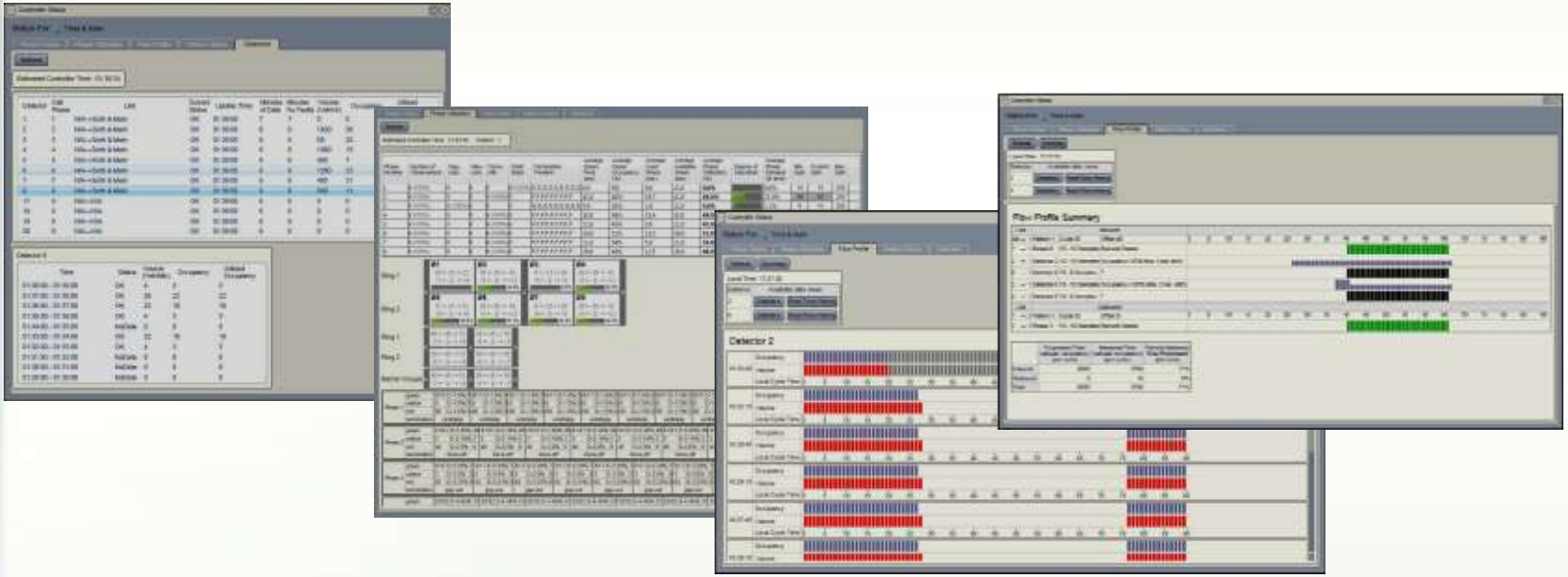
# ACSLITE

# Overview



# ACS LITE

## Outline

- *ACS Lite* Overview
- Detection Guidelines
- Getting Started
- Considerations
- Phase II Research
- Early Deployments

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# ACS LITE

# Overview

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# Why Adaptive?

- Fixed plan (TOD) systems don't respond well to traffic surges and unpredictable demands
- Limited resources lead to signals being retimed after long periods (3-5 years)
  - Outdated timing plans become inefficient due to changes in traffic demands or patterns
- Lack of ability to expand road networks to deal with increasing congestion

# *ACS Lite* - Background

U.S. Department of Transportation
Federal Highway Administration

- FHWA Funded Research project (2002-2007)
  - Research, Development and Technology Traffic Operations Program
- Siemens was the prime contractor with support from a project team

SIEMENS

ECONOLITE CONTROL PRODUCTS, INC.

McCain

The University of Arizona. Tucson Arizona

Purdue University

ITT Industries *Engineered for life*

PEEK

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# FHWA Goals for *ACS Lite*

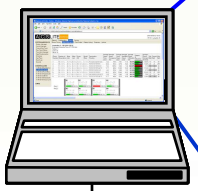
- Advance adaptive control from state-of-the-art technology to state-of-the-practice technology that can be widely deployed
- Leverage existing infrastructure
  - Standard US-style actuated controllers and logic (rings, phases, splits, barriers, gap-out/extension, etc.)
  - Leverage existing stop bar and advance detection
  - Leverage exiting closed-loop system communications – once per minute polling cycle
  - "Retro-fit" with major US signal system vendors
- Build a cost effective, easily deployable adaptive system
  - Most adaptive systems are complex to set up and require calibration to get good performance
- Make use of emerging NTCIP standards
- Focus on arterial networks

# *ACS Lite* Architecture

- Uses existing TOD or TR plan in effect and optimizes the splits and offsets based on current traffic demand – Helps fixed timing plans perform better
  - Cycle length remains constant but can change if the command source changes plan to one with a different cycle length
  - Small incremental changes made to split and offset (2-5 seconds per adjustment)
  - Phase status and detector data gathered once per minute
- Splits adjusted based on phase utilization
  - Unused split re-allocated to phases needing split
- Offset adjusted based on green arrival or flow profile
  - Offset adjusted to optimize vehicles arriving on green

# *ACS Lite* System

Remote Laptop



User Interface

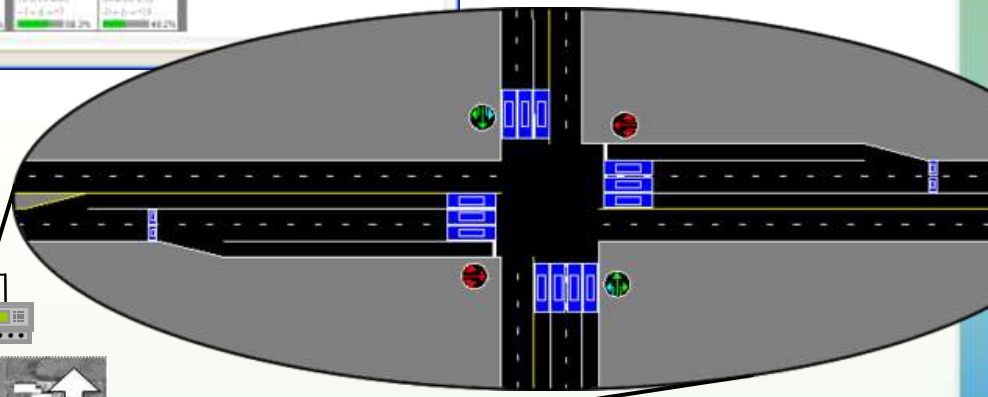

ACS Lite

On-Street Master

OR

Central Server

Vehicle Detectors



Local Controllers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# Comparative Results

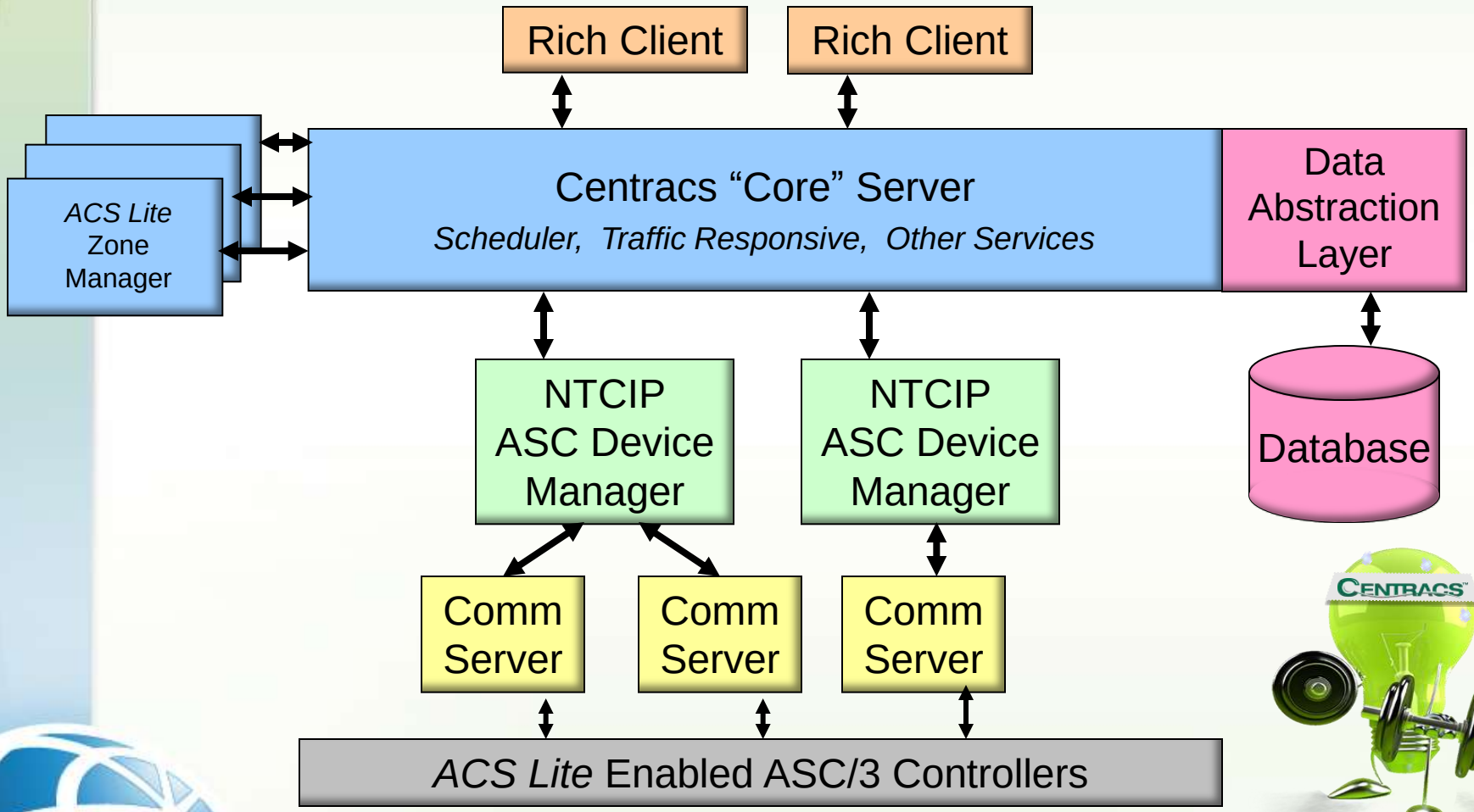
| SYSTEM | BENEFITS (Percent change in) | | | INITIAL CAPITAL COST (per intersection)* |
|---|---|---|---|---|
| | Travel Time | Delays | Stops | |
| ***ACS-Lite*** | -12% to +7% | -38% to +2% | -35% to -28% | |
| **OPAC** | -26% to +10% | - | -55% to 0% | $20,000 to $50,000 |
| **RHODES** | -7% to +4% | -19% to -2% | - | $30,000 to $50,000 |
| **SCATS** | -20% to 0% | -19% to +3% | -24% to +5% | $25,000 to $30,000 |
| **SCOOT** | -29% to -5% | -28% to -2% | -32% to -17% | $30,000 to $60,000 |

