The Urban Trails Program has constructed three major urban trails totaling 30 miles that promote non-motorized transport, serving more than two million people.

Atlanta The local PATH organization has partially completed a 10-mile route from Stone Mountain to the city's core built mainly with federal funds. Alternative transportation advocates in the area are not satisfied with recreational routes like this one because they are not planned to connect areas of activity. Their isolated locations render them useless as meaningful transportation routes.

PART-TIME GREENWAYS

Only temporary barriers and signage with hour and vehicle size restrictions are required to implement a time-share of the street network. Weekend, summer and lunchtime hours can be set in parks, shopping areas and others where the needs of a high-volume of pedestrians outweigh those of automobiles for a safe and pleasant pathway.

New York City In Central Park cars are not allowed in the park on weekends or between 10 and 3 on weekdays during the summer months to make the park more hospitable for other users. Flexible streets also exist at Fulton Street in Brooklyn and at lunchtime on Fulton Street in downtown Manhattan.

Philadelphia Fairmount Park closes its West River Drive to motor traffic on weekends. DOT notes that nearby residents complained, feeling that more privileged park visitors were being given special treatment over residents.

11. DEVICES – OTHER TECHNIQUES

DATA COLLECTION

Transportation and planning departments would be well-served by a database of city streets that can be recalled in an instant for the purpose of cataloging signs, signals, curb treatments, parking restrictions, etc. One valuable resource in this daunting task is a GeoSystem solution.

Boston The Transportation Department has used GeoSystem technology to document 750 miles of city streets in the form of continuous video, recorded from a moving van. A user selects a street, intersection, or even address from the GIS map, and sees a video of the area from right- left- or front facing perspectives, and from three levels of vertical perspectives. Resolution is sufficient for the user to zoom in closely on signage and other details of the streetscape.

Interestingly, other city departments such as Law and Assessing, who need the reliable documentation of before and after information, have used the video catalog.

Colorado Springs The Department of Public Works' Streets Division is using a $10,000 - $15,000 backpack GPS system from Compass.com out of Denver to document all street corners. In eight months their scouts rated 40% on 40 criteria. Presence and condition of handicapped access followed by concrete work were listed as two of the departments major concerns based on backlogs of complaint requests.

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Los Angeles L.A. DOT has received a grant from the State Office of Traffic Safety to update and enhance its traffic incident record system. The new system will enable engineers to receive and analyze the patterns of incidents, including pedestrian-related incidents, more expeditiously.

TEMPORARY TRIAL IMPROVEMENTS

Before creating permanent new infrastructure, some cities have first tried experimental, temporary devices at very low cost. This allows for a trial period in which effectiveness can be measured and adjustments made.

While temporary treatment is better than none at all, the tendency for such ugly temporary treatments to remain long-term makes such treatments unpopular in neighborhoods. They are perceived as eyesores. The treatment must be designed into fabric of street and must look good.

Seattle, WA; and **Las Vegas**, NV have installed roundabouts made out of barrels or sandbags.

New York City Mulrey Square was traffic calmed with new curb extensions, widened sidewalk, and refuge islands all done in paint. Columbus Circle in NYC received similar treatment. The city also uses wooden horses as barriers during school crossing times that act as neck downs to prevent fast turning movements.

Philadelphia has created some bump-outs with jersey barriers, where some have been in use for three years awaiting approvals for conversion to a permanent and more attractive solution.

EDUCATIONAL AND ENFORCEMENT CAMPAIGNS

A number of ticketing and warning blitzes have been tried in cities across the country in an attempt to ease gridlock and/or make streets safer for pedestrians. The value of their effectiveness in the long term is not definite.

Only those educational programs aimed at children have consistently proven to have long term benefits. Zegeer (1991) reports that pedestrian educational programs have been found to reduce 20% to 30% of pedestrian accidents involving young children. For the remainder of pedestrians, the effects aren't so clear.

Advocacy group Walk Boston does not feel that such campaigns are effective on jaywalking behavior. They are resigned that pedestrians will cross where and when they like for the most part.

Philadelphia Operation Crosswalk (1997 – 1999) used funds via the Philadelphia Health Management Corporation (PHMC), a non-profit institution concerned with public health and safety.

The mayor's office acted as coordinator between PHMC and the police department, who agreed to accompany the educational campaign with enforcement for a three month period.

Intersections were chosen based on accident data from the state DOT via the local traffic department. 460,000 leaflets were distributed and outside agencies, including insurance concerns, offered to help fund them in a citywide campaign. Because of the short life of the campaign, which ran from January through April, statistics could not prove any safety benefits as a result of the campaign, but official and community feeling was that there had been a beneficial effect.

