In Part 1, the state-of-the-practise of Adaptive Traffic Control Systems (ATCS) was outlined. Figure 1, a block diagram of data flow of a typical adaptive system, was included as a reference for future discussions of ATCS.

Before proceeding, a point to understand! This is a complex topic. It cannot be entirely covered in a few hundred words. Therefore, the objective of these articles is to provide enough information whereby you have a basic understanding of each of the ATCS discussed and can determine if it is an approach for your agency. Hopefully, it will also prompt you to ask pertinent questions of your potential supplier(s) should you decide to go down this path.

To make comparisons easier, the discussions will address the following topics for each system:
1. Background
2. System features
3. System architecture
4. Optimization Process
5. Data collection
6. Reporting
7. Fallback operation
8. System Configuration
9. Handling pedestrian, transit, emergency vehicles
10. Cost

The first ATCS to discuss, albeit in alphabetical order, is ACS-Lite.

As noted in the previous article, I am contacting the suppliers of adaptive systems to get their input on their solutions. What follows includes input provided by Gurtej Gill, Adaptive Systems Engineer at Econolite. You will see references to Econolite’s ASC-
Continued from page 30

Lite implementation, which they call "Centracs Adaptive".

At this point, I should point out that FHWA has been stopped from any further development of ASC-Lite. Consequently, each of the ASC-Lite suppliers will be required to complete development/improvements without FHWA assistance.

Background

I like to think (feeling good in one’s mind is always encouraging) I started this new approach to adaptive systems. At an ITS America Conference in the late ’90s, I was having coffee with Raj Ghaman, who at the time, was the Director of Research for FHWA. I suggested to him what America needed was an abridged version of the larger, more complex adaptive systems currently available – one that was easy to install, operate and maintain. One approach; take concepts from the proven adaptive systems and apply them to a new made-in-America adaptive-light solution. At the time, FHWA was heavily associated with the RT-TRACS program yet less than a decade later, the idea came to lite – pun intended!

FHWA envisioned a simpler, easier to install and maintain adaptive system could help traffic departments address the low report card score from ITE’s Traffic Signal Survey. In addition, since there were (and still are) many closed-loop traffic control systems in operation, any new adaptive system must be compatible with those systems.

As a result, ASC-Lite is available to every manufacturer to incorporate into their own traffic management system. Peek, Siemens, Econolite, McCain have added ASC-Lite to their traffic systems offering.

System Features

To quote from the FHWA’s document titled Adaptive Control Software – Lite (ACS-Lite), Implementation Template, September 2006:

• "FHWA initiated the ACS-Lite program to assess, and then pursue, the best, most cost-effective solution for applying ACS technology to current, state-of-the-practice closed-loop traffic signal control systems
• Several National Electrical Manufacturers Association (NEMA) closed-loop traffic control system vendors (Econolite, Eagle, Peek, and McCain) have provided guidance and support to the ACS-Lite team
• ACS-Lite is designed specifically for closed loop systems; 90% of the traffic signal systems in the U.S. are estimated to be closed loop systems (this does not mean all closed loop systems are suited for ACS-Lite Deployment, nor does it indicate that 90% of all traffic signals are controlled by closed-loop systems)
• ACS-Lite uses NTCIP for data and control
• ACS-Lite provides adaptive control within the readily understandable and standard context of cycle, splits, and offset
• ACS-Lite downloads new parameters to each controller every 5-15 minutes and the local controller performs the second-by-second control of the intersection
• ACS-Lite does not have the high vehicle detector requirements typically associated with adaptive systems
• ACS-Lite was developed to run on Windows-XP embedded on a field-hardened PC platform in a controller cabinet either replacing the master controller or working in concert with the master, depending on the controller manufacturer.”

System Architecture

Centracs Adaptive operates by collecting data from each intersection controller, and then processes the information at the Centracs core server. Once the data has been processed and new split/offset values have been calculated, Centracs Adaptive will push the adjustments to each signal controller

Optimization Process

Centracs Adaptive currently optimizes the split and offset values of existing coordination plans. The split is optimized using a “degree of saturation” measurement, which compares the amount of green time used per cycle versus the programmed split value within the signal controller. Centracs Adaptive aims to balance the degree of saturation across all phases, therefore, redistributing green time between over-utilized and under-utilized phases.

The offset of each intersection is optimized using a “flow profile”, which maps the arrivals on green at each intersection. Centracs Adaptive will time-stamp each vehicle’s arrival, and adjusts the offset to maximize the amount of vehicles which arrive on green.

