

An Operational Test of Adaptive Signal Control

Campbell Road Corridor Richardson, Texas

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Operational Test Objectives

- Install Rhythm adaptive system on Campbell Road prior to a regional deployment on Greenville Avenue (Integrated Corridor Management Project)
- Measure the benefit on Campbell Road compared with time-of-day plans developed with Synchro
- Measure the effect of the system on the adjacent signal grid running time-base coordination

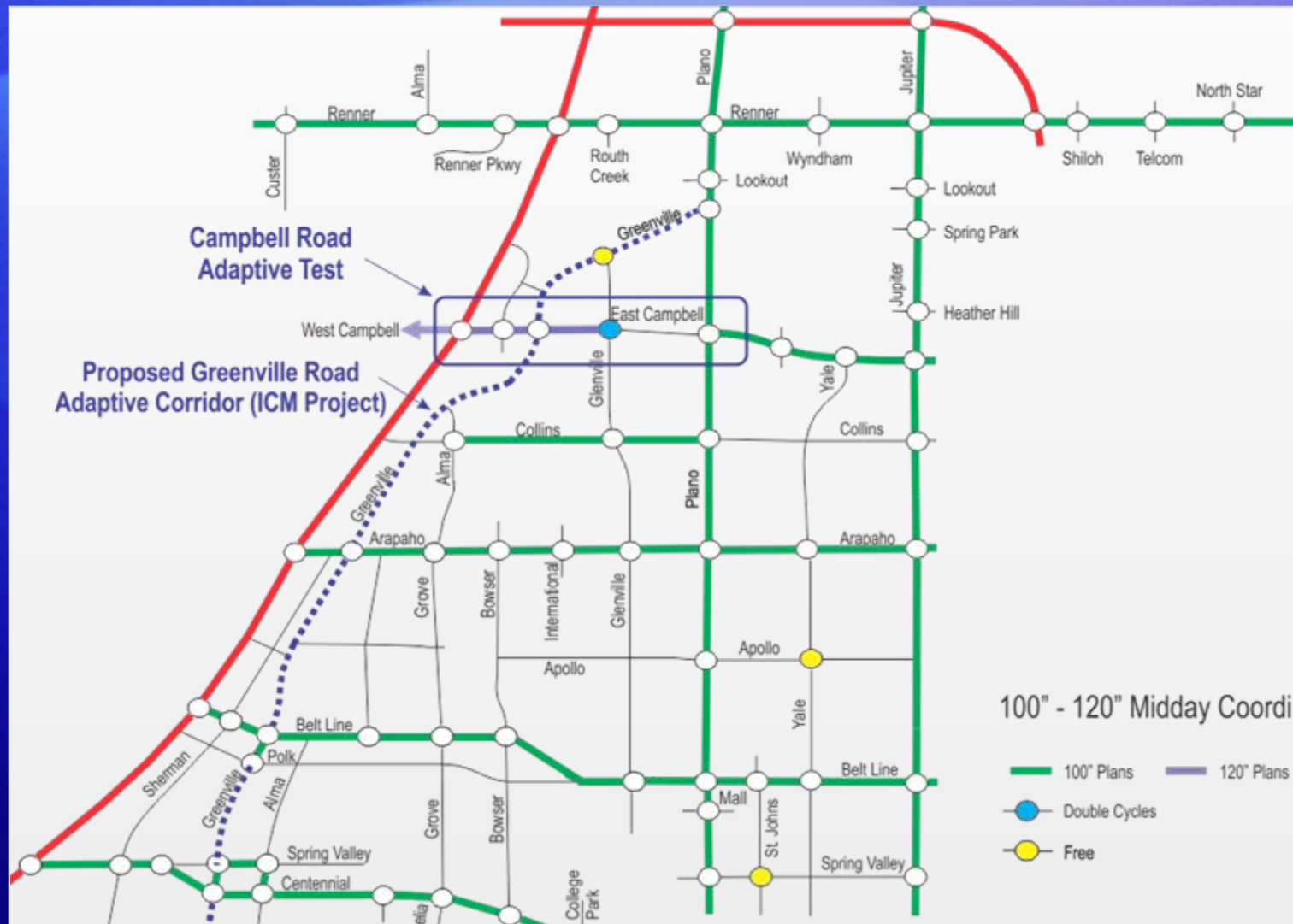
The following slides describe the existing signal system coordination prior to the operational test

