

MEMORANDUM

Date: November 29, 2007 **TG:** 07188.00

To: Idaho Transportation Department (ITD)

From: Hicham Chatila, Transpo
Zhen Li, Transpo

cc: Dan Coonce, Transpo

Subject: US-95 ACS-Lite System Evaluation

Introduction

FHWA recently developed Adaptive Control Software Lite, or ACS-Lite, with the goal of providing a “widely deployable” system. ACS-Lite is a low cost signal timing optimization system which dynamically monitors and adjusts signal timing to meet current traffic demands.

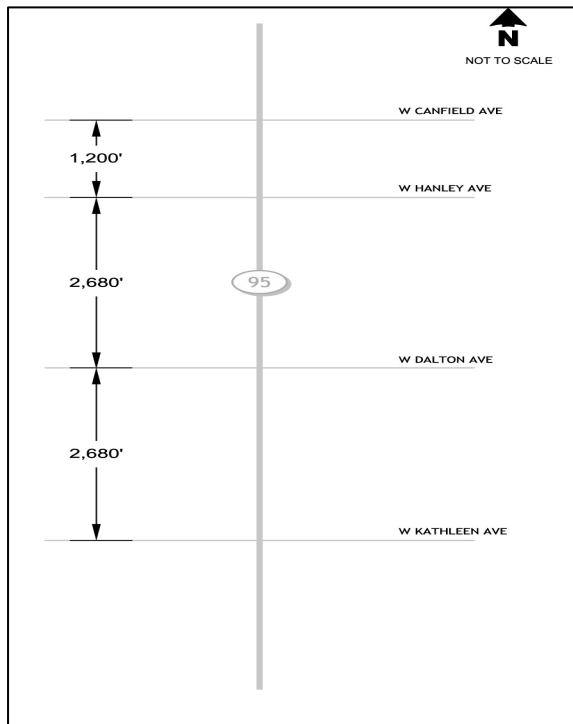
Traditionally, traffic signal timings are designed by sampling traffic demand during peak periods and designing signal timing to meet those demands. Most agencies do not have sufficient resources to manually evaluate and retime traffic signals on the recommended frequency of 3 to 5 years. ACS-Lite is a technology solution that adjusts signal timing automatically to address changes in demand. The ACS-Lite reduces traditionally high installation and operations costs, which have been the primary impediments limiting the deployment of adaptive systems in the U.S.

This memo presents an evaluation of ACS-Lite conducted on a section of US 95 in Coeur d’Alene, Idaho. The project evaluated the potential benefits of ACS-Lite. The memo presents the evaluation approach and the results. It also provides some information on how ACS-Lite would compare with other adaptive signal control systems that have been tested or used in North America. Technical information on the ACS-Lite logic and set-up is also included in the Appendix section.

The memo is organized as follows:

- Study area
- Evaluation methodology
- Measures of effectiveness
- Findings
- Other adaptive signal systems
- Conclusions
- Appendices

Study Area



The study area is shown on Figure 1. It includes a section of US 95 in Coeur d'Alene, Idaho with four signalized intersections (W. Kathleen Avenue, W. Dalton Avenue, W. Hanley Avenue and W. Canfield Avenue).

The evaluation was conducted using PM peak traffic conditions. Traffic volumes, turning movements and network geometry information were taken from an existing Synchro model. The signal timing plans were extracted from field controllers.

Figure 1: Study Area

Evaluation Methodology

The evaluation of ACS-Lite was conducted using the VISSIM hardware-in-the-loop simulation technique. This technique allows replicating the signal control logic without actually implementing it in the field. Within the simulation environment, ACS-Lite operates using the same communication protocol it would use to interact with real traffic controllers. The simulation tool was configured to study the system performance with and without ACS-Lite.

Simulation without ACS-Lite

The simulation configuration for the scenario without ACS-Lite is illustrated on Figure 2.

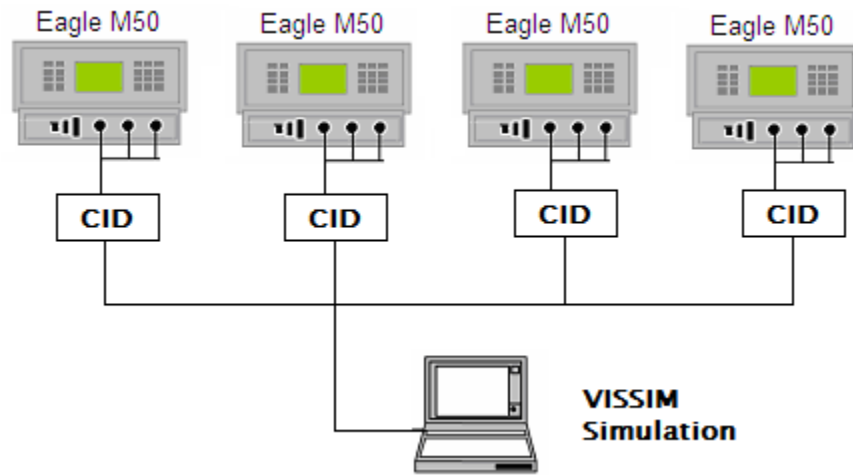


Figure 2: Simulation without ACS-Lite

Under this scenario, the VISSIM detector layout uses the existing field detector layout. Each lane has two advance detectors and one stop bar detector (with the exception of the W Dalton Avenue approaches).

The VISSIM model was developed using existing field data. The signal timing plans used in the field were programmed for the four Eagle M50 traffic signal controllers, which were connected to four CIDs (Controller Interface Device). These CIDs were connected to a computer running the VISSIM microsimulation model.

Simulation with ACS-Lite

Figure 3 shows the simulation configuration for the scenario with ACS-Lite.