Based on FHWA data source – City of Starke, FL

# *ACS Lite* In Centracs

- Eliminate need for on-street master by integrating *ACS Lite* algorithms into Centracs
- Leverages ***Centracs*** Communications/Comserver, Scheduler, Configuration tools, Alert Management, monitoring and other features
  - ***Centracs*** can run a section in TOD/Traffic Responsive or ***ACS Lite*** or switch on a TOD basis
  - Multiple *ACS Lite* solutions can be defined over the same corridor, using different combinations of intersections if needed. Up to 32 intersections can be supported per *ACS Lite* Zone
- Centralized database
  - Persists Controller and Detector Configurations
  - Data collection for other uses in Centracs

# Centracs + *ACS Lite*



# *ACS Lite* Split Tuning Process

Splits adjusted based on phase utilization

- Phase Utilization determined from stop bar detector data
- Unused split re-allocated to phases needing split

- Step 1 – Collect occupancy data
- Step 2 - Correlate data to signal phasing
- Step 3 - Perform analysis to determine phase utilization
- Step 4 – Implement phase split adjustments to attempt to balance degree of saturation amongst all phases

# *ACS Lite* Offset Tuning Process

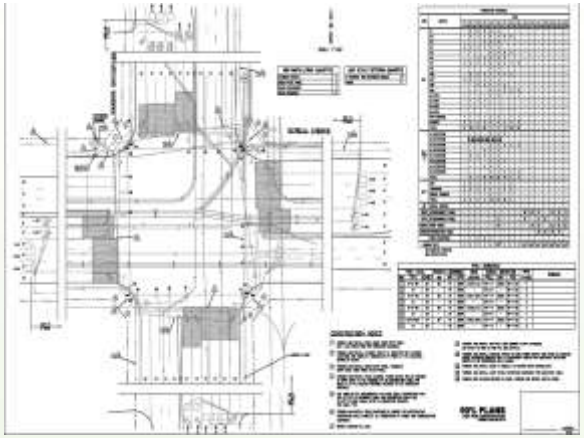
Offset adjusted based on green arrival or flow profile

- Flow Profile developed from advance detector data
- Offset adjusted to optimize vehicles arriving on green

- Step 1 - Collect data from advance detectors on coordinated approaches
- Step 2 - Develop a Statistical Flow Profile correlated to the phase state
- Step 3 - Perform analysis to capture the most arriving flow during the green interval
- Step 4 - Implement offset adjustment

ACS LITE

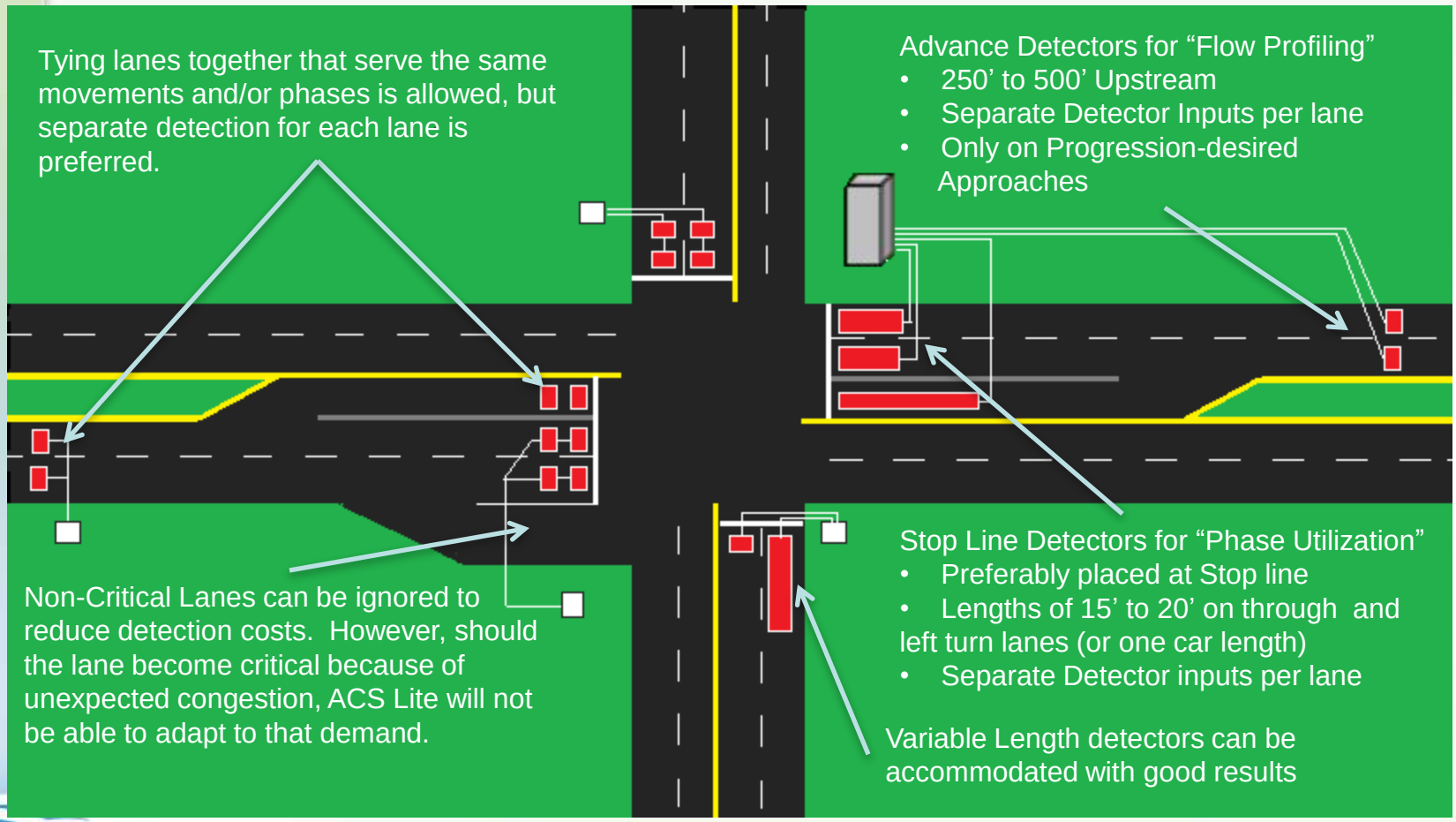
# Detection Guidelines



# *ACS Lite* Detection Guidelines

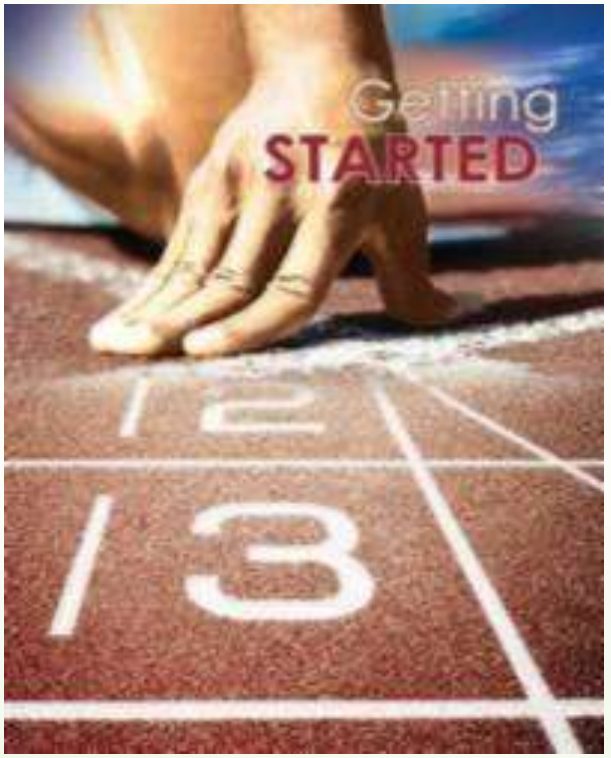
- Detector delays or extensions should be configured in the controller not in the detector
  - *ACS Lite* needs to know all timing that can affect phase duration
- Ideal detection zone sizes
  - Advance - 6x6
  - Stop Bar – 15 to 20 feet on through or left turn lanes (or about one car length)