Weekday AM Period



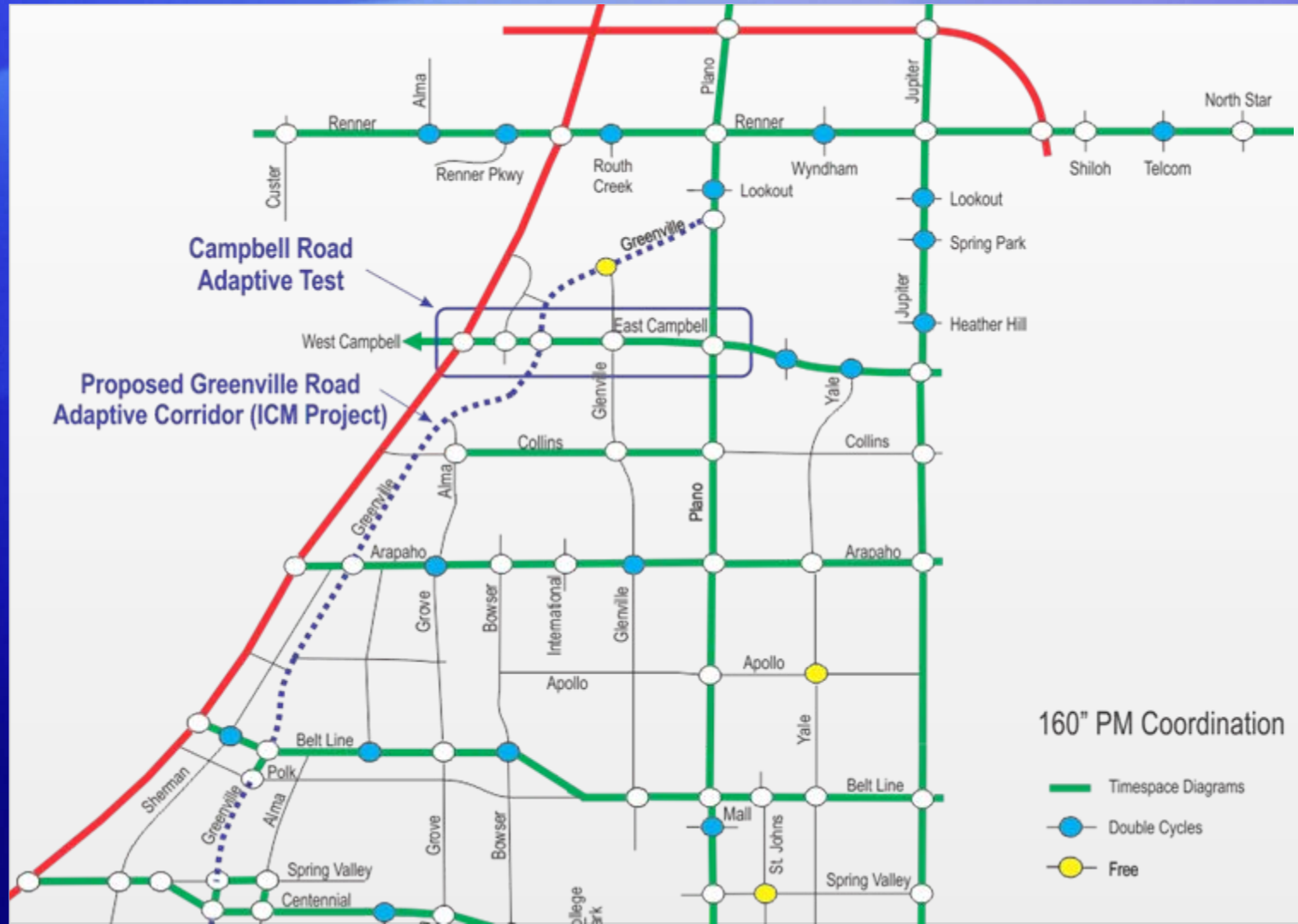
East Richardson Signal System Network

Weekday Noon Period



East Richardson Signal System Network

Weekday PM Period



East Richardson Signal System Network

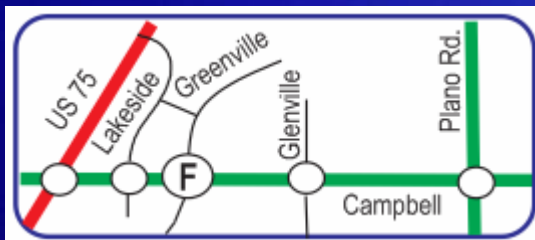
What is it?