The following year Councilwoman Happy Fernandez launched a second campaign with pro-bono contributions from an ad agency. Television ads were broadcast and print ads appeared in buses, on subways, and in bus shelters. Police agreed to step up enforcement at the same time. In 1999, Pennsylvania DOT gave the Philadelphia Health Management Corporation a grant to purchase pedestrian safety devices. Some of the money was shared directly with the police department over time to enable enforcement activities. Other

monies helped PHMC continue their outreach activities.

Philadelphia police have a division of Foot Traffic whom the Streets Department report are very effective. They would like to see the division expanded.

Washington DC In April-June 1999 D.C. police tried several enforcement measures.

Pedestrians were warned about jaywalking but not ticketed. Between May 10 and June, warnings to jaywalkers dropped from 1,164 to 567 which could indicate either improved compliance or relaxed enforcement.

Cars blocking the intersections and running red lights were ticketed. Police noted that the number of tickets for running red lights remained constant while the tickets for cars blocking intersections dropped dramatically. This may have been helped by the "NO GRIDLOCK PLEASE" sign erected by the BID in February at 14th Street, F and K Streets. Fliers were also handed out by the BID explaining that jaywalking causes gridlock. Many pedestrians did not know the definition of jaywalking or that they were committing it. The Metropolitan Police Department defines jaywalking as "walking so as to create a hazard" which can include walking out of the crosswalk's white lines and crossing against the light.

St. Petersburg, FL A 1998 campaign of positive reinforcement was instituted by the Florida Department of Transportation for $95,000. At eight intersections, researchers measured how often drivers yielded at crosswalks and then posted the results on roadside signs. Police stopped drivers who did wait for walkers and gave them promotional gifts as rewards. Organizers also distributed fliers.

LIGHT EMITTING DIODES (LEDS)

New Light Emitting Diodes (LEDs), used for red lights and pedestrian signals, are supposed to last 10 times as long as incandescent stop lights and appear brighter.

TRB found a signal intensity of 25 cd minimizes the frequency of both "too bright" and uncertain responses regardless of size, distance, or technology, or whether the message is signal or text.

Testing on 48 senior citizens was conducted on bright, sunny days, though no testing included worst case condition of direct sunlight on signal face. (TRB '97)

Caltrans converted 60,000 red light and pedestrian signals statewide to LEDs, 10/97. **Boston** did the same for all red lights, red arrows and walk signals, changing 3,600 signals at a rate of 200 a month (5/99). **Baltimore** is very happy with them, especially where very good visibility of signal is important.

Oregon DOT in 1993 installed 2,212 red LED lamps in 12 in. balls, 12 in. arrows, 8 in. balls and pedestrian "hand" symbols. Oregon notes:

- Lamps reduced power consumption in Oregon by 88% and operating costs by 26%.
- Lamps are warranted to last 5 years.

- Lamps continue to operate after several of the 620 individual LEDs fail, making the lamp more reliable.
- Longer life has reduced the number of emergency calls for lamp failures.

Philadelphia has converted all red traffic signals, and are converting greens right now. ITE has no specifications for the yellow signal so there is currently no move to convert those. Philadelphia has been a lead agency during LED testing.

Los Angeles While the L.A. DOT was one of the early testers of the new technology, they have so far passed on the option of installing it. One reason is that early versions did not hold up to the claims of a life span 10 times that of current technology.

The main concern voiced by John Fisher of DOT is one that has not been mentioned by other cities. With a lengthened maintenance cycle (7 to 10 years) the DOT is wary of the eventual major capital improvement for all 4200 traffic lights. While the maintenance budget is assured for the current practice of replacing bulbs every 18 months, the capital budget would not be assured. The city is taking a wait and see attitude.

VIDEO ENFORCEMENT

Red light running accounted for over 6% of pedestrian crashes in a study of 15 cities (Zegeer, Opiela, Cynechi, 1985). Activated by loops in the pavement, red light cameras photograph the license plate and sometimes the driver of any vehicle entering an intersection after the light has turned red. Warnings or citations can be sent to offenders. Speeding and double-parking can be discouraged with similar measures.

