Appendix J-12
Adaptive Signal Control Systems
INTRODUCTION
An Adaptive Traffic Signal Control System can adjust signal timings (offsets, cycle lengths, and splits) incrementally based on real-time traffic volume information. Adaptive signal control systems have the capability to adjust automatically to accommodate traffic patterns that are different from the peak periods during which they were designed to operate. Adjustments of when green lights start and end to accommodate current traffic patterns to promote smooth flow and ease traffic congestion are another characteristic of such systems.

APPLICATIONS/BENEFITS
Adaptive traffic control systems are effective where variability and unpredictability in traffic demand results in excessive delay and stops that cannot be reasonably accommodated by updating coordinated signal timing parameters on a frequency consistent with agency traffic signal operations objectives. An adaptive traffic signal control system has the ability to automatically respond to special events and various other unpredictable incidents that may cause significant changes in traffic volumes and speeds.

Common applications for adaptive traffic control systems include:

- Congested areas
- Schools
- Shopping Areas
- Construction
- Special Events
- High Capacity Roadways

The main benefits of adaptive signal control technology over conventional signal systems are that it can:

- Automatically adapt to unexpected changes in traffic conditions.
- Improve travel time reliability.
- Reduce congestion and fuel consumption.
- Prolong the effectiveness of traffic signal timing.
- Reduce the complaints that agencies receive in response to outdated signal timings.
- Make traffic signal operations proactive by monitoring and responding to gaps in performance.
HOW ADAPTIVE TRAFFIC CONTROL SYSTEMS WORK

By receiving and processing data from sensors to optimize and update signal timing settings, adaptive signal control systems can determine when and how long lights should be green. The process begins with traffic data collection by traffic sensors. Next, traffic data is evaluated and signal timing improvements are developed. Finally, the adaptive signal control technology implements signal timing updates. The process is repeated every few minutes to keep traffic flowing smoothly. Traditional signal retiming might only repeat this process every 3 to 5 years.

INDIVIDUAL SYSTEMS

There are several adaptive traffic control systems available. Some of the more prominent systems are listed and described below.

Split cycle Offset Optimization Technique (SCOOT) - The SCOOT system is the most widely deployed adaptive system in existence. ACS-Lite, based on this system, was developed as part of an ongoing Federal Highway Administration Research Program at the Turner Fairbank Highway Research Center in the United States, to improve progression and phase utilization for small scale arterial systems of 30 or fewer traffic signals, producing smoother flow and fewer traffic delays.

Sydney Coordinated Adaptive Traffic System (SCATS) – The SCATS system matches traffic patterns to a library of signal timing plans and scales split plans over a range of cycle times. The SCATS system optimizes cycle length, splits, and offsets on a cycle-by-cycle basis using real-time detection. The SCATS control strategy minimizes unnecessary green time throughout a system to suit the prevailing average traffic conditions. Users place detectors at the stop line for adequate coverage of the stopped vehicles. These detectors allow a vehicle movement phase and will dynamically adjust cycle, split, and offset times.

SCATS, is available in the US through Transcore and has been deployed by over 12 agencies across the nation over the last decade.

Real Time Hierarchical Optimized Distributed Effective System (RHODES) – The RHODES system uses a peer-to-peer communications approach to communicate traffic volumes from one intersection to another in real time.

VEHICLE DETECTION

With adaptive traffic control systems, magnetometer vehicle detectors can be utilized for detecting various parameters of traffic on a roadway. A number of sensors, having a compact package, along with connecting cables, may be placed in road way with a small number of standard width sawcuts. Alternatively, sensors may be placed in the roadway within tubes under the external surface of the roadway. The package design of the sensor is such that the sensor can be placed in the sawcut or tube only in a certain way or ways resulting in the most sensitive axis of the sensor being most likely affected by just the traffic or vehicles desired to be detected and measured. The sensor may be a magnetoresistive device having a permalloy magnetic sensing bridge. Multiple sensors may be placed in single or multiple lanes of the roadway for noting the presence of
vehicles and measuring traffic parameters such as average speeds, vehicle spacings, and types and numbers of vehicles. Such information is processed from the shapes, times and magnitudes of the signature signals from the sensors.

COSTS

The cost of adaptive traffic control systems typically ranges between $6,000-$50,000 depending on the current infrastructure, communications and detection requirements of the selected system. Depending on the pricing strategy of the vendor, the cost per intersection may decrease as the number of intersections included in the project increases. Costs include:

- Licensing (Number of intersections)
- Warranty (What's covered, for how long)
- Training and Support (Depth, In Person, Phone Support)
- Hardware
  - Platform Cost — Servers, Processors
  - Communications
  - Detection — Detection cost should be evaluated to consider the specific needs of the system and how flexible the system operates with existing configurations
- Operations & Maintenance (Reliability, Complexity, Failure Mode)

A study published in 2010 reported that the installation cost per intersection of Adaptive Traffic Control Systems (ATCS) varied significantly among ATCS users, ranging from $20,000 to more than $70,000 per intersection, with a median and mode of approximately $45,000 and $40,000, respectively. The study obtained the cost data from a survey of domestic and international agencies using ATCS. Responses were obtained from 34 of 42 agencies in North America (an 81% response rate). On average, the costs of installing an ATCS are approximately $65,000 per intersection.