- The Insync adaptive system from Rhythm Engineering integrates with all existing traffic signal systems – see: <http://www.rhythmtraffic.com/>
- Insync provides two modes of operation:
 - 1) VIVDS (video detection) - supports coordination and control already programmed in the local controller
 - 2) Adaptive Control - uses vehicle calls to call and extend phases based on current demand and while maintaining coordination under supervision of a facilitator (master)

Insync Hardware Overview

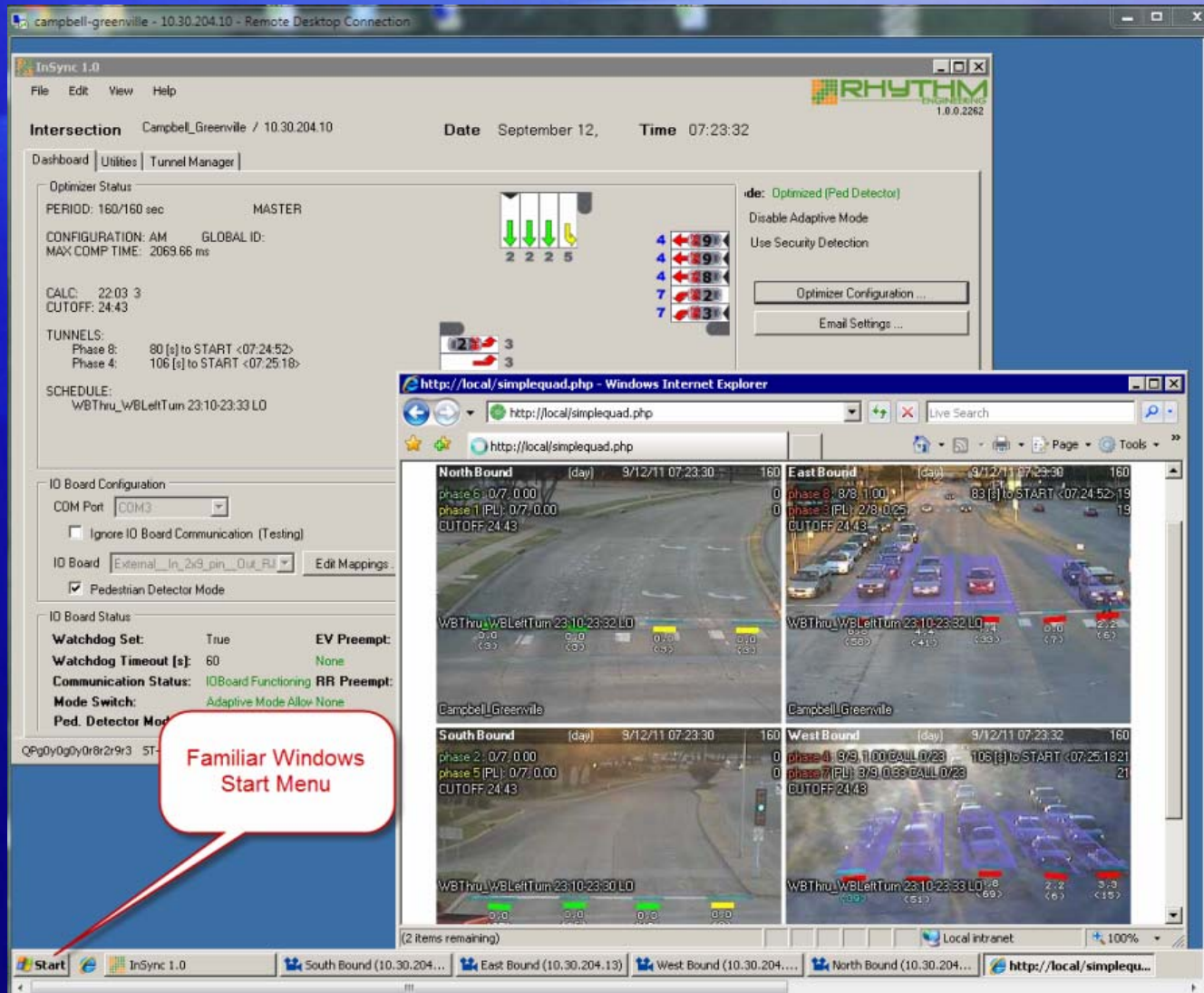


- The Rhythm “Travis Box” is a Windows XP computer that interfaces the detector rack as a VIVDS system
- Insync is a Windows app running on each “Travis Box”. One intersection is designated as the Facilitator (master)



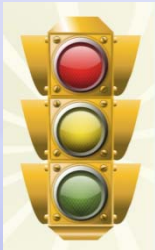
The Travis Box at Campbell/Greenville was designated as the Facilitator for adaptive control in the operational test

"Travis Box" Windows Remote Desktop



- Insync app provides local status and control at each signal
- Insync provides supervisor control at the signal designated as the facilitator master
- Embedded web server provides a web interface to program, monitor and query the VIVDS system at each intersection