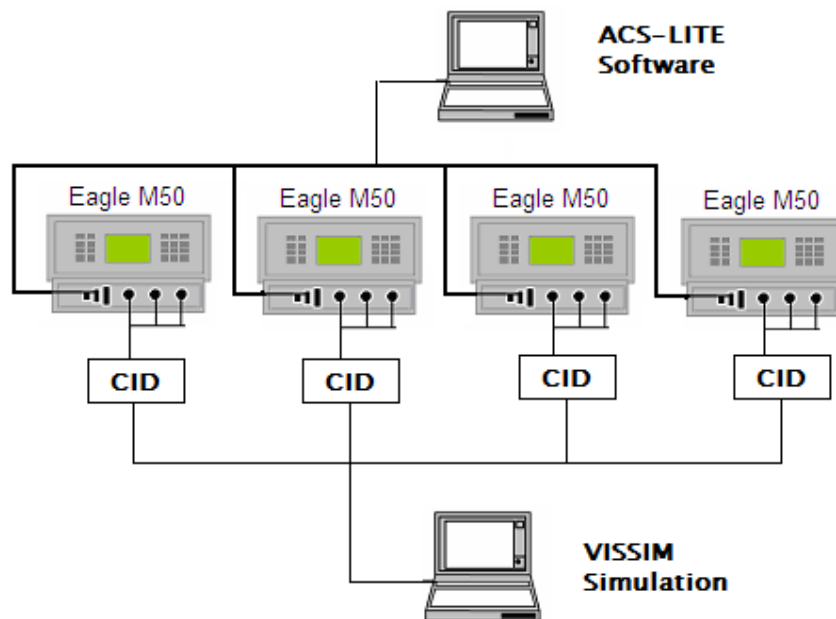


Figure 3: Simulation with ACS-Lite

The ACS-Lite split adjustment logic uses the measurements from stop line detectors to calculate the “utilization” of each phase (see Appendix B). In order to satisfy the ACS-Lite software detector layout requirements, stop bar detectors were added in the model on all approach lanes (except on exclusive right-turn lanes). These stop bar detectors are used to monitor volume and occupancy on green. In addition, one advance detector on each coordinated phase is set to adaptively fine-tune intersection offsets, to monitor cyclic flow, and to identify the arrival of platoons.

The simulation with ACS-Lite uses the coordinated phase advance detectors as ACS-Lite profiling detectors.

Figure 4 illustrates the detector set-up at one intersection (US 95 and Canfield Avenue) with and without ACS-Lite.

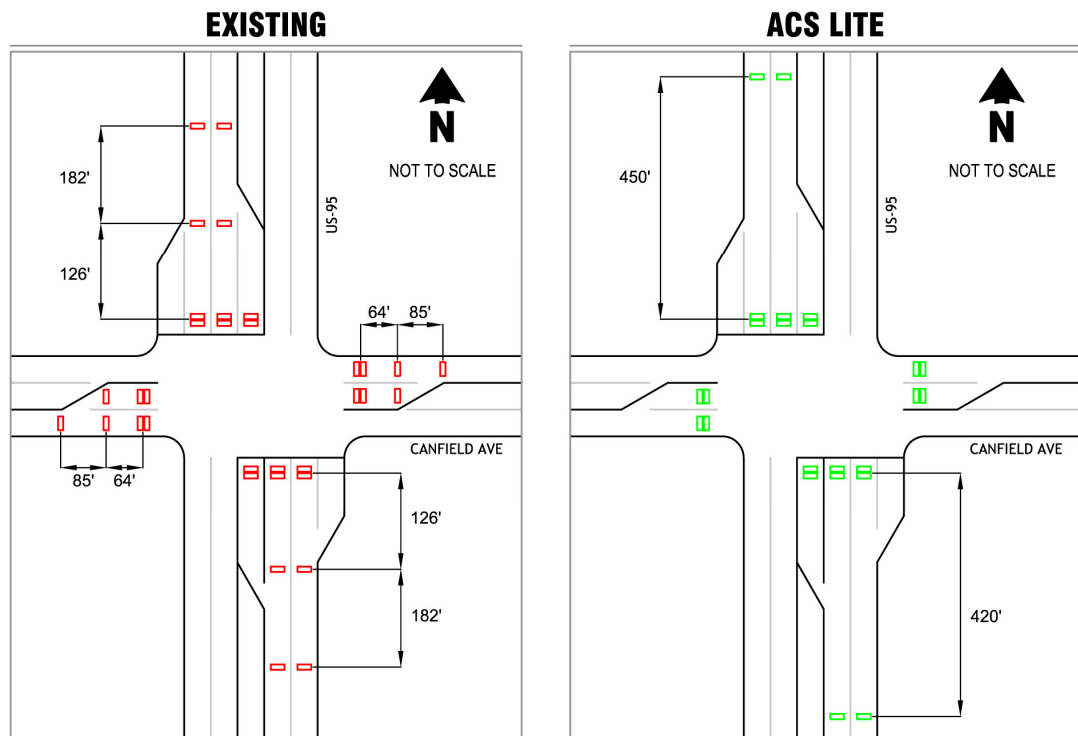
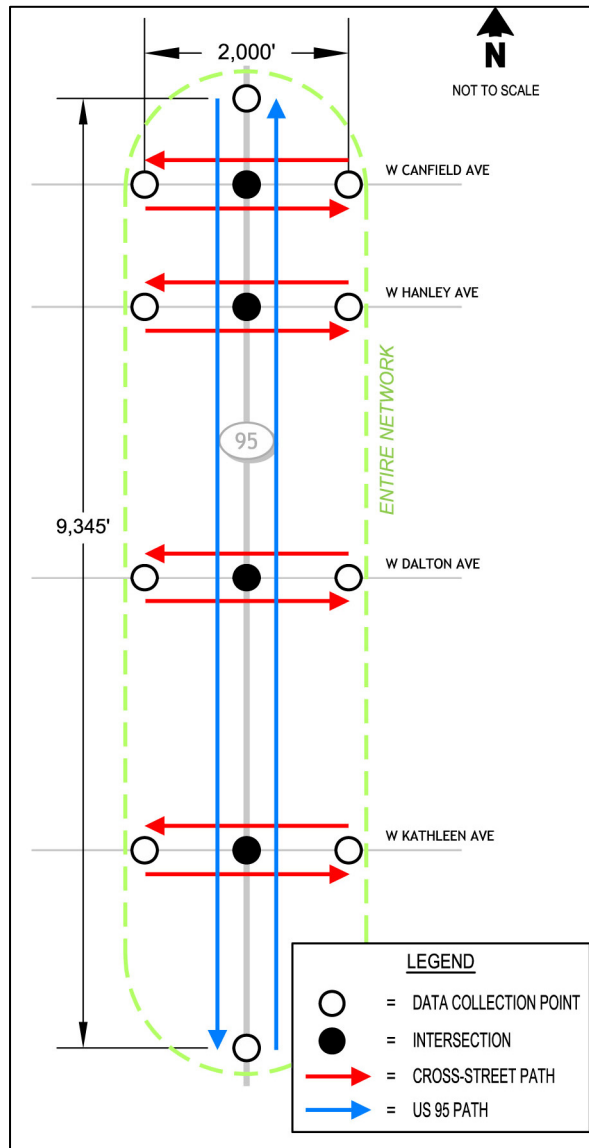