# *ACS Lite* Detection Configurations



# ACSLITE

## What's Needed To Get Started



# Information Needed

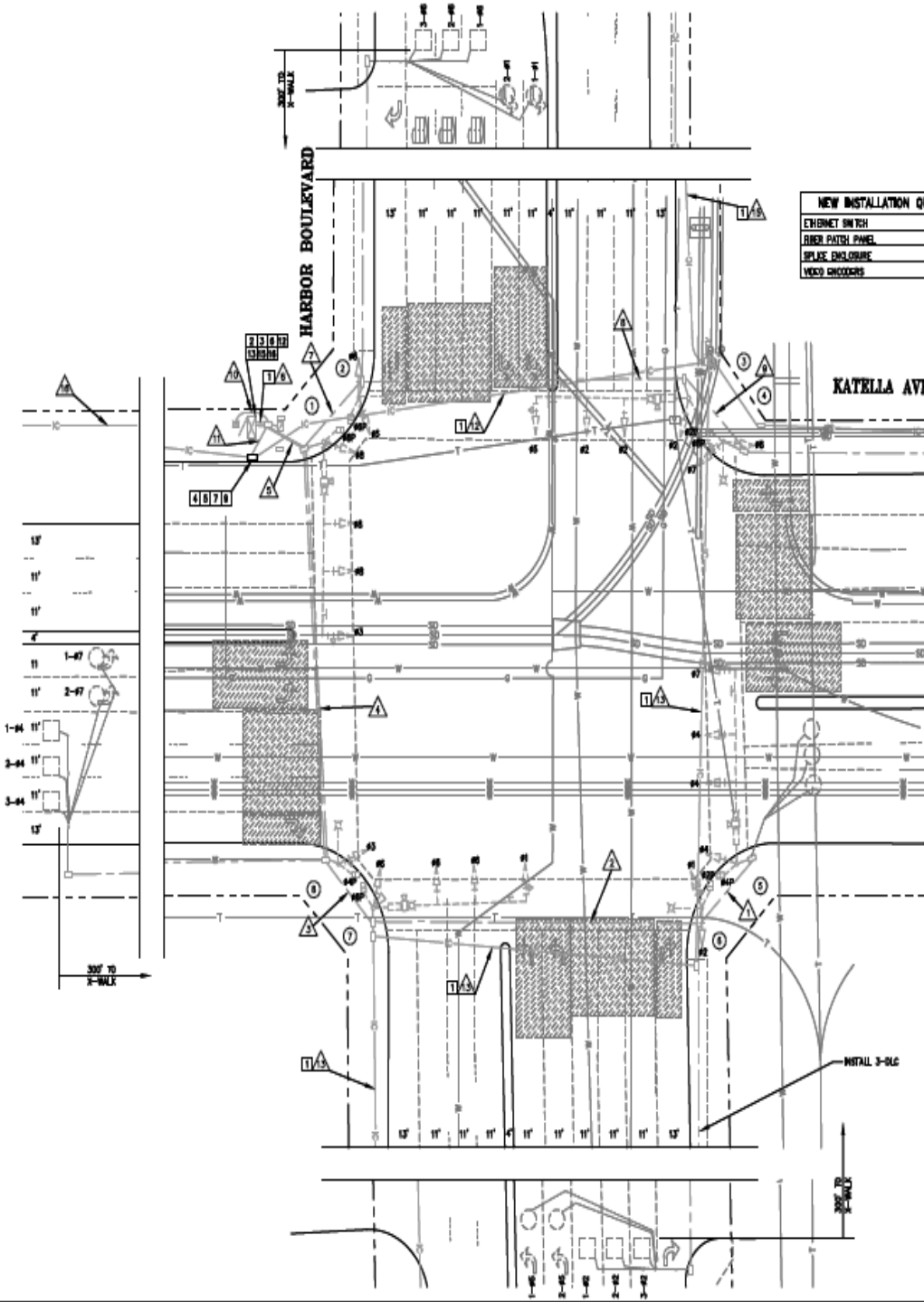
Successful *ACS Lite* deployments are dependent on having upfront information

- System Information
  - Location, arterials, intersections
  - Controller ID, phasing, intersection to intersection spacing, and posted/prevailing speeds
  - Links and Upstream-Downstream relationship of intersections
    - Traffic always flows from the Upstream intersection towards the Downstream intersection (traffic always flows downstream)
  - Intersection layout, including number of lanes on each and movements allowed per lane
  - Major and Cross street movements and phase assignment

# Information Needed

- Controller timing and configuration
  - Note any special operation, phasing or advanced features being used
    - Protected-Permissive LT, Overlaps on major movements, preemption-EVP-TSP
- Detection details
  - Detector number (at the controller) and use (Phase Utilization or Flow Profile)
  - Lane assignment
    - Or Lanes if multilane detectors are used
  - Stop Bar Detector length
  - Advance detector distance from stop bar


Monongalia
Star City
(Future)
(New)
Granville
Westover
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
79
100
7
119
Image © 2010 DigitalGlobe
Image USDA Farm Service Agency
©2009 Google
Imagery Dates: Sep 22, 2002 - Aug 25, 2007
39°39'18.73" N 79°55'14.34" W elev 0 ft
Eye alt 22995 ft




| NEW INSTALLATION QUANTITIES | |
|---|---|
| ETHERNET SWITCH | 1 |
| FIBER PATCH PANEL | 1 |
| SPLICE ENCLOSURE | 1 |
| VIDEO ENCODERS | 2 |

| LOOP VEHICLE DETECTION QUANTITIES | |
|---|---|
| 4-CHANNEL VDS EXTENSION MODULE | 3 |
| VRACK | 1 |

**CONDUCTOR SCHEDULE**

| AWG | CIRCUIT | RUN 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| #14 | #1 | – | 3 | 6 | 6 | 6 | – | – | – | – | – | – | – | – | – | – | – |
| | #2 | – | 3 | 3 | 3 | 6 | 6 | 6 | – | – | – | – | – | – | – | – | – |
| | #3 | – | – | – | 3 | 6 | 6 | – | – | – | – | – | – | – | – | – | – |
| | #4 | 3 | 3 | 3 | 3 | 3 | 3 | – | – | – | – | – | – | – | – | – | – |
| | #5 | – | – | – | – | 6 | 6 | 6 | 3 | – | – | – | – | – | – | – | – |
| | #6 | – | – | 3 | 3 | 6 | 6 | 3 | – | – | – | – | – | – | – | – | – |
| | #7 | 3 | 3 | 3 | 3 | 6 | 6 | 3 | 3 | 3 | – | – | – | – | – | – | – |
| | #8 | – | – | – | – | 3 | 3 | – | – | – | – | – | – | – | – | – | – |
| | #2P | – | 2 | 2 | 2 | 4 | 4 | 2 | 2 | – | – | – | – | – | – | – | – |
| | #4P | 2 | 2 | 2 | 4 | 4 | 4 | – | – | – | – | – | – | – | – | – | – |
| | #6P | – | – | 2 | 2 | 4 | 4 | 2 | – | – | – | – | – | – | – | – | – |
| | #8P | – | – | – | – | 4 | 4 | 2 | 2 | 2 | – | – | – | – | – | – | – |
| | #2 PPB | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | – | – | – | – | – | – | – |
| | #4 PPB | – | 1 | 1 | 1 | 1 | 1 | – | – | – | – | – | – | – | – | – | – |
| | #6 PPB | – | – | – | 1 | 1 | 1 | – | – | – | – | – | – | – | – | – | – |
| | #8 PPB | – | – | – | – | 1 | 1 | 1 | 1 | – | – | – | – | – | – | – | – |
| | PPB COMMON | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | – | – | – | – | – | – | – |
| | SPARES | 3 | 3 | 3 | 3 | 6 | 6 | 3 | 3 | 3 | – | – | – | – | – | – | – |
| | TOTAL | 13 | 23 | 31 | 33 | 71 | 71 | 31 | 22 | 10 | – | – | – | – | – | – | – |
| DLC TYPE C | #1 DETECTOR | – | – | – | – | 2 | 2 | 2 | – | – | – | – | – | – | – | – | – |
| | #2 DETECTOR | – | 2 | 2 | 2 | 2 | 2 | 2 | – | – | – | – | – | – | – | – | – |
| | #3 DETECTOR | – | – | – | – | 2 | 2 | 2 | 2 | 2 | – | – | – | – | – | – | – |
| | #4 DETECTOR | – | – | – | 3 | 3 | 3 | – | – | – | – | – | – | – | – | – | – |
| | #5 DETECTOR | – | 2 | 2 | 2 | 2 | 2 | – | – | – | – | – | – | – | – | – | – |
| | #6 DETECTOR | – | – | – | – | 3 | 3 | 3 | – | – | – | – | – | – | – | – | – |
| | #7 DETECTOR | – | – | – | 2 | 2 | 2 | – | – | – | – | – | – | – | – | – | – |
| | #8 DETECTOR | – | – | – | – | 3 | 3 | 3 | 3 | 3 | – | – | – | – | – | – | – |
| | TOTAL | – | 5 | 5 | 10 | 20 | 20 | 10 | 5 | 5 | – | – | – | – | – | – | – |
| #10 | ESN | 2 | 2 | 2 | 2 | 4 | 4 | 2 | 2 | – | – | – | – | – | – | – | – |
| | LUMINAIRE | 2 | 2 | 2 | 2 | 4 | 4 | 2 | 2 | – | – | – | – | – | – | – | – |
| | SIGNAL COMMON | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | – | – | – | – | – | – | – | – |
| | TOTAL | 5 | 5 | 5 | 5 | 10 | 10 | 10 | 5 | – | – | – | – | – | – | – | – |
| #8 | SIGNAL SERVICE | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 25PR | INTERCONNECT CABLE | – | – | – | – | – | – | – | – | 2E | 2E | 1E | – | 1E | 1E | 1E | 1E |
| 12PR | INTERCONNECT CABLE | – | – | – | – | – | 1E | – | – | – | 1E | – | 1E | 1E | – | 1E | 1E |
| 6SMFO | DROP CABLE | – | – | – | – | – | 1N | – | – | – | – | 1N | 2E | – | 2E | 2E | 2E |
| 24SMFO | DISTRIBUTION CABLE | – | – | – | – | – | – | – | – | – | – | – | – | 3N | 1N | 1N | 1N |
| | VIDEO DETECTION | 1 | 1 | 2 | 2 | 4 | 1 | 1 | 1 | – | – | – | – | – | – | – | – |
| CONDUIT SIZE | | E | E | E | E | E | 2.5" | E | E | E | 2.5" | 2.5" | 2.5" | 2.5" | 2.5" | 2.5" | 2.5" |

(E) DENOTES EXISTING
(N) DENOTES NEW

**POLE SCHEDULE**

| No | POLE DATA TYPE | HEIGHT | SIGNAL MA | LUMINAIRE MA | LUMINAIRE HPS | ISNS LEGEND | SIGNAL MOUNTING POLE | SIGNAL MOUNTING MA | SIGNAL MOUNTING PED | PPB PHASE | REMARK |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 61-5-80 | 30' | 60' | 15' | 200W | Katella Ave | SV-1-T | 3MAS | SP-1-CS | 6 | |
| 2 | 15 | 30' | – | 15' | 200W | – | SV-3-T | – | SP-1-CS | 8 | |
| 3 | 61-5-80 | 30' | 60' | 15' | 200W | Harbor Blvd | SV-1-T | 3MAS | SP-1-CS | 8 | |
| 4 | 15 | 30' | – | 15' | 200W | – | SV-2-T | – | SP-1-CS | 2 | |
| 5 | 61-5-80 | 30' | 60' | 15' | 200W | Katella Ave | SV-1-T | 3MAS | SP-1-CS | 2 | |
| 6 | 15 | 30' | – | 15' | 200W | – | SV-2-T | – | SP-1-CS | 4 | |
| 7 | CCTV POLE | 40' | 60' | 15' | 200W | Harbor Blvd | SV-1-T | 3MAS | SP-1-CS | 4 | |
| 8 | 15 | 30' | – | 15' | 200W | – | SV-1-T | – | SP-1-CS | 8 | |