Insync Time-of-Day Schedule



Insync selects Detector Mode or Adaptive Mode (Optimized) from a user specified time-of-day schedule programmed from Remote Desktop in each “Travis Box”

Edit Optimizer Configurations

Weekly Specific Date

Day-of-Week / Time-of-Day entries select the configuration

Days	Hour	Minute	Config Number
1234567	5	30	1 - Off Peak
23456	6	15	6 - AM 125
23456	7	15	3 - AM
23456	8	45	6 - AM 125
1 7	9	0	8 - Weekend 125
23456	11	0	2 - MID
23456	16	0	4 - PM

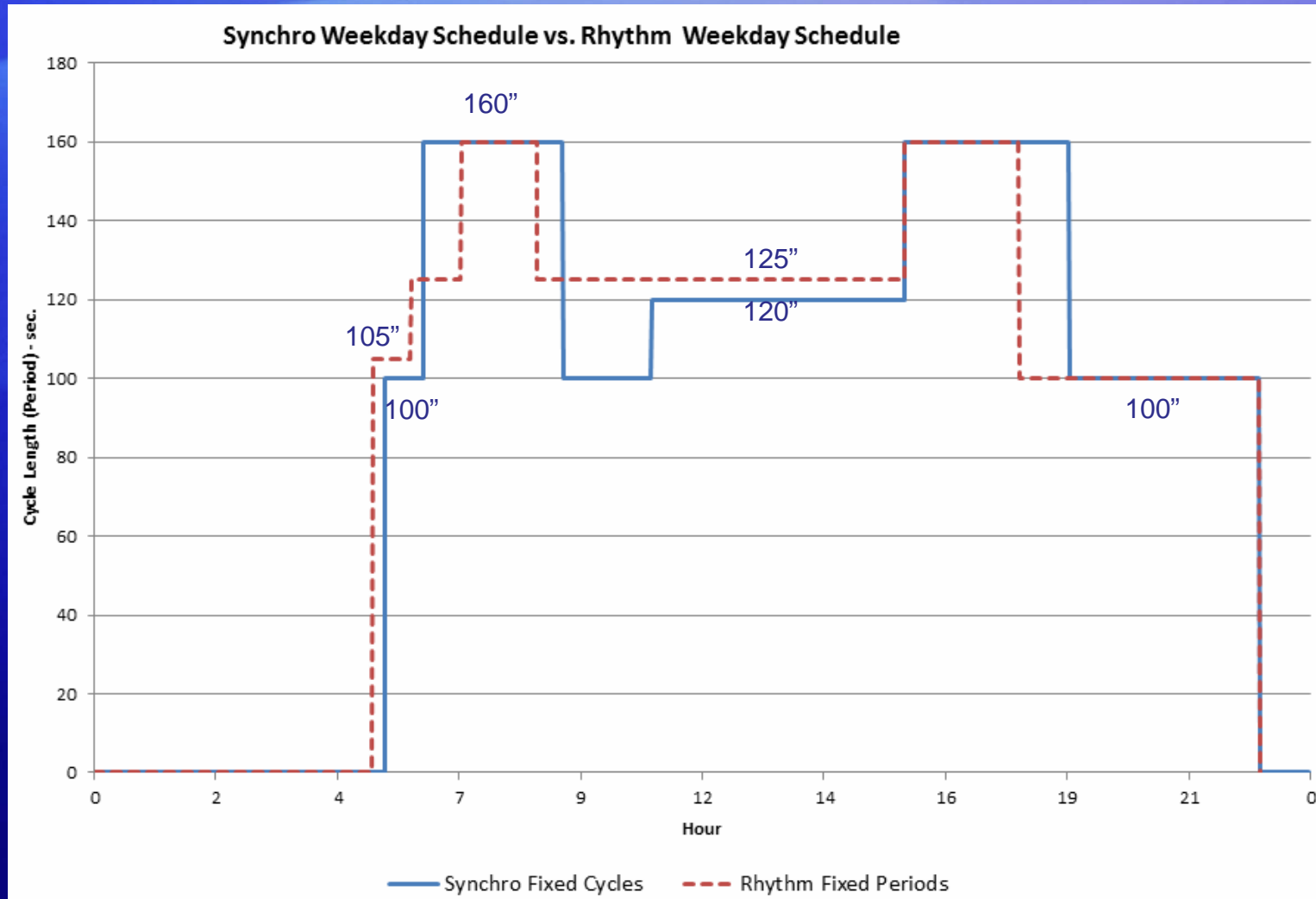
Add Delete

Configuration plans are programmed here

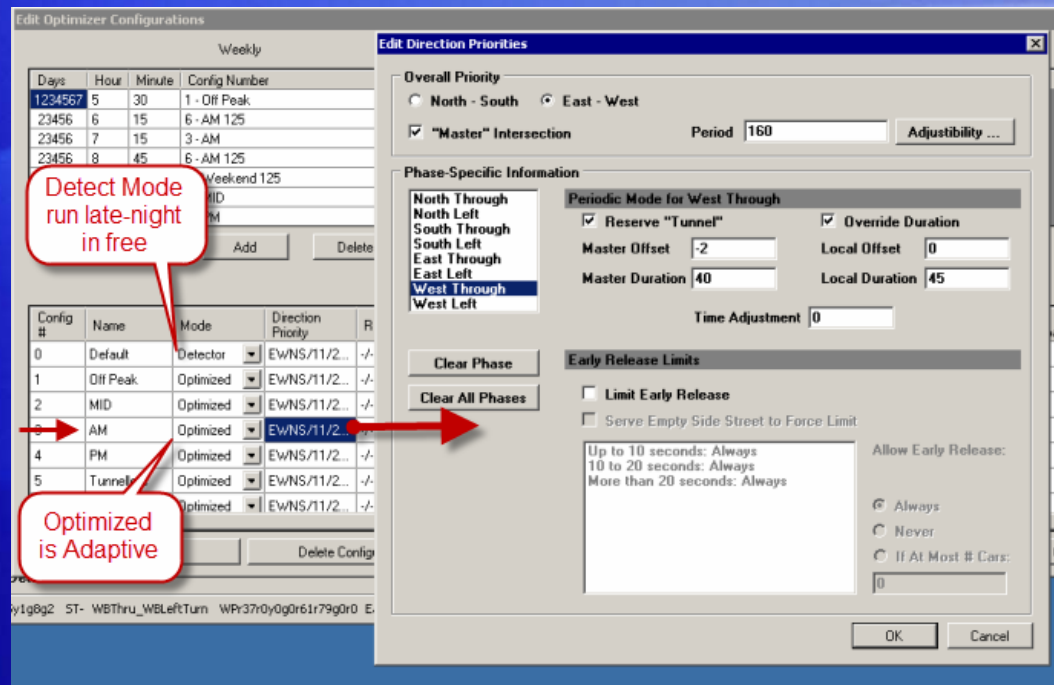
Config #	Name	Mode	Direction Priority	Permitted States	Permitted Sequences	Maximum Wait Time	Fixed Cycle	Light Limits	Maximum Detection	Gap / Occupancy
0	Default	Detector	EWNS/11/2...	11111111	1111111111111111...	120/120/12...	0/	5,999,3...	99=99/99=99/9...	
1	Off Peak	Optimized	EWNS/11/2...	11111111	11100000111000...	120/120/12...	0/	5,999,3...	99=99/99=99/9...	
2	MID	Optimized	EWNS/11/2...	11111111	11100000000000...	120/120/12...	0/	5,999,3...	99=99/99=99/9...	
3	AM	Optimized	EWNS/11/2...	11111111	11100000000000...	120/120/12...	0/	5,999,3...	99=99/99=99/9...	
4	PM	Optimized	EWNS/11/2...	11111111	11100000000000...	120/120/12...	0/	5,999,3...	99=99/6=8/99=...	
5	Tunnelless	Optimized	EWNS/11/2...	11111111	11111111111111...	65/65/65/6...	0/	8,999,3...	99=99/99=99/9...	
6	AM 125	Optimized	EWNS/11/2...	11111111	11100000000000...	120/120/12...	0/	5,999,3...	99=99/99=99/9...	

Add Configuration Delete Configuration Other Options ... OK Cancel

Existing vs. Rhythm TOD Schedules



Insync TOD Configuration Walk-Thru



The AM plan shown here is from the Facilitator at Campbell Road / Greenville

The TOD schedule selects Optimized (Adaptive) mode for all periods except late-night when the controller runs free in Detect Mode