Figure 4: Detector Set-up at US95/Canfield Avenue



Measures of Effectiveness

The evaluation focused on comparing measures of effectiveness computed by the simulation model with and without ACS-Lite. Different scenarios were tested to evaluate under what conditions the ACS-Lite system may be more or less beneficial.

The main criteria used to compare traffic performances is the average travel time along US 95 (in both directions) and the average travel time in the entire system (including cross-streets). Travel times along US 95 were computed for the paths shown in blue on Figure 5. System travel times also included paths shown in red, in addition to the US 95 travel times.

Figure 5: Travel Time Routes

Findings

The ACS-Lite evaluation was designed to address the following questions:

- Can ACS-Lite improve existing signal timings?
- Can ACS-Lite correct poor splits?
- Can ACS-Lite correct poor offsets?
- Can ACS-Lite correct for volume changes?

Can ACS-Lite improve existing signal timings?

In this scenario, the system performance is evaluated with existing traffic volumes (PM Peak) and existing signal timings. The signal timing plans were extracted from field controllers and had been developed using Synchro.

Results shown on Table 1 indicate that ACS-Lite was able to produce significant benefits over the existing signal timing strategy. The travel times along US 95 were shown to be reduced by 18%. For the entire system (including east-west cross-streets), the total system travel times were reduced by 7% with the introduction of ACS-Lite. These results demonstrate the potential benefits of ACS-Lite in this scenario, with significant improvements of travel times along US 95 without degrading travel times on the cross-streets.

Table 1. Starting with Existing Signal Timings

Average Travel Times (in sec)	Without ACS-Lite	With ACS-Lite	Difference (%)
US 95	709	582	-127 (-18%)
Entire network	1,985	1,837	-148 (-7%)

Can ACS-Lite correct poor splits?

In this scenario, the simulation without and with ACS-Lite started with poor splits. The purpose of this scenario was to evaluate ACS-Lite's ability to adjust the splits and optimize the operations.

The initial choice of split combination was arbitrary to represent a non-optimized choice of parameters. Three different split combinations were used as shown on Table 2. The indicated split changes are relative to the existing signal timings (as implemented in the field). Traffic volumes were kept the same for all cases.

Table 2. Split Combinations

Case	Side Street Splits	US 95 Splits
1	Increased by 5 sec	Decreased by 10 sec
2	Increased by 10 sec	Decreased by 20 sec
3	Increased by 15 sec	Decreased by 30 sec

The results are shown on Table 3.

Table 3. Starting with Poor Splits

Average Travel Times (in sec)	Without ACS-Lite	With ACS-Lite	Difference (%)
US 95	906	692	-214 (-24%)
Entire network	1,864	1,751	-112 (-6%)

In this scenario, the travel times along US 95 were shown to be reduced by 24% on average, with reductions ranging from 15% in Case 1 to 30% in Case 3. For the entire system (including east-west cross-streets), the total system travel times were reduced by 6% on average with the introduction of ACS-Lite, with reductions ranging from 4% in Case 2 to 9% in Case 3. All cases showed improvements after the implementation of ACS-Lite.

Can ACS-Lite correct poor offsets?

In this scenario, the simulation without and with ACS-Lite started with poor offsets. The purpose of this scenario was to evaluate ACS-Lite's ability to adjust the offsets and optimize the operations.

The initial choice of offset combination was arbitrary to represent a non-optimized choice of parameters. Three different offset combinations were used as shown on Table 4. Offsets were kept constant at two intersections and made to vary at the other two intersections.

Table 4. Offset Combinations

Case	Kathleen	Dalton	Hanley	Canfield
1	25	58	8	77
2	75	58	20	77
3	100	58	35	77

The results are shown on Table 5.

Table 5. Starting with Poor Offsets

Average Travel Times (in sec)	Without ACS-Lite	With ACS-Lite	Difference (%)
US 95	804	670	-134 (-17%)
Entire network	2,055	1,878	-177 (-9%)

In this scenario, the travel times along US 95 were shown to be reduced by 17% on average, with reductions ranging from 9% in Case 1 to 22% in Case 2. For the entire system (including east-west cross-streets), the total system travel times were reduced by 9% on average with the introduction of ACS-Lite, with reductions ranging from 6% in Cases 1 and 3 to 14% in Case 2. All cases showed improvements after the implementation of ACS-Lite.

Can ACS-Lite correct for volume changes?

The purpose of this scenario was to evaluate ACS-Lite's ability to adjust the signal timings based on variations to traffic volumes. Three cases were considered: cross-street traffic volumes were made to vary by increasing the westbound volumes respectively by 15, 30 and 45% compared to the initial existing volumes.

The results are shown on Table 6.

Average Travel Times (in sec)	Without ACS-Lite	With ACS-Lite	Difference (%)
US 95	756	651	-105 (-14%)
Entire network	2,502	2,209	-293 (-12%)

In this scenario, the travel times along US 95 were shown to be reduced by 14% on average, with reductions ranging from 9% in Case 2 to 16% in Cases 1 and 3. For the entire system (including east-west cross-streets), the total system travel times were reduced by 12% on average with the introduction of ACS-Lite, with reductions ranging from 8% in Case 3 to 18% in Case 1. All cases showed improvements after the implementation of ACS-Lite.