## CONSTRUCTION NOTES

1. FURNISH AND INSTALL SINGLE MODE FIBER OPTIC CABLE WITH 1 #10 TRACE WIRE PER CONDUCTOR SCHEDULE.
2. FURNISH AND INSTALL ETHERNET SWITCH AT IDENTIFIED FIELD CLEMENT LOCATIONS AND COMPLETE TERMINATION OF POWER AT THE LOCATIONS SHOWN ON PLANS.
3. FURNISH AND INSTALL FIBER PATCH PANEL. TERMINATE DROP CABLE USING FIBER PATCH PANEL.
4. FURNISH AND INSTALL SPLICE CLOSURE. FURSION SPLICE TWO (2) STRANDS OF DROP CABLE TO THE ASSIGNED OF THE DISTRIBUTION CABLE PER SHEET 11 TO 115, UNLESS OTHERWISE SPECIFIED ON THE CONDUCTOR SCHEDULE.
5. COIL FIBER IN PULL BOX/MANHOLE AS SLACK CABLE. CONTRACTOR SHALL COIL 25 FEET OF BACKBONE CABLE AND DISTRIBUTION CABLE AND 15 FEET OF DROP CABLE. REFER TO CONDUCTOR SCHEDULE FOR CABLE TYPE.
6. FURNISH AND INSTALL VIDEO ENCODER(S) IN CABINET PER SPECIFICATION. CONTRACTOR SHALL COMPLETE ALL CONNECTIONS TO POWER AND COMMUNICATION EQUIPMENT.
7. REMOVE EXISTING PULL BOX.
8. FURNISH AND INSTALL NEW PULL BOX NUMBER 6 WITH EXTENSION. SEE SHEET XX AND XX FOR PULL BOX DETAILS.
9. FURNISH AND INSTALL VANTAGE VRACK TSI WITH POWER SUPPLY AND FOUR (4) VANTAGE EDGE2 EXTENSION MODULES AND ALL NECESSARY CABLES FOR ADDITIONAL DETECTION INPUTS TO THE CONTROLLER VIA D-PANEL.
10. FURNISH AND INSTALL 2070-1C MODULE TO EXISTING 2070 CONTROLLERS.
11. FURNISH AND INSTALL LOOP VEHICLE DETECTION EQUIPMENT PER QUANTITIES TABLE.
12. REMOVE AND SALVAGE EXISTING D-PANEL. FURNISH AND INSTALL NEW D-PANEL.

**90% PLANS**
**NOT FOR CONSTRUCTION**
SUBMITTED 00/00/00

xx/xx/xx
DATE

# ACS LITE

## What You Need To Consider

# *ACS Lite* Considerations

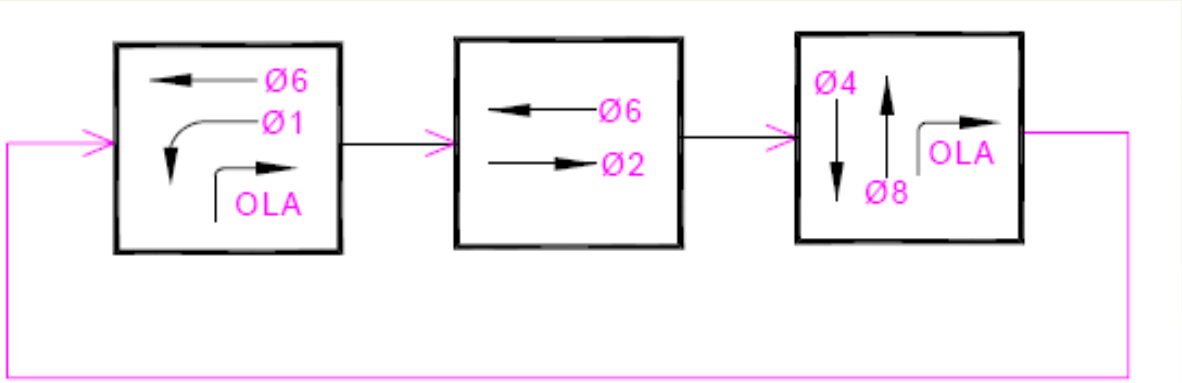
- Timing
  - *ACS Lite* starts from the existing coordination plans – good starting plans help
    - No benefit during free operation
    - Limited value where traffic is predictable and not expected to change – easily addressed by TOD
      - May be a rare case!
  - Mismatched clearance times
    - Clearance times in a concurrent group should be within one second. If the difference in greater than one second *ACS Lite* may assume a failure and stop adjustments.
    - Adjust clearance times or turn off split adjustments for the affected concurrent group

# *ACS Lite* Considerations

- Timing (continued)
  - Cycle lengths across the *ACS Lite* Zone must be the same for the plan in effect
    - Sub-Groups are not supported – all intersections in the *ACS Lite* Zone should run the same TOD plans and schedule
    - Double cycling can be supported at low demand intersections but offset adjustments cannot be made
- Phasing
  - Currently only two ring operation is supported
  - Overlaps - *ACS Lite* is only aware of phases – problems may occur if a major movement is driven by an overlap
    - Watch out for interchanges, T-intersections, FLTA
    - Texas Diamond NOT supported

# *ACS Lite* Considerations

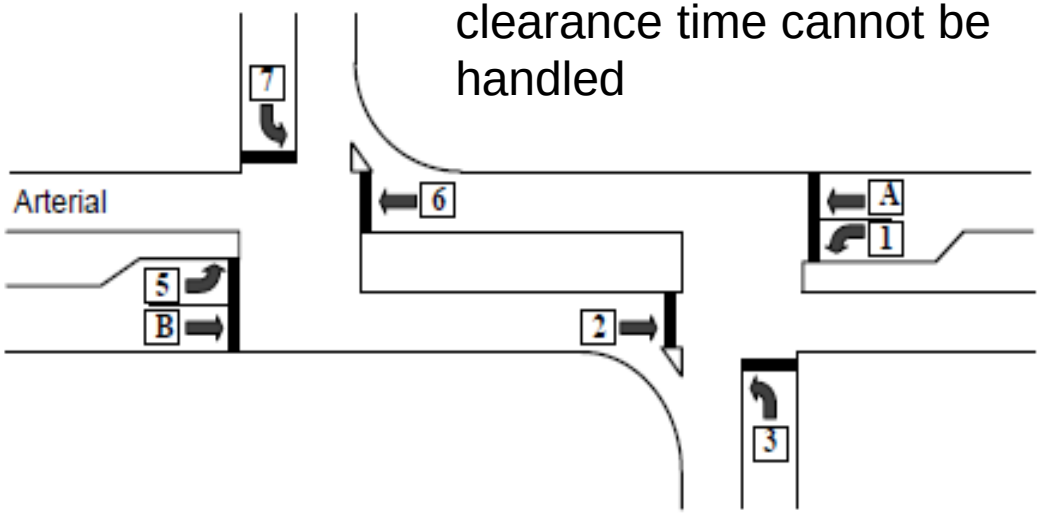
- Phasing (continued)
  - Split adjustments during permitted movements can be challenging
- Advanced Controller Features
  - Some advanced controller features aren't supported
    - Such as Early/Advanced Walk, Ped Clear Thru Yel, Ped Clr Extension, Reservice during coordination
  - Controller features that attempt to modify splits might conflict with *ASC Lite*
    - Includes TSP, Unused Split Allocation, Coordinated Phase Split Extension




Simple overlaps can be handled

OLA = 1 + 8

Overlaps that serve as a major movement or have their own clearance time cannot be handled



# *ACS Lite* Considerations

- Communications
  - Only Ethernet is supported with ***Centracs***
    - Serial data rates are too slow to support both ***Centracs*** and *ACS Lite* data packet needs
    - No specific *ACS Lite* communications setup required in ***Centracs***
  - Always get communicates working under normal ***Centracs*** control before attempting to bring *ACS Lite* online
- Controllers
  - Only ASC/3s or 2070s running ASC/3 2070 software are currently supported. Must be updated to latest release. License key required.
    - 2070s must be compliant to TEES 2002 or later

# *ACS Lite* Considerations

- Expectations
  - Successful adaptive system deployments are dependent on meeting expectations
  - Need to manage expectations up front – agencies often have unreasonable expectations based on misleading information they have heard
  - Avoid hype and over claiming *ACS Lite* improvements – customers appreciate honesty