Richard Retting explains the effectiveness of the cameras. “The real advantage of automated enforcement is this deterrent effect. We can’t convince most motorists they might be in a crash, but with automated enforcement we can convince them they’ll get a ticket if they break the law. The threat of a ticket, not the fear of a crash, is what prevents deliberate traffic violations.”[7]

The introduction of red light cameras has consistently reduced the incidence of red light running in cities that have measured its effect. Oxnard, California experienced a 42% reduction.[8] Where increased driver compliance spilled over to non-equipped intersections as well.

The use of the cameras has spread to a number of cities. Those who haven’t yet taken the plunge cite concern over responsibility for operating the cameras, a wait-and-see approach, or various approvals. Atlanta officials want the cameras but state approval is currently held up by concerns in some parts of the state that the cameras will worsen a reputation for setting speed traps as revenue generators.

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[7] Insurance Institute of Highway Safety, *Status Report*, Vol 35, No. 3, Mardh 11, 2000.

[8] "Evaluation of Red Light Camera Enforcement in Oxnard, CA, "Accident Analysis and Prevention 14 (1982), pp 219-234)

New York City In 1999, the Department of Transportation reported a 40% reduction in red light violations at intersections with the camera. Community response has been positive from groups like Transportation Alternatives, a pedestrian and bicycle advocacy group with 6,000 members in New York City.[9] Rudolph E. Popolizio P.E., Chief of the Red Light Camera Program for NYC has posted a description of that city's experience on the NACTO web site. The write-up includes a history of the RFP procedure, tips on site location and loop placement, cost, fine structures, and an interesting cautionary tale about privacy issues:

> Lawmakers raised concerns on the issue of privacy. We had an unconfirmed report that one photographic monitoring system (not in New York City) had been shut down because it used frontal shots; to avoid this problem, we use only rear view photos. By so doing, we are only able to cite the registered owner of the vehicle because we cannot identify the driver. However, this has a positive side to it. If the violation had been treated as a moving violation, (driver identification needed) then all revenue would pass to the State (except for administrative fees) and points would be assessed against the driver's license. If for some reason the program proved to be unsuccessful or contained a major fault, it was conceivable that a driver could have been unfairly penalized. To reverse a wrong of this nature would not only be costly and time consuming but very difficult to rectify.

Montgomery County MD. The county learned some valuable lessons as an early testing ground for a red light program:

- Officials learned that the camera they installed using a $50,000 federal transportation grant could not be used to ticket motorists – only to issue warnings. A locality cannot make money off a federal grant.[10]
- The digital cameras used at first (from Peek Traffic Systems, Inc.) had more problems than the standard wet-film models. Malfunctions ranged from computer failures and image clarity problems to overheating on hot days. Failure of the system's telephone line to download information means the camera has to be reset manually.[11] The advantage of the digital cameras is that they provide real-time information and don't require manual retrieval of film. Peek and other manufacturers continue efforts to make digital cameras more reliable.

Baltimore The Department of Transportation is happy with their contract, which requires that the contractor for the cameras bear the burden of maintenance. This means it is up to the contractor to maintain profitability if he chooses to switch to digital from wet film cameras. Wide media coverage including camera locations preceded implementation, though no signs identify camera locations.

Los Angeles L.A. DOT videotapes parents near 21 schools who double-park when dropping off or picking up children then issues citations by mail. The program has

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[9] Transportation Alternative's 1999 Recommendations to the City; www.transalt.org.

[10] Bruce Mangum, Sr. Engineer for Mont. County transportation systems management section (8/13/98 *Bethesda Gazette*)

[11] per Michael Kinney, county engineer as quoted in *Gazette*

significantly reduced the illegal behavior.

See photos, details, suppliers: http://www.redlightcamera.com/photoseq.html
NYC Red Light Camera Experience: NACTO web site "Best Practices" page: http://www.nacto.org/
Further information from Montgomery County is available at http://www.dpwt.com/redlight/
Victoria, Australia established the Traffic Camera Office in Jun 1990 and had 35 total cameras in 1989. Their web site is http://home.vicnet.net.au/~tco/index.htm.

REDUCING NUISANCES

Noise and air pollution, along with dirty or snowbound sidewalks may not be the responsibility of transportation departments, but they do pose a significant assault on the walkability of cities.

Cars and utility vehicles, insulated by design from their surrounding environments, are protected from the horn honking that drivers direct at each other, while the vulnerable pedestrian is assaulted with a harmful decibel level of noise pollution. The Council on the Environment of New York City recently published the decibel level for common sounds, stating that sustained exposure to noise higher than 85 decibels can cause permanent hearing loss. An air-conditioner, for example, creates a noise level of 75 decibels, while honking horns, jackhammers and loud music each create 120 decibels.