The report highlighted that reported costs often include more than simply the installation of the adaptive components of the system. For example, reported costs may include replacement of the local intersection hardware, software, or even new communication infrastructure. (Survey responders could only report on the total costs per intersection of their deployments.)

A number of funding sources can support traffic signal management and operations activities, equipment and specifically ASCT. In practice, however, funding for traffic signal system management and operations must often rely on the discretionary budgets of individual jurisdictions and/or agencies. The implementation and operating costs for ASCT is eligible for Federal reimbursement from National Highway System and Surface Transportation Program funding. For projects located in air quality non-attainment and maintenance areas, and in accordance with the eligibility requirements of 23 USC 149(b), Congestion Mitigation and Air Quality Improvement Program funds
may be used for operating costs for a 3 year period, so long as those systems measurably demonstrate reductions in traffic delays. Operating costs include labor costs, administrative costs, costs of utilities and rent, and other costs, including system maintenance costs, associated with the continuous operation of the system.

CASE STUDY: CITY OF WHITE PLAINS

The following is a press release outlining the adaptive traffic control system deployed in the City of White Plains located along Route 119 (Tarrytown Road) between the I-287 Ramps and Battle Avenue. The system consists of 7 signals.

NYSERDA And NYSDOT Fund City Of White Plains Deployment Of Adaptive Traffic Signal Control System On Tarrytown Road

December 7, 2011

WHITE PLAINS, N.Y.--(BUSINESS WIRE)--

The City of White Plains deploys a new adaptive traffic signal control system on Tarrytown Road as a result of a $250,000 cost-shared research agreement from the New York State Energy Research and Development Authority (NYSERDA) and the New York State Department of Transportation (NYSDOT). The system is intended to improve traffic flow and reduce carbon dioxide emissions along one of the most congested corridors in the city.

The funding was made possible through the Low Carbon Transportation Alternatives Program Opportunity Notice, a partnership between NYSERDA and NYSDOT, to support programs and technology that provide pathways to energy efficiency, enhanced economics, sustainability and improved livability throughout the state of New York.

Tarrytown Road in White Plains is a major arterial that carries approximately 50,000 – 60,000 vehicles daily and serves as a primary route for commuter access to and from downtown White Plains. The roadway experiences traffic surges due to significant downtown retail activity including six major downtown malls / retail centers and events at the Westchester County Center. Tarrytown Road is also the primary route when traffic
is diverted from I-287. The Tarrytown Road corridor experiences fluctuation in demand throughout the day with significant congestion during the morning and afternoon peak traffic hours.

"NYSERDA is pleased to be working with the New York State Department of Transportation and the City of White Plains in reducing traffic congestion which benefits not only the environment but the drivers and communities located in this heavily trafficked area," said Francis J. Murray Jr., president and CEO of NYSERDA. "This project demonstrates how one technological change can allow a community to reduce greenhouse gas emissions and fossil fuel consumption. We hope more communities across New York follow this example."

Mayor Thomas Roach said, "The City of White Plains is pleased to have the opportunity to implement adaptive signal control technology on Tarrytown Road. It will ease traffic congestion in this heavily-trafficked corridor of the City, reduce vehicle emissions and improve air quality."

The New York State Department of Transportation is proud to partner with NYSERDA and the City of White Plains on this important project. Reducing vehicle delay and greenhouse gas emissions using advanced technology without widening the roadway will benefit the people who work and live in the City of White Plains.

The adaptive traffic signal control system will collect real-time information and then adjust signal timing parameters on a cycle-by-cycle basis. It can speed throughput in the corridor and reduce congestion, subsequently reducing energy requirements and greenhouse gas emissions by reducing vehicle idle times.

Previous conventional traffic control techniques such as time-of-day signal timing and responsive timing plan selection were not able to accommodate all the variable and unpredictable traffic conditions experienced on the route. Adaptive signal control offers the capability of rapidly responding to changing traffic demands. Until recently, traffic signal control systems in New York State's cities, towns and municipalities were either centrally based or closed loop systems that were not designed to rapidly respond to changing traffic demands.

The City of White Plains will utilize the Sydney Coordinated Adaptive Traffic System (SCATS) for this project, a proven adaptive traffic system with a long history of field deployment. SCATS is an advanced off-the-shelf software product that requires no software development, has been operational for over 30 years and currently controls more than 28,000 intersections worldwide. Although not previously installed in New York State, SCATS has been deployed in twelve cities across the United States by TransCore, a firm that has worked with the City of White Plains traffic management systems since 1991.
NYSERDA, a public benefit corporation, offers objective information and analysis, innovative programs, technical expertise and funding to help New Yorkers increase energy efficiency, save money, use renewable energy, and reduce their reliance on fossil fuels. NYSERDA professionals work to protect our environment and create clean-energy jobs. NYSERDA has been developing partnerships to advance innovative energy solutions in New York since 1975.