Other Adaptive Signal Systems

ACS-Lite was developed by the Federal Highway Administration as a downgraded version of ACS. It was primarily developed for linear arterial networks where the traffic patterns are predictable. It can handle a very small grid such as one or two crossing arterials. It adapts to traffic patterns by changing the split cycle allocated to each movement. The version of ACS-Lite used in the US 95 evaluation test does not have the capability to change cycle lengths based on varying traffic demand, it can only adjust splits and offsets.

Two other adaptive signal control systems have been deployed worldwide, including North America: SCOOT (Split Cycle and Offset Optimization Technique) and SCATS (Sydney Coordinated Adaptive Traffic System).

The primary difference between SCOOT and SCATS is the method used to calculate splits and cycle lengths. Both systems are more complex, more expensive, and more difficult to configure than ACS-Lite. They are capable of handling a broader range of cases, including networks with several linear signals with unpredictable traffic demands and large urban networks with several thousand signals.

Table 7 presents a summary of the main characteristics of the three systems.

Characteristics	ACS-Lite	SCATS	SCOOT
Number of US cities with system	4 to 12 ¹	11	8
Average number of intersections per system	6-10	84 ²	-
Range of intersections	6-16 ³	9 ¹ to 4,500 ⁴	-
Changes cycle length?	N	Y	Y
Changes splits?	Y	Y	Y
Operates on arterials?	Y	Y	Y
Operates in grid networks?	N	Y	Y
Rough cost estimate for 14-intersection network	\$80,000-\$140,000	\$250,000-\$450,000	-

1. 4 test locations and 8 other agencies contemplating installation
2. Statistic for U.S. cities only
3. Santa Rosa, CA has 9 intersections with plans to expand system to other corridors
4. Melbourne and Sydney (Australia) both have approximately 4,500 signals in SCATS system, other large systems in Mexico City, Singapore, and Dublin

Conclusions

The ACS-Lite hardware in the loop evaluation for four intersections on US 95 was designed to address the following questions:

- Can ACS-Lite improve existing signal timings?
- Can ACS-Lite correct poor splits?
- Can ACS-Lite correct poor offsets?
- Can ACS-Lite correct for volume changes?

Key travel time findings are summarized on Figure 6.

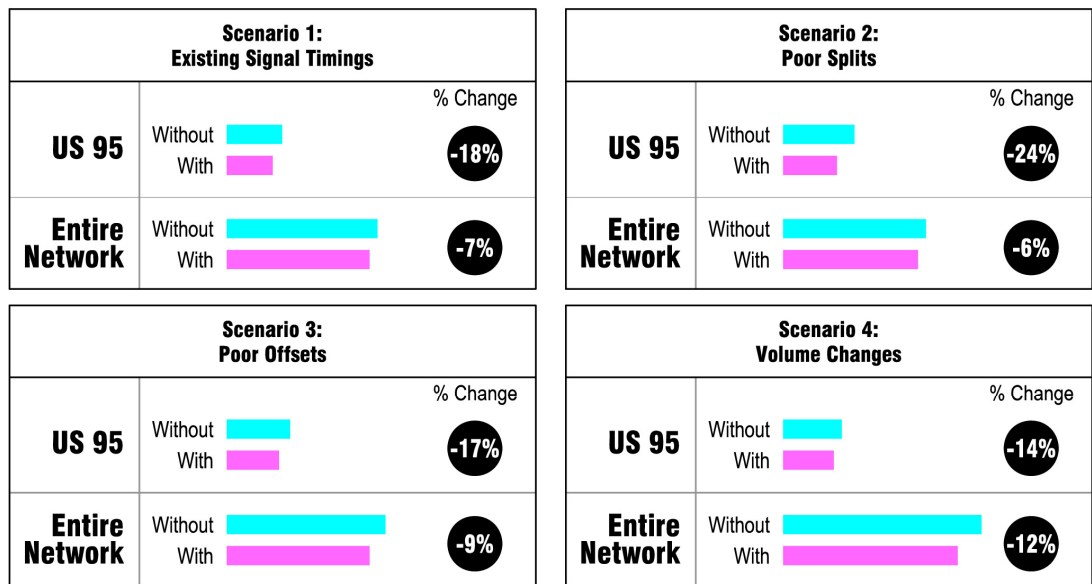


Figure 6: Simulation Results Summary

Based on the above results, ACS-Lite was able to improve intersection operations under all tested scenarios and as documented in this technical memorandum. Travel time benefits along US 95 ranged between 14% and 24%. Travel time benefits for the entire system (including east-west cross streets) ranged between 6% and 12%.

The following observations regarding ACS-Lite evaluation are noted:

- The ACS-Lite system was easy to set up and configure. The software package has a simple web interface that allows the user to input and/or modify all of the required system parameters.
- Implementing ACS-Lite does not require any special or custom hardware.
- ACS-Lite system works on different types of traffic controllers from different manufacturers.
- ACS-Lite requires that the traffic signal controllers use NTCIP communications.
- No system calibration is required for ACS-Lite.
- ACS-Lite can be turned on or off as desired by the user via the web interface.
- The detector layout and configuration is critical to the operation of any ACS-Lite system. Poorly laid out detectors and/or detector that are not functioning properly has a big impact on the system operations. This is due to the fact that ACS-Lite uses real-time data from these detectors to adjust splits and offsets.
- Currently ACS-Lite (as tested in this evaluation) does not optimize cycle lengths. A separate signal timing and optimization tool is required to determine the best cycle length for the intersections/corridor. Once the best cycle length is determined, ACS-Lite can be implemented. It is recommended that the splits and offsets that are generated by the signal optimization tool to determine the best cycle length be used as inputs with the ACS-Lite system.

Appendix A: GLOSSARY

NTCIP The National Transportation Communications for Intelligent Transportation Systems (ITS) Protocol is a family of standards that define the functional control and communications profiles for electronic traffic control equipment (<http://www.nema.org/stds/ntcip.cfm>).

CID Controller Interface Device. The CID allows a computer to communicate with traffic control hardware by allowing the simulation models to send detector actuations to the control device and to read phase indications back from the control device. The CID functions as a bridge between the electrical signals of the computer and those of the traffic signal controller.