Not all cities perceive honking as a problem. In Atlanta, loud car radios are a much larger nuisance.

Pedestrians and bicyclists are also the street users most at risk from vehicle exhaust. The young are particularly susceptible to pollution-related asthma.

New York City The Metropolitan Transportation Authority included plans to purchase a large proportion of clean-fuel buses, along with traditional diesel, in its latest budget. Meanwhile the Department of Transportation has been active in converting its franchised buses and city fleet to clean vehicles.

Los Angeles In June 2000 the South Coast Air Quality Management District Board in California unanimously adopted new rules that would force the use of cleaner-burning alternative fuels in public vehicles in the Los Angeles Metropolitan area.[12]

The action immediately bans the purchase of diesel buses by transit operators in Los Angeles, Riverside and San Bernardino counties that operate more than 100 buses. They will be allowed to purchase buses that run on natural gas, methanol, electricity or fuel cells instead. Operators with 15 to 99 buses were given until July 1, 2001, before being required to buy alternative fuel vehicles. The lone exception is for articulated buses, which can still be diesel powered. Low sulfur diesel is currently be considered by the Board and will be permitted if it can be proven to be as clean as the other fuels.

[12] This rule is distinct from and even stricter than the measure passed by the California Air Resources Board in late February which gives agencies ten years to comply with tighter emissions standards.

The mandate emerges from the AQMD's conclusion last year that diesel emissions are responsible for most of the cancer risk in the region, which includes Riverside, San Bernardino and Orange counties. The Sacramento Bee reported that urban areas hard hit by ozone such as Houston and Dallas are looking to the California board's measure as a model for similar measures. (*Mobilizing The Region: A Weekly Bulletin from the Tri-State Transportation Campaign*, Electronic Edition Number 275, June 26, 2000)

CROSSWALK MARKING MATERIALS

Thermoplastic Markings

Textured Thermoplastic Crosswalk markings are placed in the pavement while the hot asphalt is being rolled. This provides a much longer life span that heightens long-term visibility and reflectivity.

Inlay tape

According to the Transportation Research Board, the best material today from marking crosswalks is inlay tape. It is highly reflective, long lasting, and slip-resistant. Although initially more costly, it is more cost-effective than paint or thermoplastic in the long run; it is most cost-effective when laid down as a street is being re-paved." (TRB *Toolbox*, p182)

Philadelphia. The Streets Department has had trouble in the past marking textured crosswalks. An engineer comments that "if he can mark it, he has no problem with it". Raised crosswalks however, are a serious threat to traffic movement, because they slow traffic unnecessarily and impede flow. Thermoplastics are used extensively, replacing inlay tape in most cases. City forces are trained and have been installing the thermoplastic or inlay tape markings successfully since the mid-70s. Officials are very pleased with the longer life and higher visibility. Expectation is for the markings to last the life of the road, which allows re-paving and re-marking maintenance to be coordinated.

Salt Lake City Because the material can be slippery when wet, Public Works installs two sections of ladder-style markings on either side of a section of unmarked asphalt, which provides nearly identical visibility to the approaching motorist and mitigates the slip hazard. (*Improving Conditions for Bicycling and Walking: A Best Practices Report*, FHWA 01/98, p23)

Baltimore Thermoplastics are in use and working moderately well. The main concern is that workers who install these and inlay tape require a higher degree of skill. That concern is the reason Baltimore hasn't even tried the recommended installation as hot asphalt is being rolled.

Boston Director of Technology Tom Kadzis said that although thermoplastics were used extensively, he is not convinced that the material is being optimally applied. If not applied *perfectly*, he says, the thermoplastic cracks, doesn't wear as long as it should. More labor is required for reapplication because the former application must be sanded

down first. The state requirement is only for two parallel lines, and this is insufficient.

Los Angeles. Thermoplastic is used in most cases, especially with high-visibility ladder style markings. The application is more labor intensive but can last seven years without maintenance.

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14. MORE INFORMATION

Many resources proved invaluable during compilation of this chapter`. In the category of authoritative reference, we recommend two works by the Institute of Traffic Engineers (ITE). *The Traffic Safety Toolbox* includes a chapter on Designing for Pedestrians which provides concise overviews and guidelines for pedestrian-sensitive treatments. ITE's *Design and Safety of Pedestrian Facilities* covers a broader range of recommended practices in a more comprehensive manner. Material from both guides proved useful although neither focused specifically on urban areas. ITE publications are available to order online at http://www.ite.org or telephone: 202-554-8050 x130.