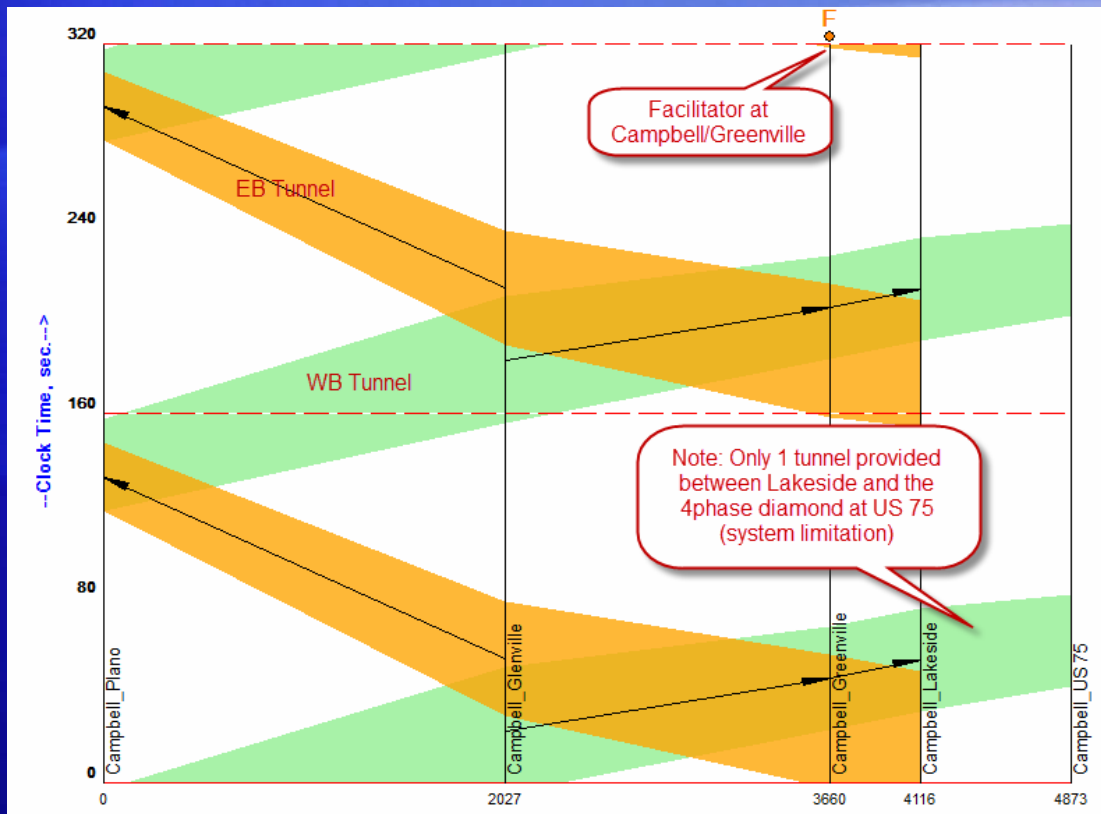
The user specifies a NS or EW direction priority for the corridor (Insync cannot optimize a grid network). One intersection is specified as the "Master" (Facilitator)

Each "Tunnel" (Green Band) is specified by the "Offset" to the start of the tunnel and the "Duration", or width of the tunnel

All plans developed by Rhythm Engineering for the operational test call for a "Fixed Period" (cycle length) with "Adjustability" turned off at the facilitator

NEXT: How Rhythm Determines Tunnel Offset and Duration:

Offline Tunnel Offset and Duration Design



CentralSync is Rhythm's offline program that models time-space relationships for the adaptive plan.

The user enters intersection distance, speed (or travel time) and a Fixed Period (or cycle length) for the corridor

The user manually adjusts the offset and duration of each tunnel in the model.

The user is responsible for leaving enough time outside of the tunnels to service the demand for the non-coordinated phases. Rhythm has recently implemented a "watchdog feature" to kick the intersection free if phases are skipped for 2+ periods.

Insync TOD Configuration Walk-Through (Cont.)

InSync 1.0
File Edit View Help

Intersection Campbell_Greenville / 10.30.204.10

Dashboard Utilities Tunnel Manager

Optimize
Edit Optimizer Configurations

PERIOD Weekly

CONFIG MAX CO

Days	Hour	Minute	Config Number
1234567	5	30	1 - Off Peak
23456	6	15	6 - AM 125
23456	7	15	3 - AM
23456	8	45	6 - AM 125
1 7 9	0	0	8 - Weekend 125
23456	11	0	2 - MID
23456	16	0	4 - PM

Add

Config #	Name	Mode	Dis Ph
0	Default	Detector	EW
1	Off Peak	Optimized	EWNS/11/2...
2	MID	Optimized	EWNS/11/2...
3	AM	Optimized	EWNS/11/2...
4	PM	Optimized	EWNS/11/2...
5	Tunnelless	Optimized	EWNS/11/2...
6	AM 125	Optimized	EWNS/11/2...

Add Configuration Delete Configuration Other Options ...