HILS Hardware-in-the-loop Simulation. A simulation model generates detector input data, which is then sent through the CID to the actual traffic controller. The traffic controller then analyzes the detector input data, determines the status of signal control, and sends the data back to the simulation model through the CID. This data exchange between the simulation model, the CID and the simulation model is done every simulation time step.

ACS-LITE A reduced-scale version of the Federal Highway Administration's (FHWA) Adaptive Control Software (ACS), offers small and medium-size communities a low-cost traffic control system that operates in real time, adjusting signal timing to accommodate changing traffic patterns and ease traffic congestion. ACS Lite can be used with new signals or to retrofit existing traffic signals. It is designed for closed-loop systems, providing cycle-by-cycle control.

VISSIM A microscopic simulation program for multi-modal traffic flow modeling. http://www.ptv-ag.com/cgi-bin/traffic/traf_vissim.pl

Adaptive Control A method by which input from sensors automatically and continuously adjusts in an attempt to provide near optimum processing conditions. <http://composite.about.com/library/glossary/a/bldef-a130.htm>

SCOOT Split Cycle and Offset Optimization Technique. A tool for managing and controlling traffic signals in urban areas. It is an adaptive system that responds automatically to fluctuations in traffic flow through the use of on-street detectors embedded in the road.

SCATS Sydney Coordinated Adaptive Traffic System. The System can operate in real time to adjust signal timing in response to changes in traffic demand and system capacity. By using video detection and or inductive loops installed within the road pavement to measure traffic at each intersection, the program adapts and adjusts to varying traffic flow by changing the timing of intersection lights. This immediate correction results in reduced traffic congestion and travel times.

Appendix B: ACS-LITE OVERVIEW

ACS-Lite operates by monitoring traffic signals, running normal coordinated timing plans, and making incremental adjustments to splits and offsets as often as every five to ten minutes. ACS-Lite currently cannot adjust cycle length.

ACS-Lite runs on a central processing unit that resides in a traffic signal cabinet or traffic management center (see Figure 1). An NTCIP communication link between the field controllers and ACS-Lite allows the software to monitor and evaluate traffic conditions and provide refinements to signal timing on a cycle by cycle basis.

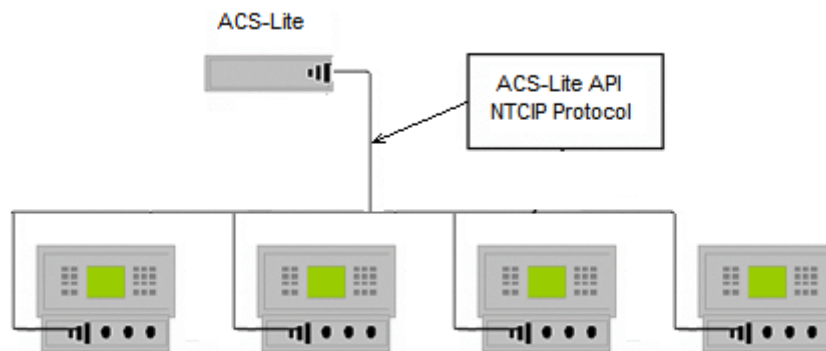


Figure 1: ACS-Lite Controlling System Architecture

ACS-Lite uses three levels of optimization to refine and update traffic signal timings (Figure 2).

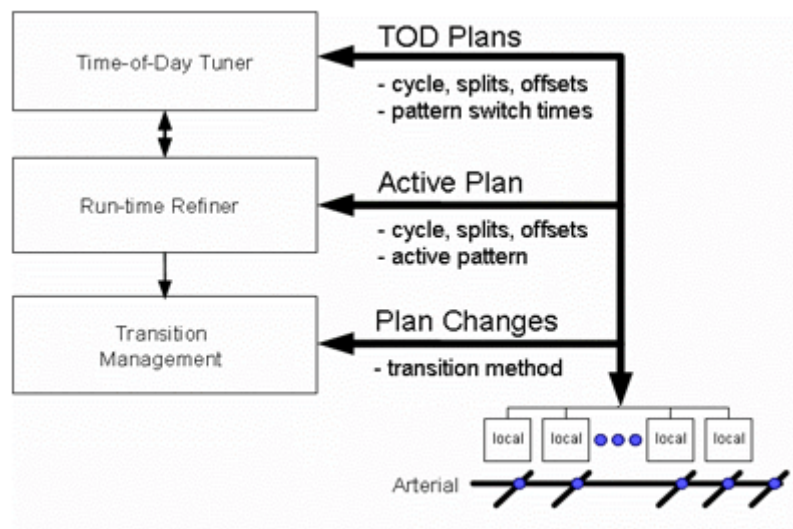


Figure 2: ACS-Lite Adaptive Control Logic

The Time-of-Day Tuner keeps timing plans updated by incorporating observations about traffic conditions into the signal timing plans.

The Run-time Refiner adjusts signal timings (splits and offsets) on a cycle by cycle basis in real time. The Run-time Refiner also determines the best time to transition from the current plan to the next plan in the schedule.

The Transition Manager finds the methods for shifting between traffic signal timing plans. It selects the best signal timing plan transfer method (for example, short way or dwell) to balance the time spent out of coordination during plan transition.

Split Adjustment Logic

Split adjustments are based on measures of the “utilization” of each phase. During the green intervals, detector volume and occupancy data is processed by measuring the amount of time that traffic is flowing across the stop line.

ACS-Lite estimates the degree of saturation of each phase, which is often referred to as volume-to-capacity ratio (or v/c ratio). In order to balance the degree of saturation across all phases, the adjustment logic reallocates time from a phase with an excessively long (i.e., unutilized) split time to provide more split time for an oversaturated phase. The degree of saturation balancing is the adjustment logic reallocates split time to balance the degree of saturation across all phases, subject to constrained by configured minimum green time and pedestrian interval requirements.

Figure 3 shows a screen-capture of the ACS-Lite’s web-based user interface, which provides a color-coded bar chart indicating the degree of saturation for each phase. This ring-diagram portrays the trade-offs of adjusting split time between phases.

