ATSAC: 25 Years Later

THE AUTOMATED TRAFFIC SURVEILLANCE AND CONTROL (ATSAC) SYSTEM OPERATED BY THE CITY OF LOS ANGELES DEPARTMENT OF TRANSPORTATION (LADOT) WAS CONCEIVED AND DEVELOPED TO AUTOMATICALLY DETECT CHANGES IN TRAFFIC PATTERNS AND ADJUST TRAFFIC SIGNAL TIMING WITHIN A TRAFFIC SIGNAL NETWORK. OVER TIME, THE SYSTEM HAS EVOLVED BEYOND ITS TRAFFIC SIGNAL SYSTEM MANAGEMENT FUNCTION TO BECOME MUCH MORE.

BY JOHN E. FISHER, P.E., T.E., PTOE

A CONTINUING HERITAGE

Los Angeles, California, USA has a long history in managing its network of traffic signals. The Automated Traffic Surveillance and Control (ATSAC) system is the current expression of that heritage and builds on previous historic efforts in traffic signal system control. The first effort was in 1924, when 31 interconnected Acme traffic signals in downtown Los Angeles were operated from a central station, the first known traffic control center in the world. It generally operated on a time-of-day basis, although it could be manually changed from the center. However, due to standardization of traffic signals that would soon follow and the absence of yet-to-be- invented vehicle detection, this vintage traffic signal system became obsolete. The second effort was in 1960, when the city of Los Angeles was the first in the world to use computer control to operate traffic signals. (The city of Toronto, Ontario, Canada reportedly developed a computer controlled system later that same year.) However, the continuation and expansion of that system was soon abandoned, due to reliability problems associated with analog computers, telephone cable interconnect, and pressure pad detectors.

These two previous efforts, as well as many other pioneering systems elsewhere in the nation, followed a familiar path to obsolescence. However, that has not been the case with the ATSAC system. After 10 years, many systems start to become technologically outmoded, might no longer be supported by consultant software, and often face challenges with field hardware maintenance. They are politely termed as "legacy" systems. Although the ATSAC system recently celebrated its silver anniversary, the term "legacy" does not capture the sprit of this sustainable program that is continuing to evolve to meet new transportation needs.

THE GENESIS OF ATSAC

Like many cities, Los Angeles was able to address congestion, resulting from a growing population, through the extensive freeway construction of the 1950s and 1960s. However, by the 1970s, environmental sentiment, the decline in transportation funding revenue, and anti-freeway revolts created a new paradigm where very few freeway and street-widening projects could proceed forward to address congestion. In addition, growth brought with it new traffic patterns to which the traditional time-of-day, partially interconnected traffic signal system could no longer adequately respond. New ways needed to be identified to address traffic growth and new traffic patterns in a cost-effective, community-friendly manner.

By the mid-1970s, microprocessors made their debut, fiber-optic cable started to be used by communication utilities, and inductive loop detectors had become commonplace. These advances in technology offered a new opportunity to revisit automated traffic signal system control. Based on the promise offered by these new technologies, the concept of automated traffic signal system control was revisited in the late 1970s as a viable means of addressing traffic growth.

Within three short years, this concept evolved to a pilot project when the L.A. Department of Transportation (LADOT) secured funding for three areas of the city: the central business district, the coliseum/sports arena/USC area, and the airport area. Because Los Angeles had recently been selected as the site of the 1984 Olympic Games, the coliseum/sports arena/USC area, where most of the events were to be held, was selected to be the first system to go online. It was believed that the extreme variations in traffic demand resulting from multiple event arrivals and departures would be an excellent test of the capabilities of the ATSAC system in actively managing traffic flows.

The coliseum system was brought online in July 1984, one month before the XXIIIrd Olympiad. During the 16 days of the Olympic Games, the ATSAC system served as a key traffic management tool in responding to traffic fluctuations and in avoiding the traffic gridlock that many had feared. Based on this early success, the mayor and city council approved, in concept, the expansion of ATSAC citywide, subject to available funding. LADOT aggressively pursued funding from traditional federal, state, and regional sources to expand ATSAC from a pilot project to a citywide program. In addition, ATSAC funding was sought from new and expanded land development projects in the city, in fulfillment of traffic mitigation requirements. The developer funds collected by LADOT helped to provide local-match funding that was necessary in order to secure a larger share of grant funds.