Ped. Detector Mode: none

QPr2r0r3r0r0r3r0 ST- NBThru_SBThru WPr0r87r0r9r0r81r0r0 NorthSouthLeadNorthOverlap 13

Edit Permitted States

State	Permitted	Start Even if Empty
North Bound Left Turn, South Bound Left Turn	<input checked="" type="checkbox"/>	<input type="checkbox"/>
North Bound Through, South Bound Through	<input checked="" type="checkbox"/>	<input type="checkbox"/>
South Bound Through, South Bound Left Turn	<input checked="" type="checkbox"/>	<input type="checkbox"/>
North Bound Through, North Bound Left Turn	<input checked="" type="checkbox"/>	<input type="checkbox"/>
East Bound Left Turn, West Bound Left Turn	<input checked="" type="checkbox"/>	<input type="checkbox"/>
East Bound Through, West Bound Through	<input checked="" type="checkbox"/>	<input type="checkbox"/>
West Bound Through, West Bound Left Turn	<input checked="" type="checkbox"/>	<input type="checkbox"/>
East Bound Through, East Bound Left Turn	<input checked="" type="checkbox"/>	<input type="checkbox"/>

OK Cancel

Edit Permitted Sequences

Sequence	Permitted
North South Lead	<input checked="" type="checkbox"/>
North South Lead North Overlap	<input checked="" type="checkbox"/>
North South Lead South Overlap	<input checked="" type="checkbox"/>
North South Lag	<input type="checkbox"/>
North South Lag North Overlap	<input type="checkbox"/>
North South Lag South Overlap	<input type="checkbox"/>
South Lead North Lag	<input type="checkbox"/>
North Lead South Lag	<input type="checkbox"/>
East West Lead	<input type="checkbox"/>
East West Lead East Overlap	<input type="checkbox"/>
East West Lead West Overlap	<input type="checkbox"/>
East West Lag	<input type="checkbox"/>
East West Lag East Overlap	<input type="checkbox"/>
East West Lag West Overlap	<input type="checkbox"/>
West Lead Lag East	<input type="checkbox"/>
East Lead Lag West	<input checked="" type="checkbox"/>

OK Cancel

Each TOD Plan specifies the phases that are permitted to run together and all allowable phase sequences

Insync TOD Configuration Walk-Thru (Cont.)

Edit Light Limits

Phase	Min Green	Max Green	Amber	Red	Change Time	RG Return / Operation
South Bound Left Turn	5	999	3	2	9	Flashing_Yellow_or_Dall
North Bound Through	5	999	4	3	9	
East Bound Left Turn	5	999	3	2	9	
West Bound Through	10	999	4	2	9	
North Bound Left Turn	5	999	3	2	9	
South Bound Through	5	999	4	3	9	
West Bound Left Turn	5	999	3	2	9	
East Bound Through	10	999	4	3	9	

Minimum Time For Scheduling Miscellaneous State: ☐ Use Maximum

☐ Pedestrian Detector Mode

Maximum Detectable Queue Sizes

	Maximum Detection	Corrected Queue
South Left	99	99
North Thru	99	99
East Left	99	99
West Thru	99	99
North Left	99	99
South Thru	99	99
West Left	99	99
East Thru	99	99