This ring-diagram screenshot illustrates that phase 6 (a northbound through phase, using typical NEMA phase numbering) is 88.4% saturated, whereas the main-street phases (1 and 5) are less than 54% saturated. The adjustment logic provides an optional “progression biasing” mechanism which distributes “extra” or “slack” green time in the cycle (if it is available) in greater proportion to designated progression phases, which are typically arterial through phases. This feature is effective in exploiting the availability of “slack” time to provide a wider green band for improved progression.

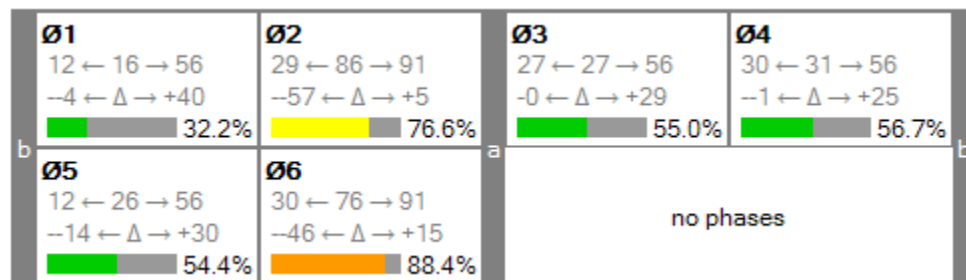


Figure 3: ACS-Lite Ring-Diagram Screenshot

Offset Adjustment Logic

Offset adjustments are based on cycle flow profiles, which are compiled by monitoring advance loops on progression approaches. The offset adjustment logic computes total (and percentagewise) arrivals on green for each offset option, and selects the offset that maximizes traffic flow arriving to green lights.

ACS-Lite makes incremental adjustments to the offset (e.g. a few seconds earlier, no change, or a few seconds later). The adjustments are made for each signal independently, considering all inbound and outbound designated progression lanes to the intersection. This prevents signal transition from deteriorating on existing traffic platoon progression.

ACS-LITE Detector Layout

ACS-Lite was designed to be relatively flexible with respect to the size, location, and capability of detectors in an effort to reduce the sensitivity of adaptive control performance and cost with respect to detection layouts and detector accuracy.

The ACS-Lite detection scheme is compatible with typical layouts used for intersections under fully-actuated control. The benefits of this design include the likelihood of a reduced total cost to instrument a typical arterial for adaptive control. Stop line detectors monitor volume and occupancy on green. The split adjustment logic will use the measurements from stop line detectors to calculate the “utilization” of each phase.

The stop line detectors are preferably placed at stop lines, and have a length of 15 to 20 feet on through lanes and 30 to 40 feet on left turn lanes. They should be set with separate detector inputs for each lane. ACS-Lite requires stop line detectors for each phase, preferably separated out for individual lane by lane monitoring. All detector lengths and types of detection technology are supported. The lanes serving the same phase/movement may be tied together.

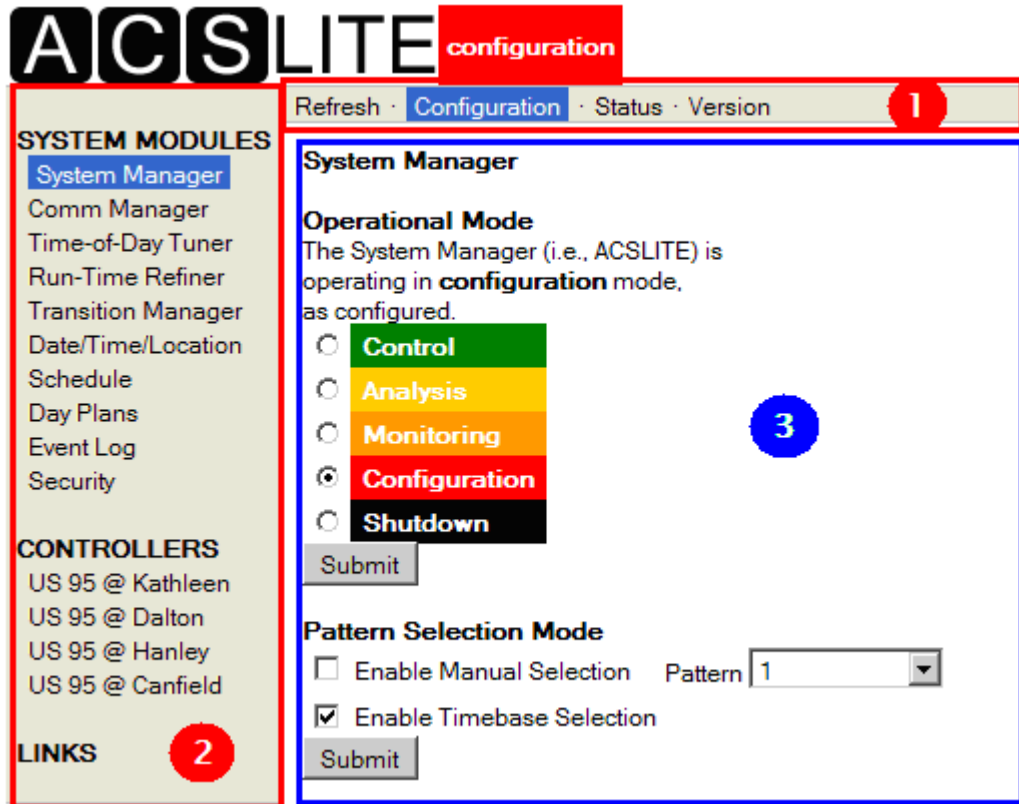
Adaptive tuning of intersection offsets requires at least one advanced detector on each coordinated phase. The detector can use any type of detection technology including loops, video, and radar at typical standard placements 150 feet or more from the stop bar. On the arterial approaches, advance loops are used to monitor cyclic flow and, to identify the arrival of platoons; this data is used to adjust offsets to improve progression.