# ACSLITE

## Phase II Research

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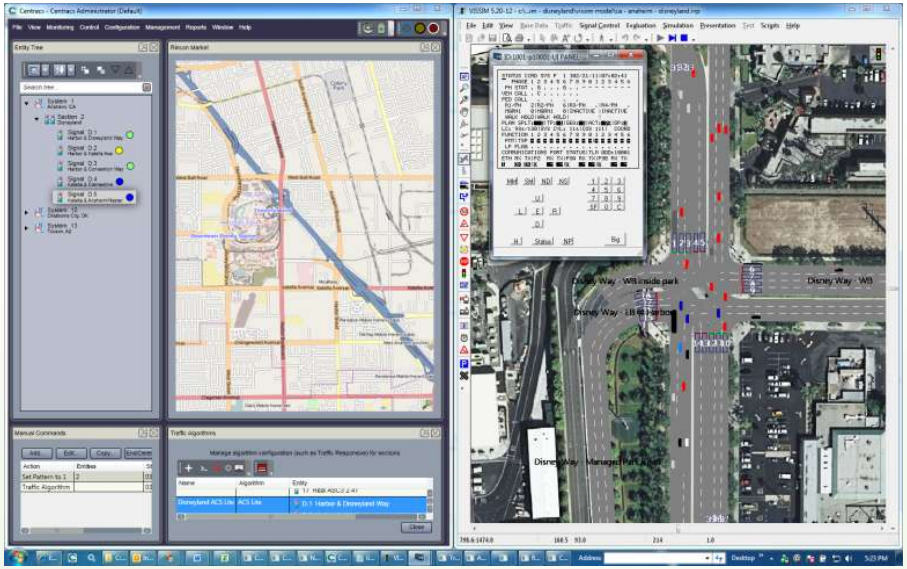
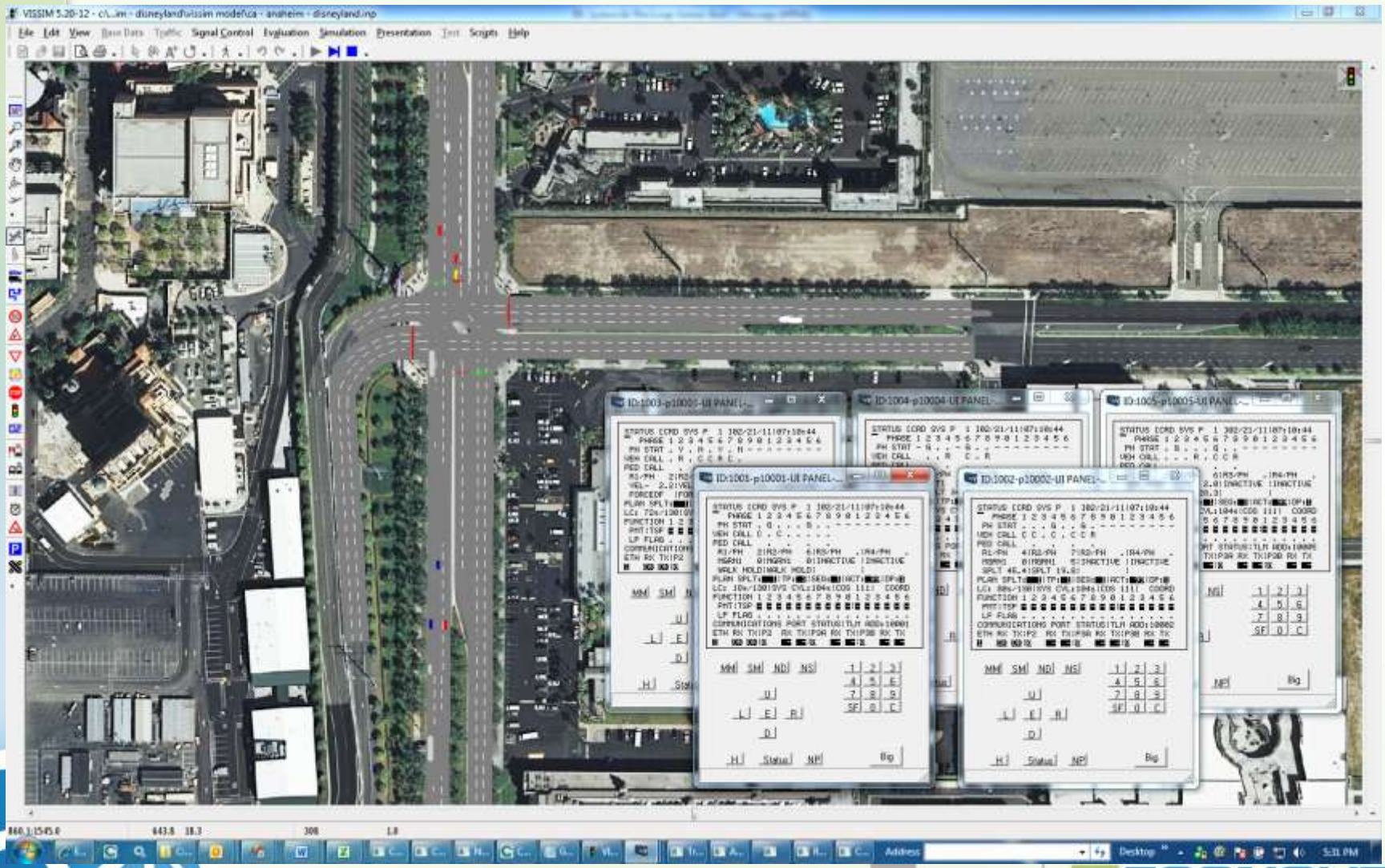
# System-In-The-Loop

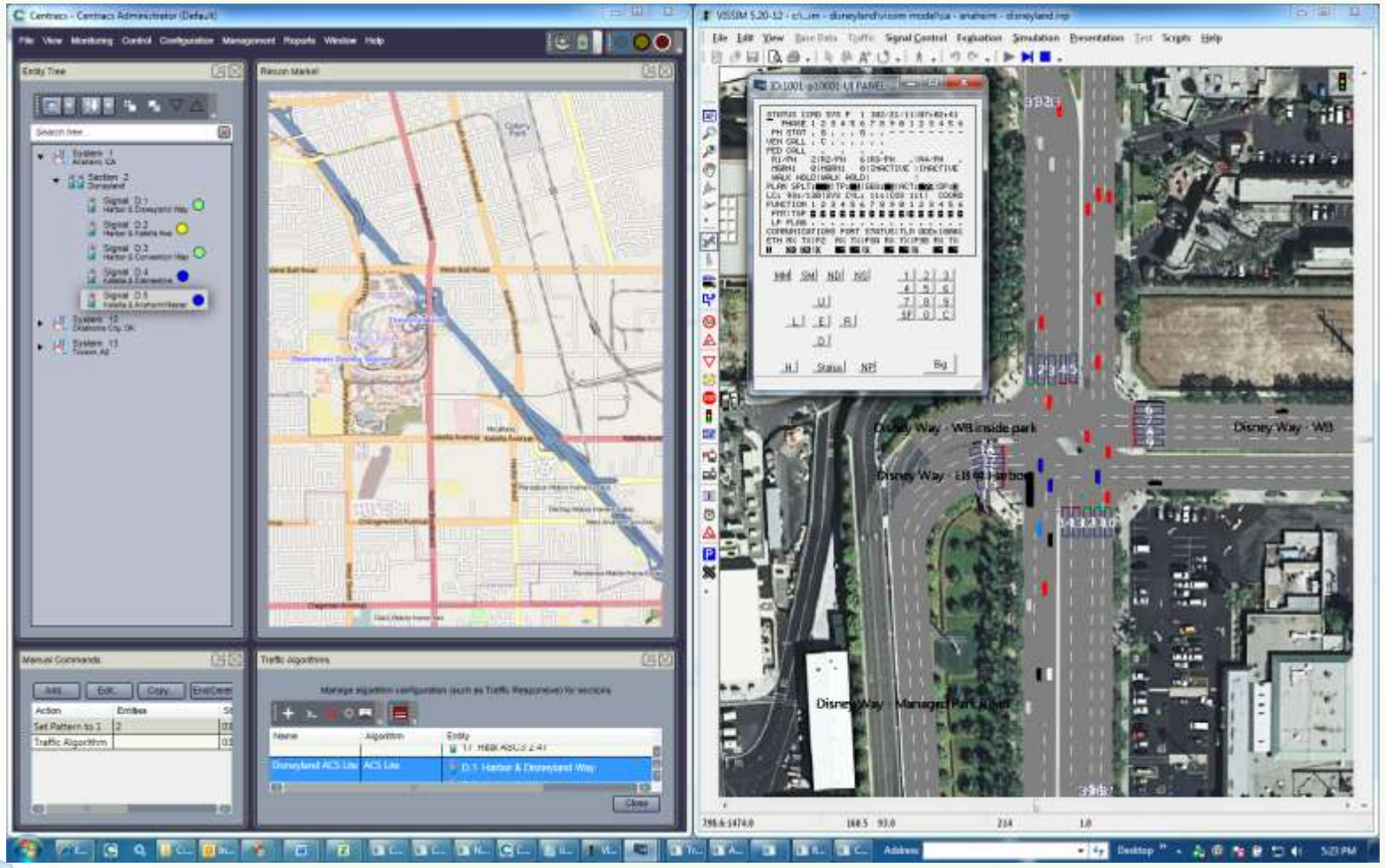
- System simulation before deployment
  - Allows validating adaptive performance and expectations prior to deployment
  - System-In-The-Loop simulation
    - VISSIM
    - Centracs – *ACS Lite*
    - ASC/3 SIL



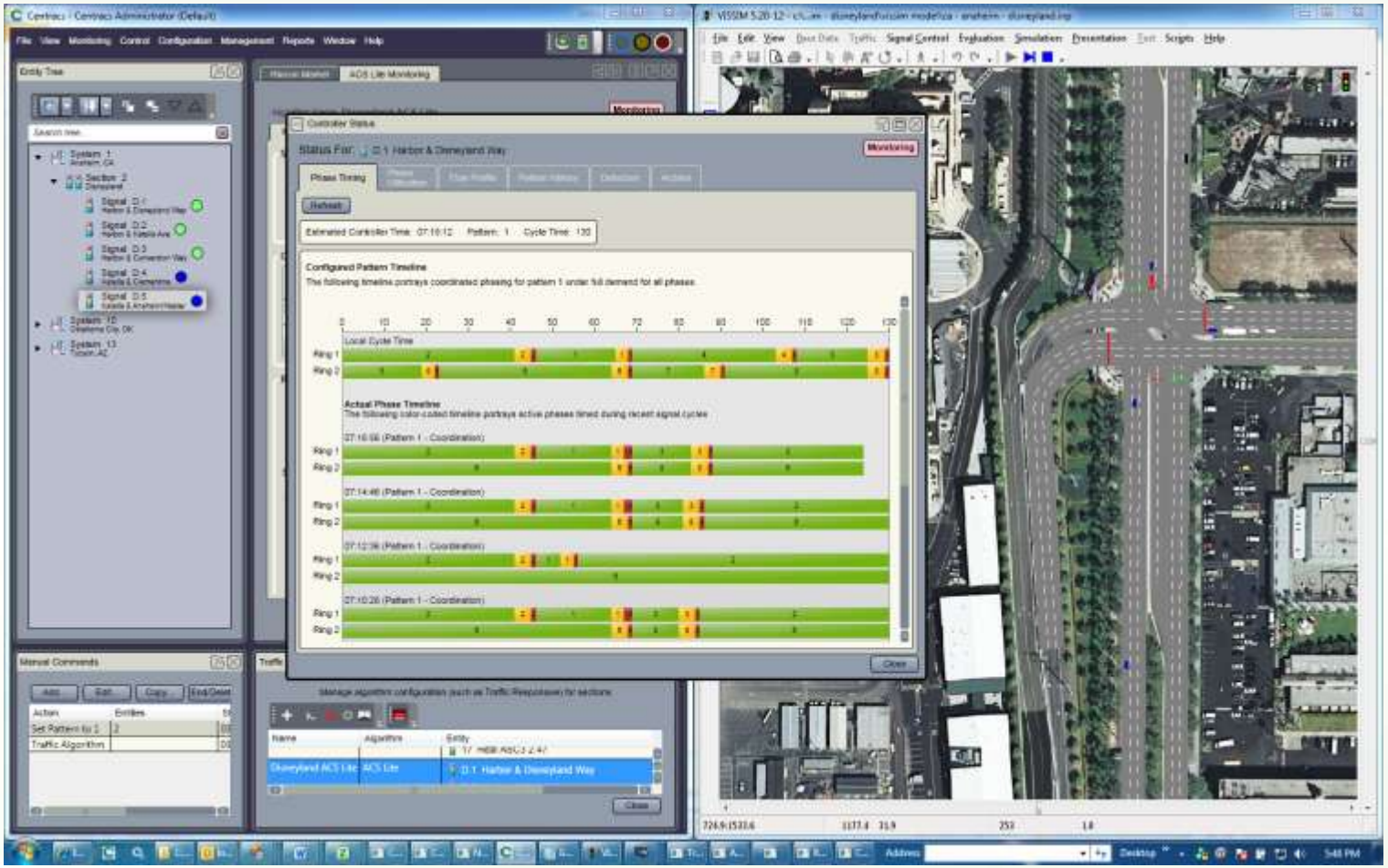
# VISSIM with Software In The Loop Controllers