In addition, the following was extracted from Siemens’ “ACS Lite Adaptive Control - Balanced control for smarter streets, 2009” publication:

“ACS Lite downloads new splits and offsets for the currently-running pattern every 5 to 15 minutes, maintaining the same cycle length as determined by the traffic engineer and implemented by the Time-of-Day scheduler.”

March/April 2014
During each cycle, the local controller software manages the duration of each split using gap-out and coordination logic, as designed by the traffic engineer. If communication is interrupted, the local controller still maintains full operation of the intersection.

ACS Lite performs its optimizations by polling each local controller for custom NTCIP detector and phase status data once per minute. ACS Lite takes these minute-by-minute polls and matches the occupancy measured on each detector with the red and green intervals of each phase that the detector serves. This allows the software to assess whether or not traffic is arriving to a green light (used for tuning the intersection offset), and whether or not traffic is using all of a phase’s split time (used for split adjustment). Currently, each ACS Lite installation can manage up to 16 intersections in a loop.

After computing these measures of phase/split utilization and determining how effective the offset is at each intersection, optimization algorithms are run to reallocate split time from phases that are not using their entire split to other phases that need more time and to determine whether an earlier or later offset would be more effective for traffic progression. ACS Lite then downloads the new values to each controller in the system.

Since the changes to the split and offset values are small (2-5 seconds), transition from the current settings to the new settings is typically completed within one cycle. The frequency of optimizations and the maximum amount of split and offset to be added or subtracted from the current values is controlled by the traffic engineer.”

Cycle length optimization will be left to each of the suppliers to develop and implement.

Data Processing
Centracs Adaptive supports any data collection methodology, which provides accurate volume and occupancy measurements.

Volume and occupancy data is collected at each signal controller and sent to the Centracs core server (central) every second. The data processing is at the core server.

Fallback operation
There are two primary situations, which cause Centracs Adaptive to enter fallback operation:
• Communications failure
• Detector failures

In the event of a communication failure, Centracs Adaptive will poll the signal controller for five minutes. If communications have not been restored within five minutes, Centracs Adaptive will revert the signal controller to local time-of-day operation.

In regards to detection failure, there are two primary situations that
may arise. If a stop-line detector fails, Centracs Adaptive will recognize the failure and revert that specific split to the programmed time-of-day value. This split may still be extended beyond the programmed value; however, the adaptive algorithm will not allow the split to be adjusted lower until the detection failure has been resolved. In the event of an advanced detection failure, Centracs Adaptive will revert the offset to the time-of-day programmed value until the detection failure has been resolved.

**Reporting/MOE**
The two primary MOE’s which are utilized within Centracs Adaptive are the degree of saturation and flow profile, which have been explained above. In addition, Centracs Adaptive in a module that is fully integrated into the Centracs ATMS. This allows any and all intersections controlled by the adaptive algorithm to use the MOE’s available within Centracs. For example, Econolite offers a “Measures of Effectiveness” module, which provides reports including volume to capacity ratios, split failures, flow rates, green times, cycle lengths, percent pedestrian calls and the Purdue Coordination Diagram.

**System configuration**
First, the coordination parameters directly from the compatible controller. Once the controller is uploaded, the user simply specifies each detector’s length, distance from stop bar and the free flow speed along that particular link.

After each detector has been configured, the user configures the system links by specifying the distance and speed limit between two signal controllers. Once the links have been configured, the user specifies the adaptive parameters of operation (i.e. time between adjustments, maximum split adjustment, maximum offset adjustment etc.)

Handling of pedestrians, transit, emergency vehicles

Centracs Adaptive will service pedestrian movements while maintaining adaptive operation.

In the event of pre-emption (EVP, railroad etc.), Centracs Adaptive will service the pre-emption and then resume operation from the previous adaptive control parameters.

At this time, transit priority is not supported.

Additional items required
Adaptive operation is housed entirely within the Centracs client and local controller software. Therefore, no additional hardware is required within the traffic cabinet. A high-speed communications network is recommended.

**Cost**
Other sources estimate ASC-Lite cost to be in the range of $6-10k per intersection. However, as Econolite points out, it is very dependent on the existing infrastructure.

**For more information**
Additional reading materials include …


… or contact one of the ASC-Lite supporting suppliers.

Hope you find this information helpful.

Something to think about!

---

**OBITUARIES**

**Far Western Section**
**George H. Palacio, Jr.**

George Palacio, Jr. with the City of Carson, CA had been a member since 2007

**Florida Section**
**Dennis L. Murphy**

Dennis Murphy an Engineering Assistant in Traffic had been a member since 2000.

**Ontario Section**
**Paul Batchelor**

Paul Batchelor had been a member of IMSA since the 1970’s. Paul’s obituary is on page 78.