Some state and local transportation authorities have compiled their own recommended practices. A strong entry in this category is Washington State's *Pedestrian Facilities Guidebook*. The guide covers intersections, crossings, sidewalks and walkways, and general design considerations. That document is available free online in Acrobat format at http://www.wsdot.wa.gov/hlrd/PDF/PedFacGB.pdf.

Mean Streets: Pedestrian Safety and Reform of the Nation's Transportation Law (1997) by the Surface Transportation Policy Project and the Environmental Working Group challenges the status quo with makes-you-think statistics on pedestrian safety and ranks the largest 25 metropolitan areas for pedestrian safety — Pittsburgh and Milwaukee took first and second place. The main focus of the report though is explained in its subtitle. *Mean Streets* convincingly outlines why federal, state and local laws are insufficient regarding pedestrian safety and how public spending on pedestrian safety is woefully out of proportion with other transportation spending - while 13% of traffic fatalities are pedestrians, less than 1% of federal spending goes to pedestrian safety projects. Mean Streets is available free in Acrobat format at http://www.ewg.org/pub/home/reports/meanstreets/mean.html. A recently released 2000 edition is now also available. See the STPP website, below.

Another project analyzed data from three years of pedestrian fatalities in New York City (1994-1997) to determine cause and culpability. *Killed by Automobile: Death in the Streets in New York City (1994-1997)* by Charles Komanoff and Members of Right of Way is available in Acrobat format at http://www.panix.com/~jlefevre/cars-suck/research/kba_text.pdf.

Professional journals provide articles by transportation experts addressing theories on traffic safety, apply those theories, and produce research results that help determine the value of certain safety initiatives to different environments. Some noteworthy journals are The *Transportation Research Record*, *Transportation Quarterly*, *Accident Analysis and Prevention*, the *ITE Journal*, and the *Journal of Safety Research*, among others.

Numerous organizations now have web sites that were immensely helpful. Some of the most interesting sites are listed below. None has a specifically urban focus but they share a lot of good general information on topics from federal policy and funding to statistics on pedestrian safety to design guidelines to educational conferences and programs.

GENERAL RESOURCES

Federal Highway Administration -Bicycle and Pedestrian Program:
http://www.fhwa.dot.gov/environment/bikeped/

The Pedestrian and Bicycle Information Center (PBIC)
The Center is a program of the University of North Carolina Highway Safety Research Center in cooperation with the Association of Pedestrian and Bicycle Professionals.
http://www.walkinginfo.org/main/index.htm

The USDOT and FHWA's Pedestrian Safety Roadshow
The purpose of the Roadshow is to assist communities in developing their own approach to identifying and solving the problems that affect pedestrian safety and walkability.
http://www.ota.fhwa.dot.gov/walk/

The FHWA's Pedestrian and Bicycle Safety Research Page
http://www.tfhrc.gov/safety/pedbike/pedbike.htm

The FHWA's Design Guidance for Accommodating Bicycle and Pedestrian Travel:
http://www.fhwa.dot.gov/environment/bikeped/Design.htm

The National Center for Bicycling and Walking.
This site provides lots of good technical guidelines for pedestrian planning including Curb Ext. & Radii, Signal Timing, Signing And Marking, Pedestrian Amenities, Reconfiguring Arterial Streets, Bridges, Traffic Calming, Maintenance, Walkways, Intersections, Crosswalks, Curb Ramps.
http://www.bikewalk.org/

New York Department of Transportation Pedestrian Information
http://www.ci.nyc.ny.us/html/dot/html/get_around/ped/pedest.html

Surface Transportation Policy Project (STPP) – includes Mean Streets 2000
http://www.transact.org/

Walkable Communities, Inc.
Walkable Communities, Inc. is a non-profit corporation, established in the state of Florida in 1996. It was organized for the express purposes of helping whole communities, whether they are large cities or small towns, or parts of communities, i.e. neighborhoods, business districts, parks, school districts, subdivisions, specific roadway corridors, etc., become more walkable and pedestrian friendly.
http://www.walkable.org/index.htm

LOCAL PEDESTRIAN (& BIKE) ADVOCACY GROUPS

Transportation Alternatives, New York City: http://www.transalt.org/

PEDS, Atlanta: http://www.peds.org/

Walk Boston: http://www.walkboston.org

Walk San Francisco: http://walksf.org/

BayPeds, San Francisco: http://www.baypeds.org/index1.html

WALK DC: http://www.walkdc.org/