# Centracs Fully Integrated with VISSIM Controllers



# *ACS Lite* Status During Simulation Run



# Phase II *ASC Lite* Research

- Develop capability to adjust cycle lengths as warranted by changing traffic flow
  - In negotiation with FHWA to complete this work at Econolite
- During a detector fault, allow the affected phase to revert to its historical activity based on time-of-day
  - Current version has limited response to detector failures and depends on local detector diagnostics
- Develop/document a means to allow a daily log of adaptive timing adjustments and data to be automatically backed up to a central server each night

# Phase II *ACS Lite* Research

- Hide more advanced user interface display data within optional/alternative "advanced" screens, to provide simplified "basic“ screens by default.
- Provide an option to display split durations as a percentage of the cycle length in addition to seconds.

ACS LITE

# Early Projects

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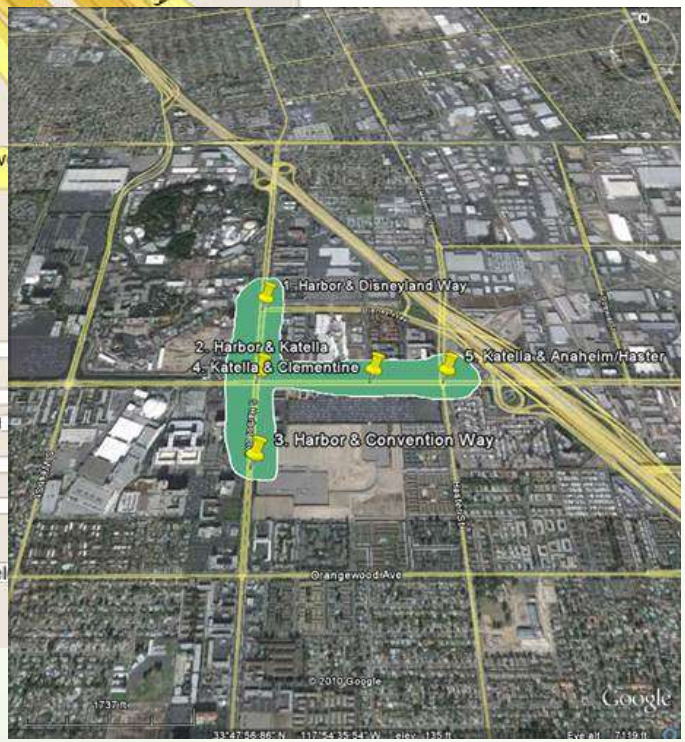


Anaheim
5 Intersections
Harbor & Katella
near
Disneyland

FHWA ACS Lite Evaluation Site

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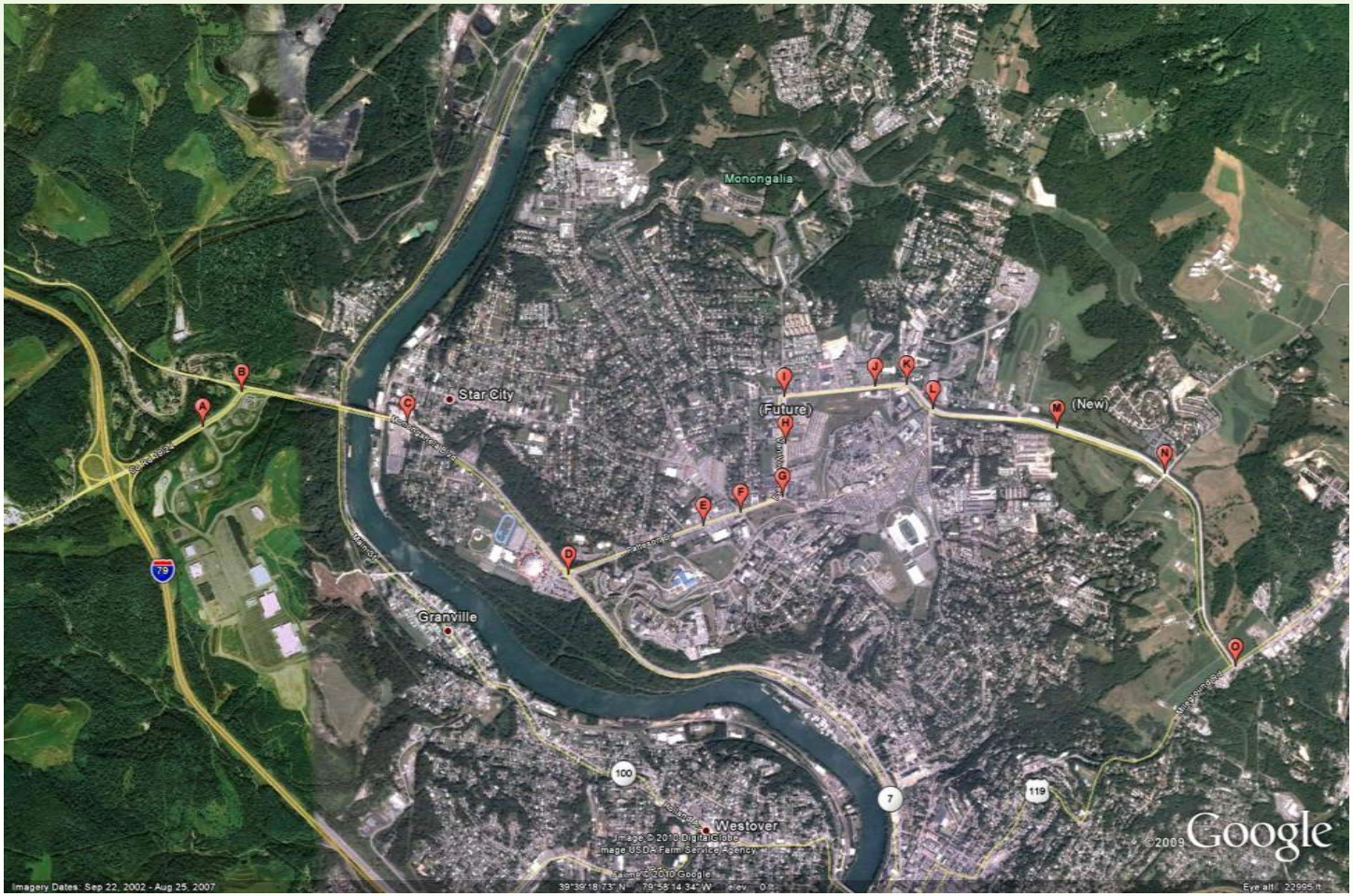


Morgantown, West Virginia
15 Intersections around
West Virginia University


Lexington, KY
9 Intersections
Nicholasville Rd./US 27
near
University of Kentucky