The advance detectors should only be set on the progression-desired approaches and for the flow profiling. They should be placed far enough upstream (250 to 500 feet) to avoid queue spillback. ACS-Lite functions best with separate detector input for each lane. Detectors serving the same movements and/or the same phase can be tied together. However, this will degrade performance benefits.

ACS-Lite can account for variable detector length to derive good phase utilization measures from existing detector layouts. It is not necessary to replace detectors to meet precise dimensional requirements. 4-foot to 70-foot detectors are acceptable for ACS-Lite. If video detection cannot precisely separate two vehicles traveling closely together, this could cause “sensitivity reduction.” Non-critical lanes detection may be ignored, such as right turn lane. But if the ignored lane becomes critical during unexpected congestion, ACS-Lite will not be able to adapt to that demand.

ACS-LITE Configuration

All configuration and operational tasks pertaining to ACS-Lite are carried out via a web-based graphical user interface (GUI) as shown below.



ACS-Lite Graphical User Interface

The user interface is divided into a navigation area and a content area, delineated in red and blue respectively. The navigation area consists of the horizontal menu at the top of the screen menu (marked “1” on the figure), and the menu of the left hand side of the screen (marked “2”). The content area is the white portion of the screen on the lower, right hand side (marked “3” on the figure).

ACS-Lite software includes the following modules: System Manager, Controller Manager, Web Server, Run-Time Refiner, Analysis Engine, and Transition Manager.

ACS-Lite must be in configuration mode when new or different parameters are entered by the user or uploaded from the field controllers.

The various operational modes of ACS-Lite are summarized as follows:

- **Configuration Mode** enables users to change configuration parameters, upload databases from field controllers, and download some configuration parameters to controllers. Status polling and adaptive control are disabled while in configuration mode. This mode is shown at the top of the ACS-Lite user interface highlighted in red.
- **Synchronization Mode** occurs when ACS-Lite detects that parameters have been independently changed on one of the controllers. In this mode, ACS-Lite automatically re-uploads (i.e. re-synchronizes) data from those controllers that are out-of-sync. No configuration is allowed in this mode, status polling is disabled, and adaptive control is disabled. This mode is shown at the top of the ACS-Lite user interface highlighted in purple.
- **Validation Mode** entails processing configuration data to make sure it is error free and/or consistent. ACS-Lite briefly passes through this mode just prior to entering monitoring mode. This mode is shown at the top of the ACS-Lite user interface highlighted in blue.
- **Monitoring Mode** enables status polling and statistical processing of data. This mode is shown at the top of the ACS-Lite user interface highlighted in yellow.
- **Analysis Mode** enables status polling and statistical process of the data, and adaptive decisions are made, but not downloaded to the controllers.
- **Control Mode** enables adaptive control of the system. This mode is shown at the top of the ACS-Lite user interface highlighted in green.
- **Shutdown Mode** terminates ACS-Lite.

Appendix C: ACS-LITE SETUP FOR US 95 EVALUATION

Run-Time Refiner Setup

This step will setup all parameters related to the ACS-Lite adaptive control logic (please refer to Figure 10). The parameters are explained in Table 1. They should be configured as follows.

The screenshot shows the ACS LITE configuration interface. On the left is a sidebar with 'SYSTEM MODULES' (System Manager, Comm Manager, Time-of-Day Tuner, Run-Time Refiner, Transition Manager, Date/Time/Location, Schedule, Day Plans, Event Log, Security) and 'CONTROLLERS' (US 95 @ Kathleen, US 95 @ Dalton, US 95 @ Hanley, US 95 @ Canfield). A red box highlights the 'Run-Time Refiner' section in the sidebar (labeled '1'). The main content area has a top navigation bar with 'Refresh', 'Configuration', 'Status', and 'Version' (labeled '2'). Below this is the 'Run Time Refiner' form with the following parameters:

Max Offset Increment	6	The amount (in seconds) by which an offset may
Max Offset Deviation	18	The maximum amount (in seconds) by which an
Max Split Increment	10	The maximum amount (in seconds) by which a s
Max Split Deviation	16	The maximum amount (in seconds) by which an
Adjustment Interval	5	Minimum scheduled interval (in minutes) between
Offset Selection Method	Local	Method used to adjust offsets values.
Min Offset Duration	15	The minimum time (in minutes) between change

A 'Submit' button is located below the form (labeled '3'). Below the form is the 'Controller Options' section, which contains a table:

No.	Controller Description	Adjust Splits	Phase No.						Oversize Peds	Adjust Offset	Dummy Patterns
			1	2	3	4	5	6			
1	US 95 @ Kathleen	Timing	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	103
		Biasing	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	106
2	US 95 @ Dalton	Timing	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	103
		Biasing	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	106
3	US 95 @ Hanley	Timing	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	103
		Biasing	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	106
4	US 95 @ Canfield	Timing	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	103
		Biasing	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	106

A 'Submit' button is located below the table.

The key setting:

- Dummy Patterns must be “103 and 106”
- Offset Selection Method should be “Local”
- Other parameters can be set as needed

Detector Set-up

This step will setup Kathleen detector layout. They should be configured as follows.

ACS LITE configuration

Refresh · Configuration · Status · Version

Communications · Phases · Ring Sequences · Patterns · Schedule · **Detectors**

Controller 1 - US 95 @ Kathleen

Detector Configuration

Edit Download

Status	Result	Timestamp
Changes in settings related to volume occupancy (VO) data collection will be downloaded to the controller.		
VO Download	inactive	
VO Sync	Volume occupancy (VO) detector settings synced with local controller	as of Sun Jun 26, 2005 03:42:56 PM