Figure 1. ATSAC Center

INITIAL ATSAC FEATURES

The core functions of the ATSAC system provide two-way communication to respond to varying traffic flows, using state-of-the-art computer and communication technologies. The ATSAC Center is shown in Figure 1. The initial system involved the following:

- Real-time monitoring of traffic conditions (volume and occupancy) using inductive loop system detectors spaced at approximately one-half mile intervals;
- Processing of the detector data through microprocessor-based (Type 170) controllers;
- Interconnection and communication of that data to a local hub (usually at a fire station) using copper cable;
- Communication of traffic data for all traffic signals in the system, via a fiber-optic cable trunk line, from the local hub to the ATSAC Center, located several miles away in downtown;
- Evaluation of second-by-second system information by an area computer in the ATSAC Center and development of responsive timing plans that adjust splits, cycles, and offsets;
- Color computer graphic displays of real-time traffic data at the system, sub-area, and intersection levels;

Figure 2. Video camera atop traffic standard.

Figure 3. Decorative variable message sign.

- Communication of the timing plans to each controller in the system via the copper and fiber-optic trunk cable lines; and
- System operator monitoring and intervention, if necessary, for unusual situations that are noted from the graphic displays.

ADDED FEATURES OF ATSAC

Soon after the initial system came online, the ATSAC program started to evolve. As new ATSAC systems and other city projects were developed, new features started to be added. After several years of incorporating new features, it started to become evident that ATSAC was more than an automated traffic signal timing system. The added features are discussed below.

Closed circuit television (CCTV): In 1989, LADOT added CCTV (cameras) atop 45-foot-high rigid poles at selected crossroad intersections to supplement traffic data from detectors. One is shown in Figure 2. They can pan, tilt, and zoom to allow viewing of conditions within a quarter-mile radius but are not used for recording conditions. When proposed new high-rise buildings are being reviewed for traffic impacts, CCTV cameras often are required atop them as a traffic mitigation measure. They can provide a grand view of the surrounding area within a two-mile radius. The CCTV cameras are not used to detect problems, as detectors fulfill that function, but rather to confirm the causes of problems (roadway construction, an emergency situation, traffic collision, and so forth). Today, there are more than 400 CCTV cameras to supplement information from system detectors.

Light rail priority: In 1990, the Metro Blue Light Rail Line began operation, the first modern street-running line to operate in Los Angeles after a 27-year absence. This line was immediately successful and later had to be expanded from two to three cars per train. Near the downtown area, the Metro Blue Line operates in the street-running mode under traffic signal control. The block lengths in a critical segment are so short that a three-car train stopped at a red light would block an upstream intersection. In order to avoid this occurrence, whenever an approaching train is detected in the critical segment, the ATSAC system holds the green for the downstream traffic signals so that there will be no stopped trains or intersection blockage. Although this special signal timing was implemented as an operational necessity, it helped to usher in a new LADOT mindset more favorable to transit priority. A few years later, the ATSAC system was used to provide priority for the Metro Gold Light Rail Line and then the Metro Orange Busway Line.

Traveler Information: In 1993, LADOT installed five LED variable message signs (VMSs) on streets approaching Santa Monica Freeway (Interstate 10). They served to advise motorists of adverse freeway conditions so that parallel arterials could be voluntarily used as alternate routes. This was the beginning of our involvement with traveler information. Heretofore, all the department's efforts in traffic signal system operation had been focused on providing traffic data internally to system operators and computers so that appropriate timing changes could be made in reaction to traffic patterns. For the first time, VMSs served to provide traffic information externally to motorists as an aid to them in making informed choices in response to nonrecurrent traffic conditions. Today, there are 25 VMSs. The first wave of signs used standard tubular structures similar to those used on freeways. With an increasing awareness of context-sensitive design, the subsequent VMSs were designed with ornamentation and community-specific features in order to make them more appealing. One is shown in Figure 3.

Traffic information Web site: In 2000, the Democratic National Convention was held in Los Angeles. LADOT recognized that there would be heightened interest in traffic conditions in response to traffic impacts of the anticipated marches and demonstrations during the week of the convention. By this time, home and office computers were starting to become commonplace. Since the ATSAC Center was already receiving volume and occupancy data from which travel speeds were estimated, it was believed that this information could be formatted for public use in a user-friendly fashion. Accordingly, LADOT set and successfully met a goal to have a traffic information Web site online before the date of the convention. Today, by going to the LADOT Web site, www.ladot.lacity.org, or directly to www.trafficinfo.lacity.org, one can see inferred travel speeds on links of surface arterial streets. This information helps motorists to make informed travel choices before initiating trips. In recent years, LADOT has been coordinating with its regional transportation partners—Caltrans, the Metropolitan Transportation Authority (the transit operator), and the Los Angeles County Department of Public Works—to display consolidated regional traffic information, which can now be viewed on the Web site www.rtmap.metro.net.