# Questions

# ACS LITE

## Configuring *ACS Lite* in *Centracs*


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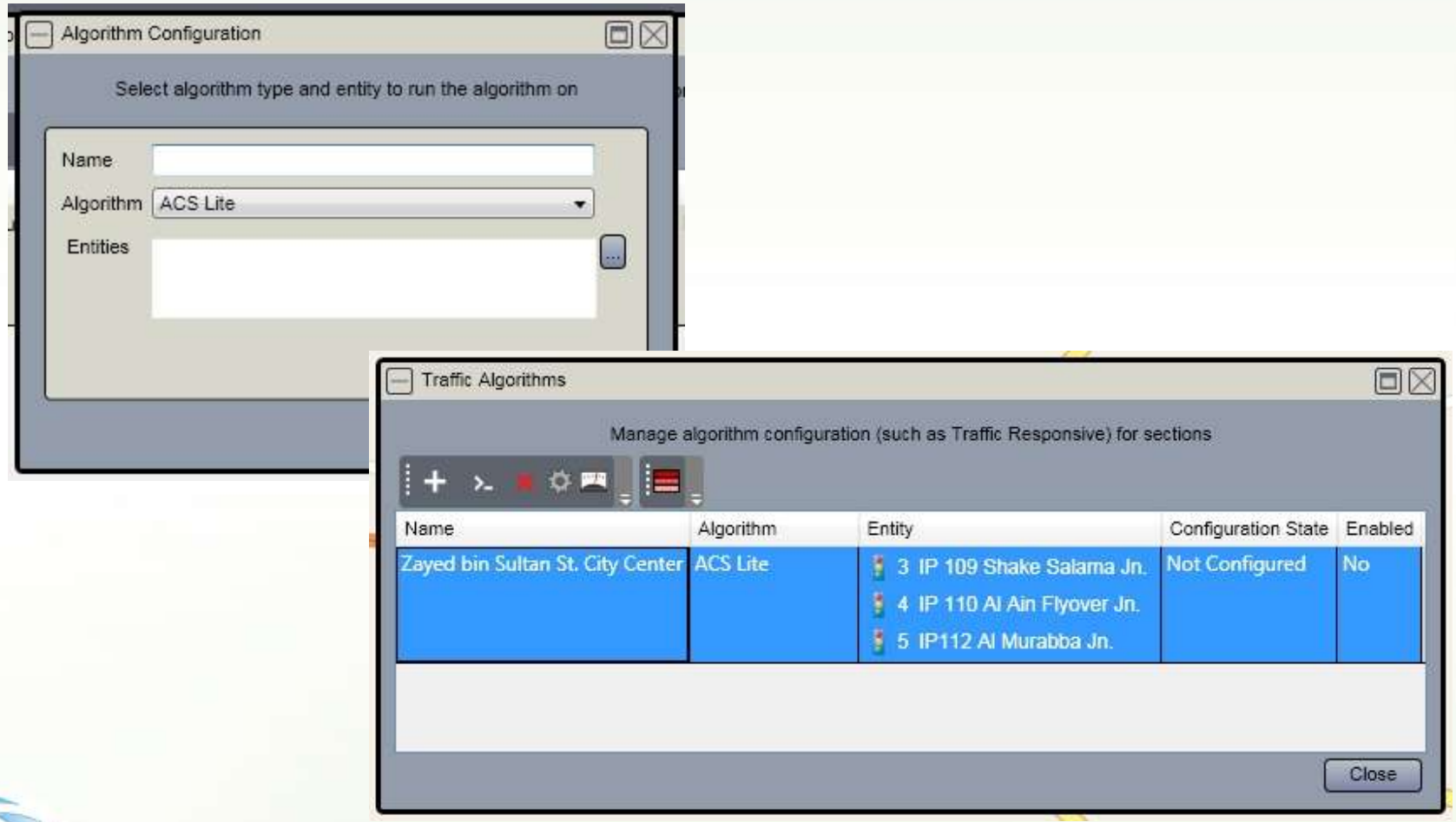
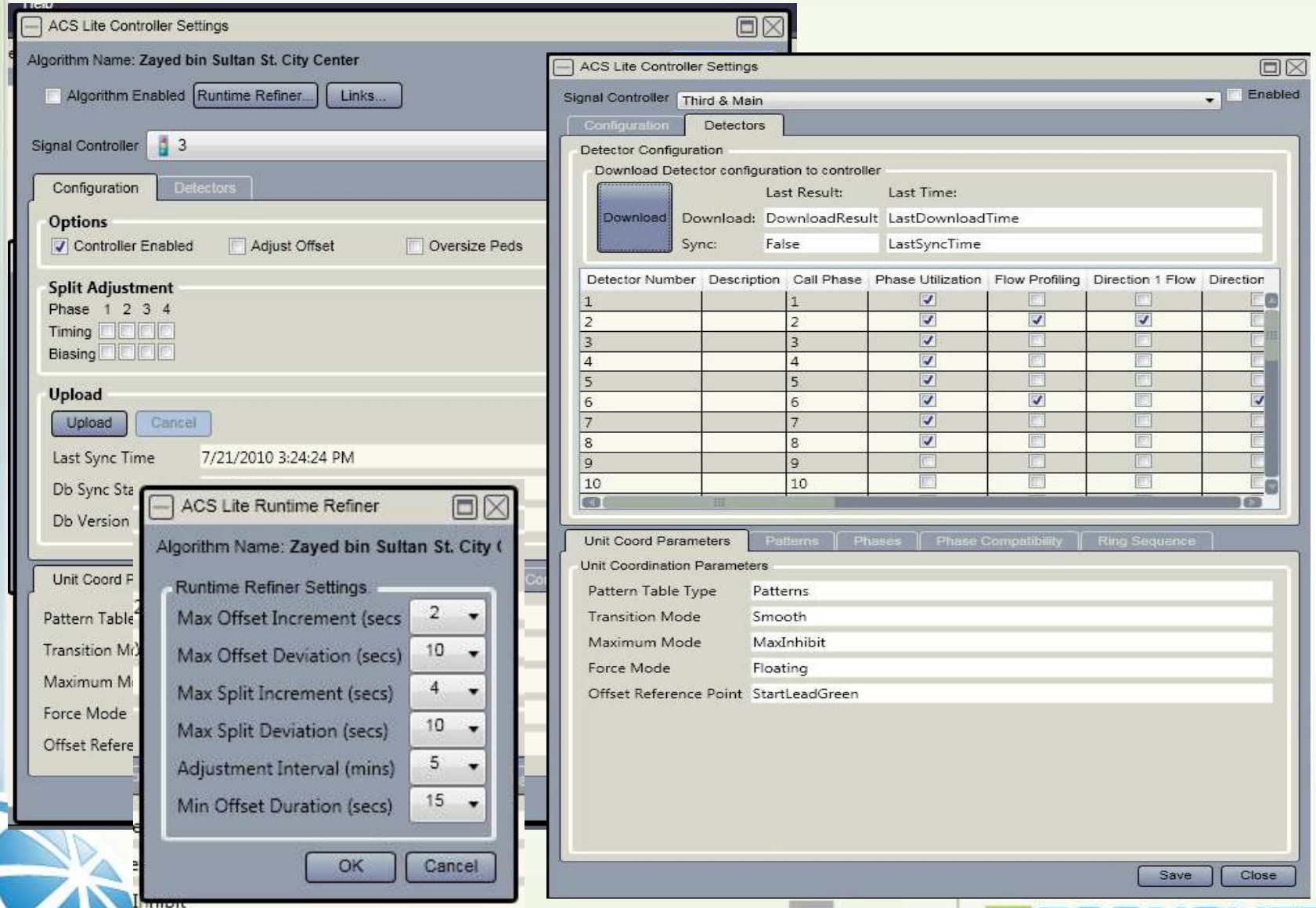
# Setup *ACS Lite* Zone