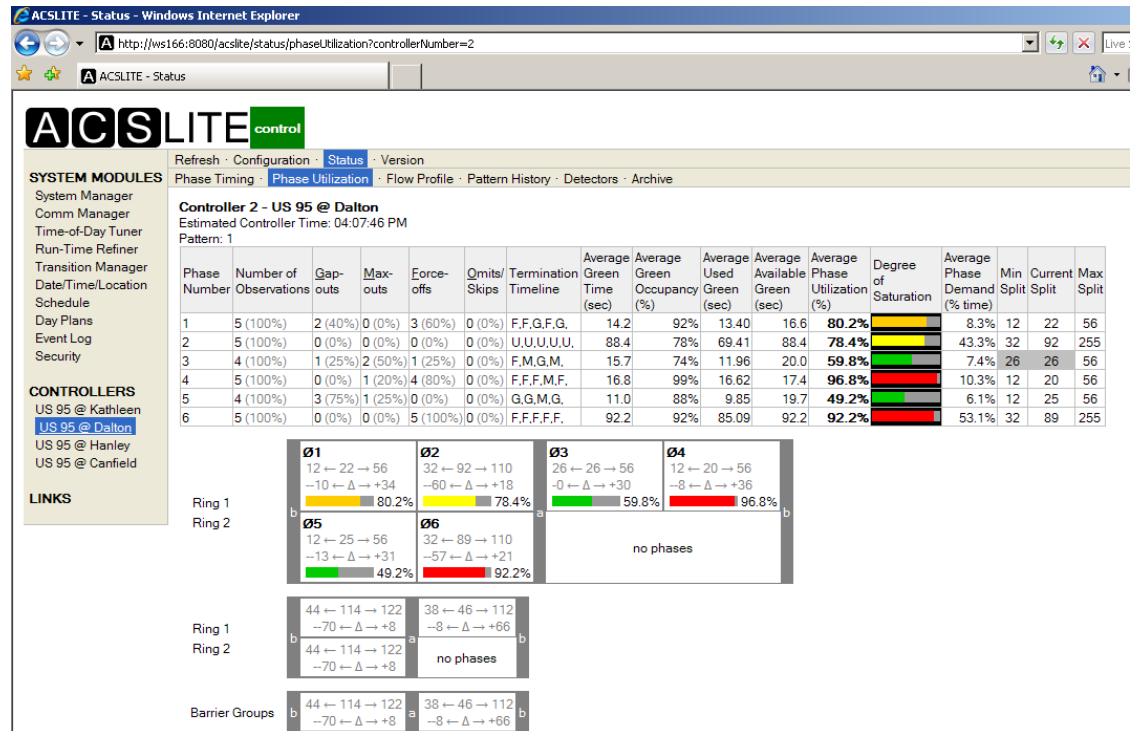
Detector Number	Description	Call Phase	Phase Utilization	Flow Profiling	Direction 1 Flow	Direction 2 Flow	Upstream Controller	Downstream Controller	Distance Upstream(ft)	Detector Length(ft)	Free Flow Speed(mph)	Time to Flow(sec)	Eff. Green Time Ext.	Sec Shift To Brake Point
1	Detector 1	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0	1	50	16	45	3	3.7	-
2	Detector 2	6	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0	1	50	16	45	3	3.7	-
3	Detector 3	6	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0	1	50	16	45	3	3.7	-
4	Detector 4	6	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0	1	360	10	45	22	3.7	2
5	Detector 5	6	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0	1	360	10	45	22	3.7	2
6	Detector 6	5	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2	1	50	16	45	3	3.7	-
7	Detector 7	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2	1	50	16	45	3	3.7	-
8	Detector 8	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2	1	50	16	45	3	3.7	-
9	Detector 9	2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2	1	400	10	45	24	3.7	2
10	Detector 10	2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2	1	400	10	45	24	3.7	2
11	Detector 11	3	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0	1	50	16	35	3	3.1	-
12	Detector 12	3	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0	1	50	16	35	3	3.1	-
13	Detector 13	3	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0	1	50	16	35	3	3.1	-
14	Detector 14	4	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0	1	50	16	35	3	3.1	-
15	Detector 15	4	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0	1	50	16	35	3	3.1	-
16	Detector 16	4	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0	1	50	16	35	3	3.1	-

The key setting:

- The stop bar detectors are for “Phase Utilization”
- The Advance detectors are for “Flow Profiling”
- The “Direction 1 Flow” is southbound flow
- The “Direction 2 Flow” is northbound flow

Phase Utilization

The following figure shows Dalton intersection phase utilization.



Run-Time Refiner Real-Time Status

The following figure shows Run-Time Refiner real-time status.

ACSLITE control

Refresh · Configuration · **Status** · Version

SYSTEM MODULES

- System Manager
- Comm Manager
- Time-of-Day Tuner
- Run-Time Refiner**
- Transition Manager
- Date/Time/Location
- Schedule
- Day Plans
- Event Log
- Security

CONTROLLERS

- US 95 @ Kathleen
- US 95 @ Dalton
- US 95 @ Hanley
- US 95 @ Canfield

LINKS

Run-Time Refiner
 Current Time: 05:24:53 PM
 Last Analysis Time: 05:20:00 PM
 Next Analysis Time: 05:25:00 PM
 The following table displays recommended parameter adjustments of the Run-Time Refiner.

Baseline settings are displayed in a row with a gray background color.
 Pre-adjustment (previous ACSLITE settings) and unadjusted settings have this gray font color.
 Post-adjustment (i.e., new recommended) settings are **GREEN** if increased or **RED** if decreased.
 Warnings/reasons for not adjusting parameters are displayed with this background color.

Controller	Pattern	Cycle	Offset	Split 1	Split 2	Split 3	Split 4	Split 5	Split 6	Split 7	Spl
1	103	160	145	26	57	41	36	33	50	0	0
1	103, 106	160	139	25 → 20	67 → 70	36 → 35	32 → 35	32 → 25	60 → 65	0	0
2	103	160	58	22	72	36	30	25	69	0	0
2	103, 106	160	64	18 → 23	82 → 88	32 → 26	28 → 23	21 → 26	79 → 85	0	0
3	103	160	68	14	69	41	36	27	56	0	0
3	103, 106	160	62	12 → 13	75 → 81	45 → 40	28 → 26	21 → 22	66 → 72	0	0
4	103	160	77	16	66	37	41	26	56	0	0
4	103, 106	160	83	12	76 → 78	41 → 40	31 → 30	22 → 18	66 → 72	0	0

We can see from this figure:

- Kathleen offset is reduced from 145 to 139
- Kathleen “Split1” is reduced from 25 to 20
- Kathleen “Split6” is increased from 60 to 65
- Etc.