Adaptive traffic control: After many years of using the 1970s traffic signal system software, the Urban Traffic Control System, developed by the Federal Highway Administration (FHWA), LADOT staff capabilities had developed to the point where software improvements were being developed in house. After a few years of experimentation, LADOT adopted its in house software, the Adaptive Traffic Control System (ATCS), as the standard for new systems brought online beginning in 2001. Today, LADOT is retrofitting older systems that came online before 2001 with more detectors (generally at quarter-mile intervals), Model 2070 controllers, and ATCS software so that they can operate in a more real-time, customized manner. Currently, there are more than 21,000 system detectors. Through a special arrangement with the FHWA, this non-proprietary software is available to any public agency for a relatively small fee from the McTrans Center in Gainesville, Florida, USA.

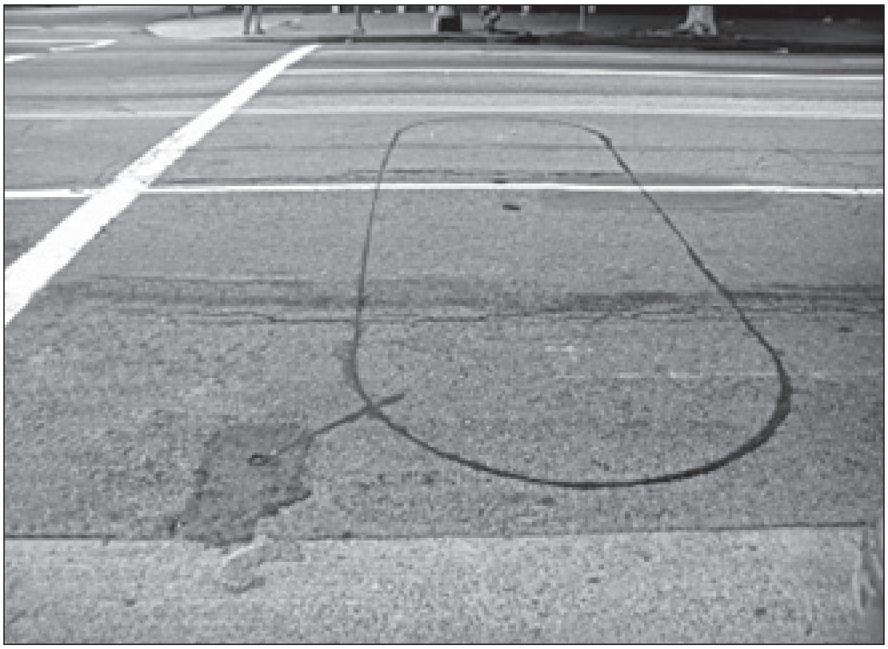

Figure 4. Smart transit priority detector.

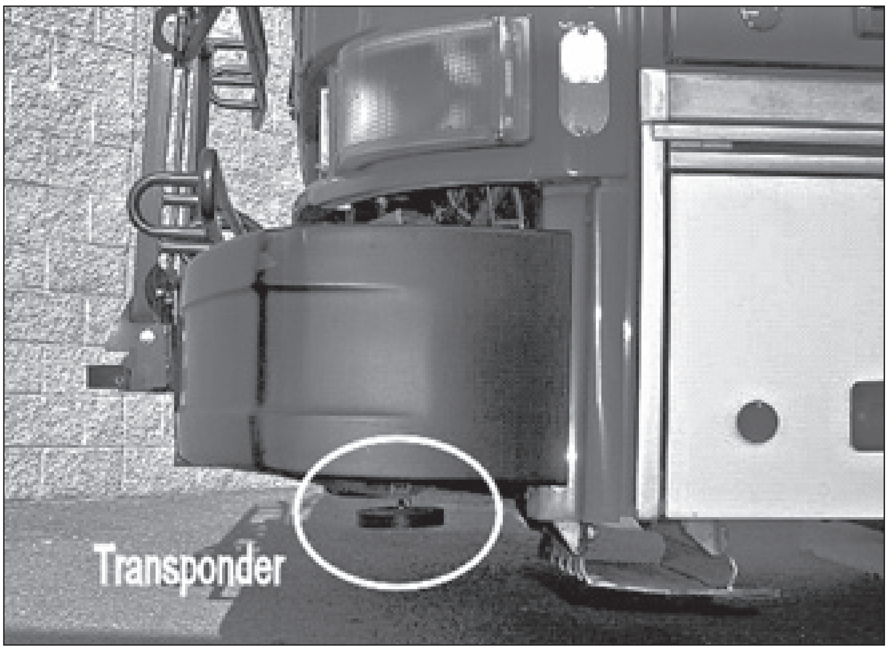

Figure 5. Smart transit priority transponder.