# *ACS Lite* Controller Settings

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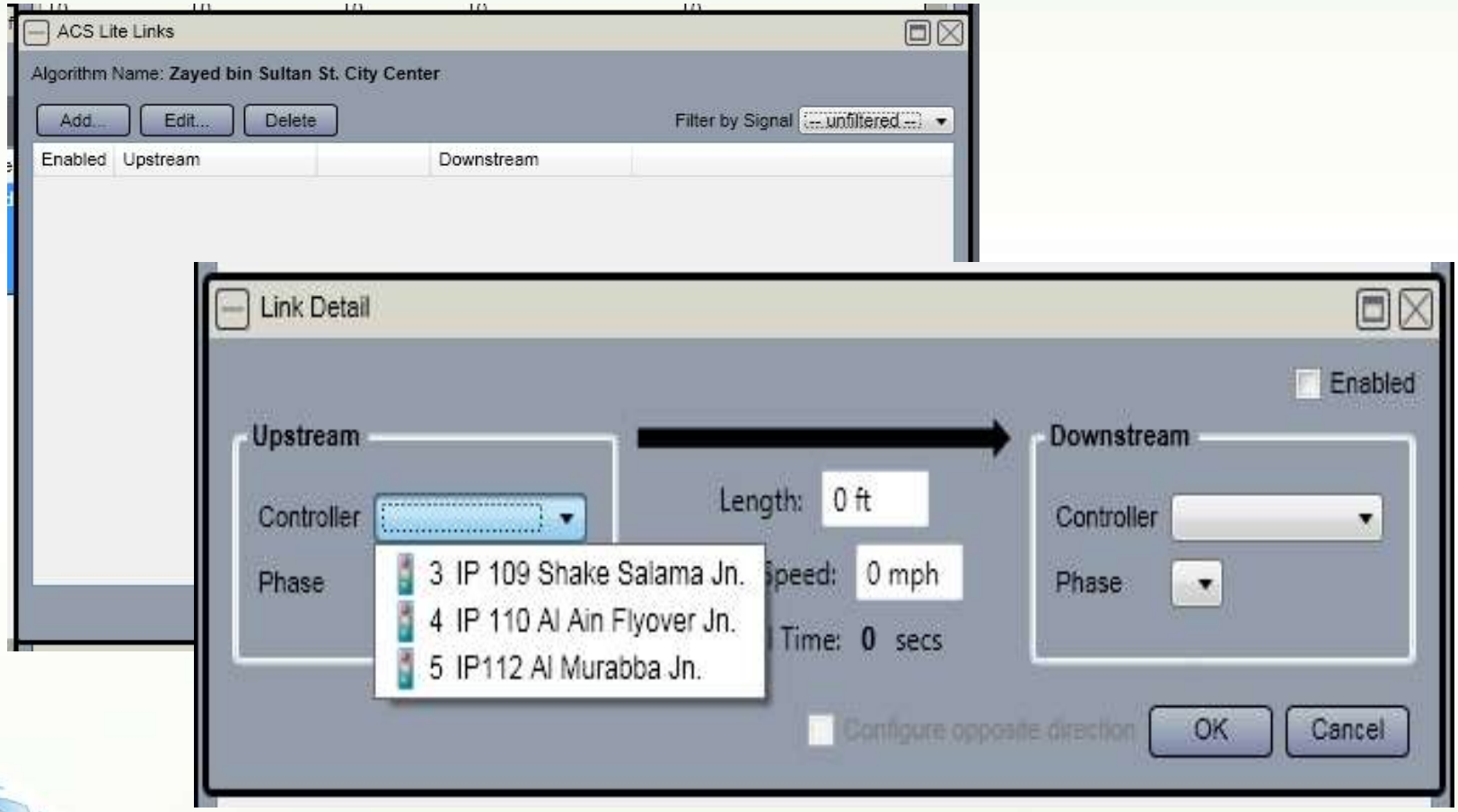
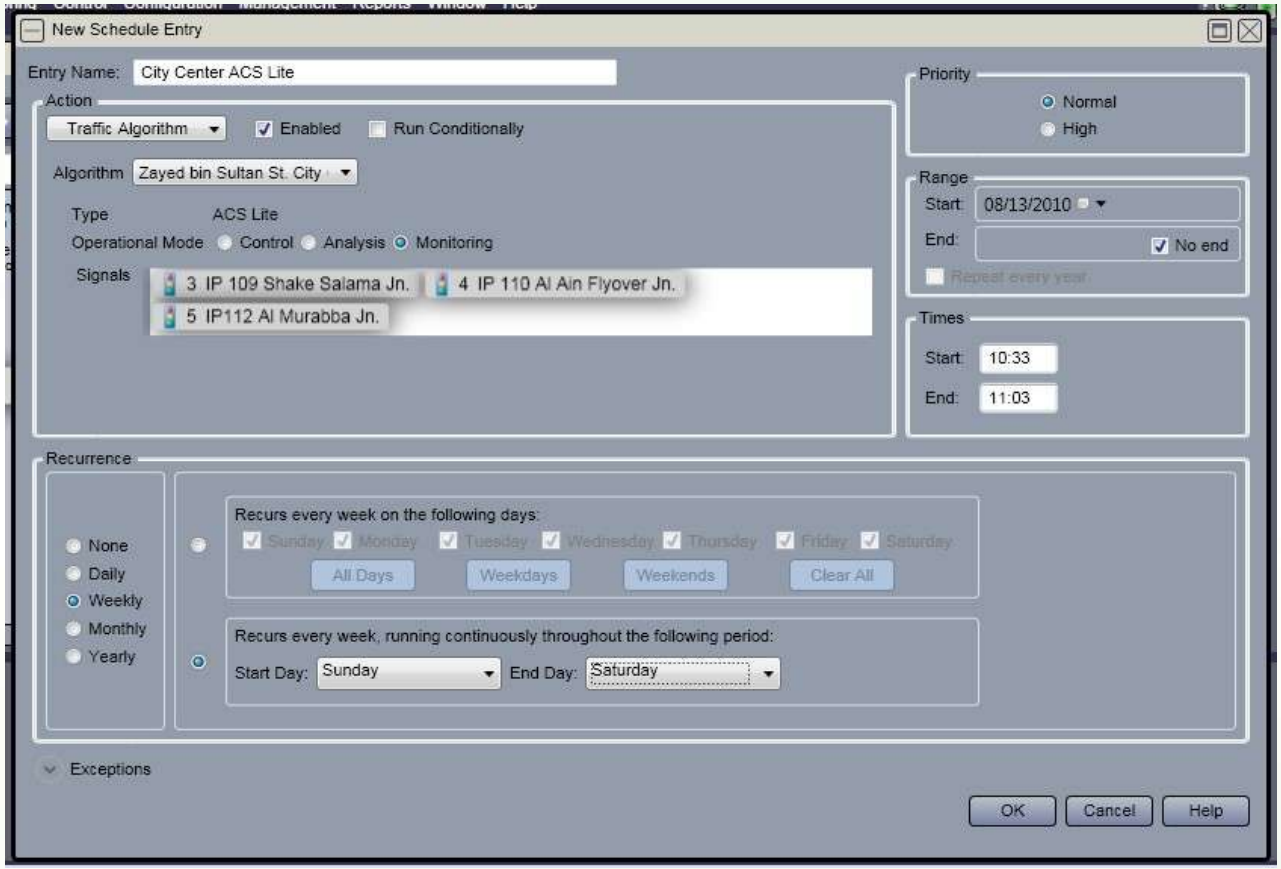
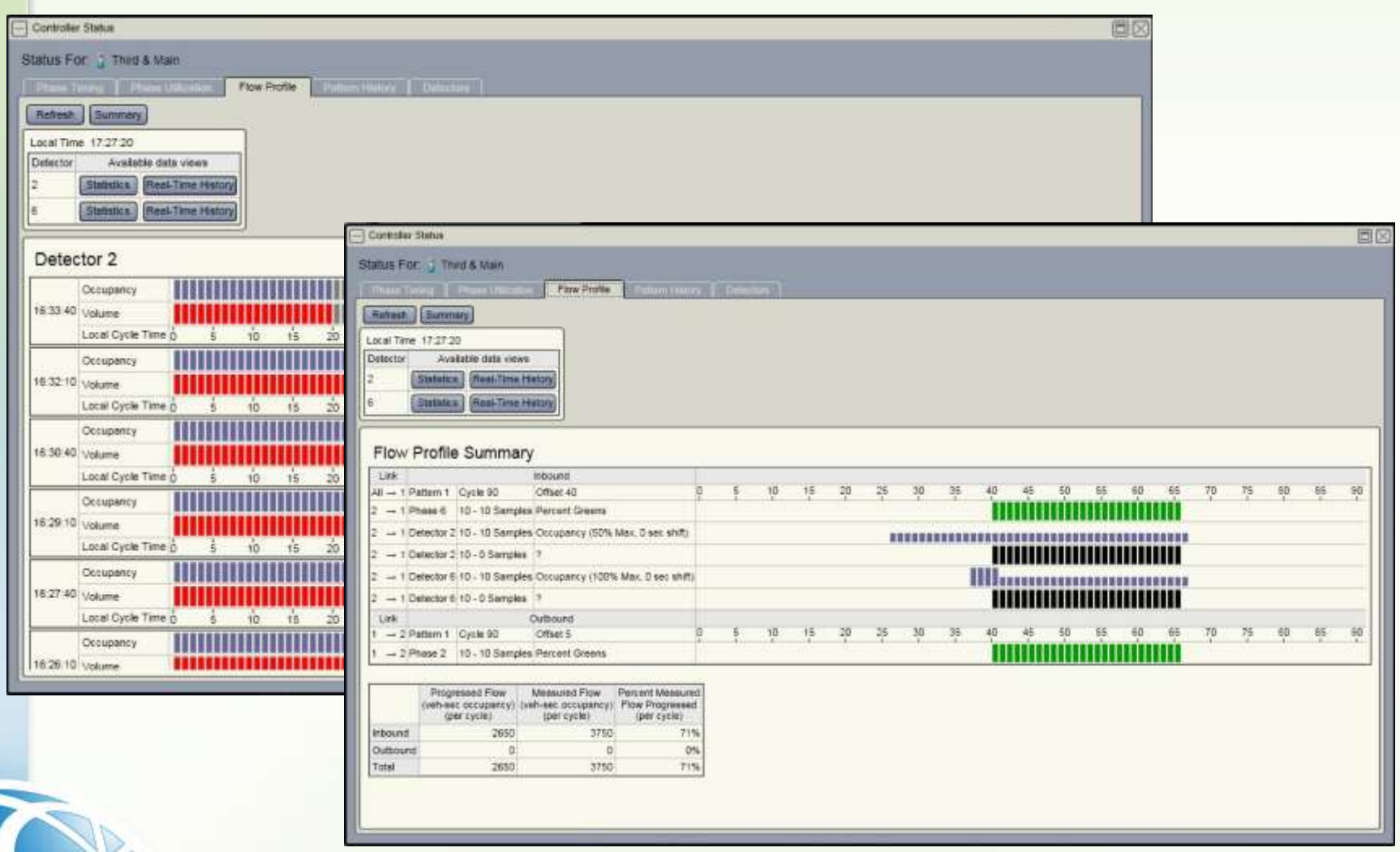
# *ACS Lite* Link Setup



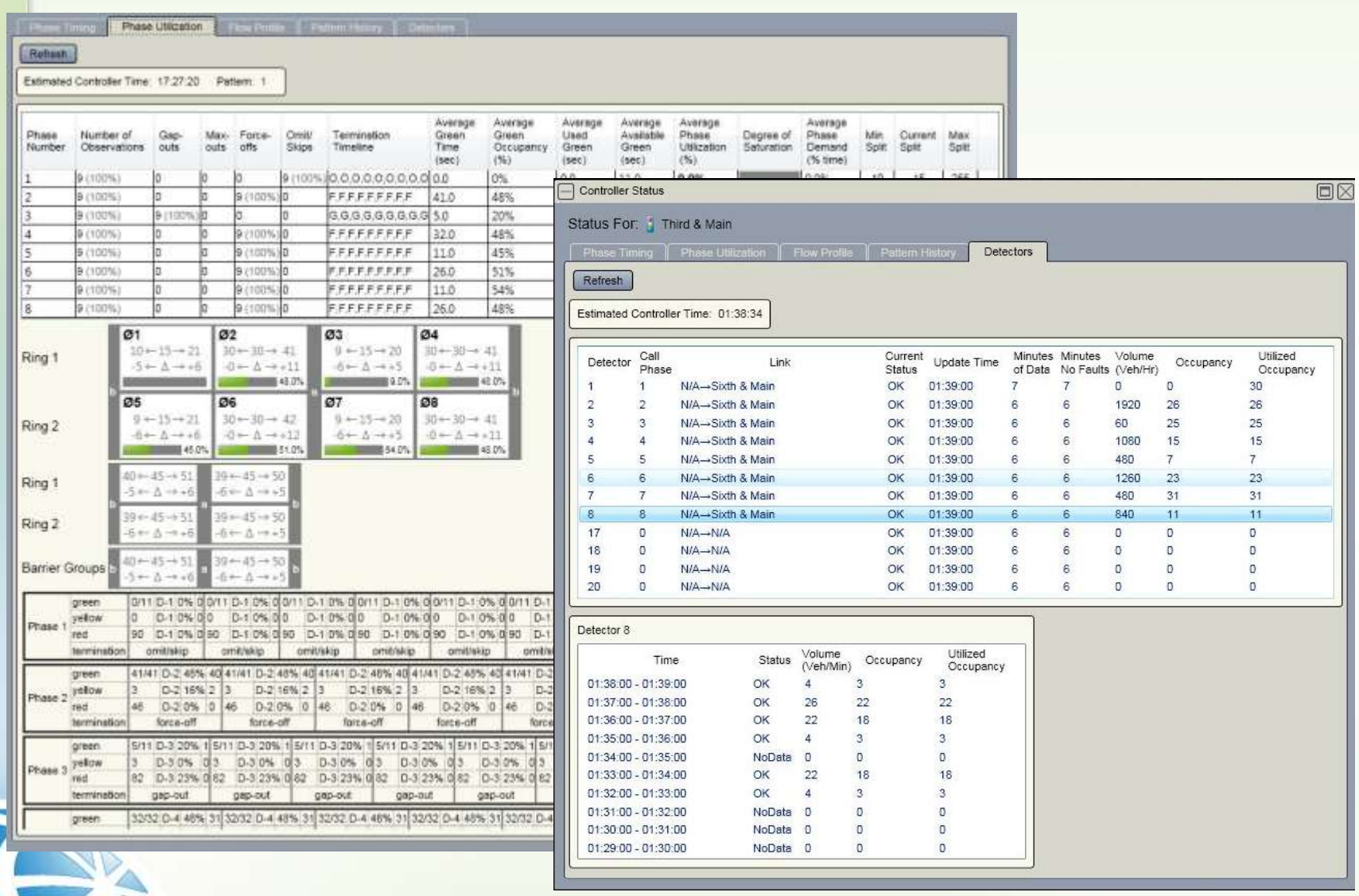
# Schedule *ACS Lite*



# Controller Status



# Controller Status



# *ACS Lite* Monitoring