Smart bus transit priority: The completion of two branches of the Metro Red Subway Line in 2002 marked the beginning of smart transit priority. Buses interface at each of the two end-of-line branch stations and transport patrons up to 10 miles downstream. Bus transit priority features include low-floor buses, farside loading, stops one mile apart, and priority on a selective basis. LADOT staff developed transit priority utilizing the ATSAC infrastructure, along with special bus detectors (inductive loop detectors across all lanes) and transponders mounted below the buses. A smart transit priority detector is shown in Figure 4, and a mounted transponder is shown in Figure 5. This system detects approaching buses and identifies headways between arrivals. If the real-time headways are greater than those of the official bus schedule, smart transit priority is allowed in order to help restore consistent bus frequency. However, if the actual headways are less, priority is not granted, since doing so would further degrade consistent bus frequency. This headway information is sent to bus stations to display "Next Bus, X Minutes." Today, there are 28 smart bus transit priority routes. This non-proprietary software also is available from the McTrans Center.

Incident detection: As the number of traffic signals in the ATSAC system continued to expand, it became increasingly difficult to determine if congestion at a given location was a recurrent pattern or the result of a non-recurrent situation. Hence, an effort was launched to identify locations that were significantly more congested than normal. In 2006, LADOT staff developed an incident-detection algorithm that uses detector data to automatically identify abnormal traffic patterns. When abnormal patterns are identified, they are immediately evaluated using video cameras to determine the causes and the appropriate actions to be taken. The automation of incident detection ensures that the traffic signal network is actively managed.

AFTER A QUARTER-CENTURY OF OPERATION, LADOT'S ATSAC SYSTEM CONTINUES TO BE A RELIABLE AND ADAPTIVE PLATFORM FOR TRANSPORTATION MANAGEMENT.

Transportation improvement programming: It became apparent that the ATSAC system had the potential to identify those recurrent bottleneck locations where further improvements might be required to alleviate the situations. The incident-detection system was used as a basis for identifying those bottleneck locations that are recurrently oversaturated and cannot be remediated through traffic signal timing alone. These locations are then examined to determine if operational measures should be developed or if street-widening measures should be programmed to alleviate the problems.

Emergency vehicle priority: The year 2008 witnessed the debut of emergency vehicle priority for fire trucks using transponders mounted below them. This system is operating along the routes with bus transit priority.

Technology test bed: In 2009, LADOT began experimenting with a wireless in-pavement detection system that holds the promise of reducing detection cost and maintenance. More importantly, it might be able to recognize individual vehicle signatures, which would enable the ATSAC system to track actual vehicle travel times and speeds across a traffic signal network rather than infer speeds, as it does now. Although the durability and performance of this detection system is still being evaluated, it holds promise in revolutionizing the vehicle-detection technology. As a test bed for state-of-the-art technology, the ATSAC infrastructure offers opportunities to incorporate Connected Vehicle features as they become available.

SUMMARY

After a quarter-century of operation, LADOT's ATSAC system continues to be a reliable and adaptive platform for transportation management. Through the development of a long-term vision, support from elected officials, the securing of outside funding, the use of non-proprietary software, and a dedicated, highly capable, and proud support staff, LADOT has been able to update and reinvent the ATSAC system to not only serve traditional functions but also meet emerging transportation needs. Today, 3,900 of the city's 4,400 traffic signals are online, and designs have been completed for the remaining 500 traffic signals. Funding has been secured to complete the system and to upgrade older systems within the next three years.

One might draw an analogy with the satellites. Conceived solely for national defense purposes in the late 1950s, they are used more than a half-century later for a wide variety of daily uses, such as global positioning systems, geographic research, and cell phone reliability. Likewise, the initial investment and ongoing upgrades in ATSAC have paid dividends many times over in terms of traveler information, transit priority, emergency vehicle priority, incident detection, transportation improvement programming, active traffic management, and a test bed for new technology. And there are many more dividends yet to be realized in the next 25 years. ■

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