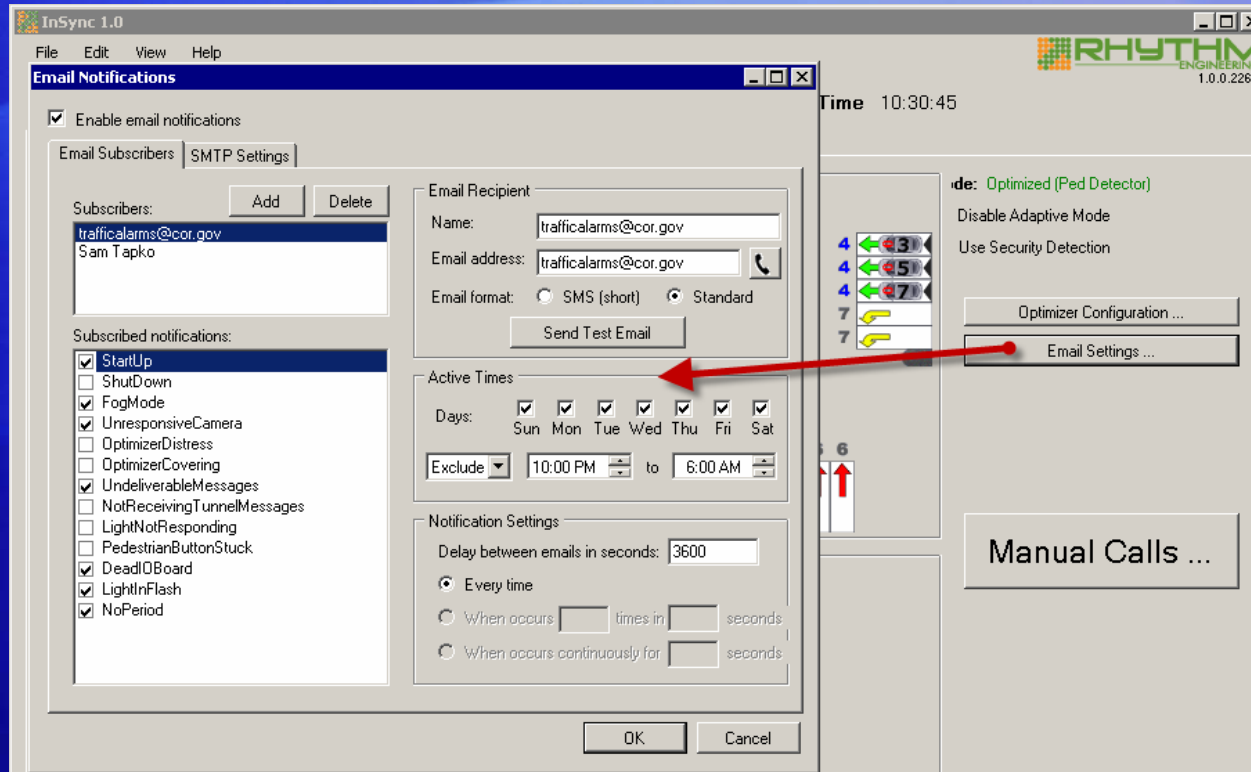
OK Cancel

Min/Max times and MaxDetect/Corrected Queue values are set for each movement

Values > 99 simply directs the adaptive algorithm to determine those values

The only Max Detect / Queue values varied for the corridor were at Campbell/US 75

System Status Configuration



E-mail settings specified at each “Travis Box” are used to report all system status

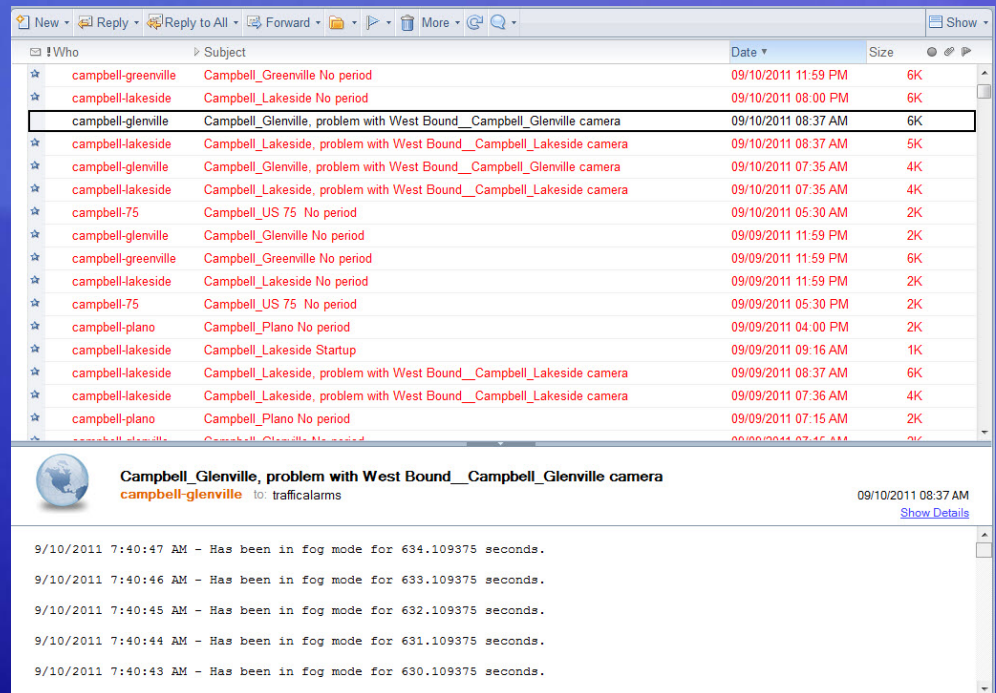
Status may be turned off by TOD to mask bogus messages – i.e., “NoPeriod” during free

Rhythm Engineering is currently working to enhance CentralSync to allow the Optimizer Configuration and E-mail setting to be accessed from central

At present you need to access and program Insync for each “Travis Box” using Windows Remote Desktop

Central System Monitoring and Control

- All alarms arrive via email direct from each TraVis Box
- No MoE alarms
- No aggregate alarms or commands to multiple intersections
- System needs manuals and documentation for advanced users

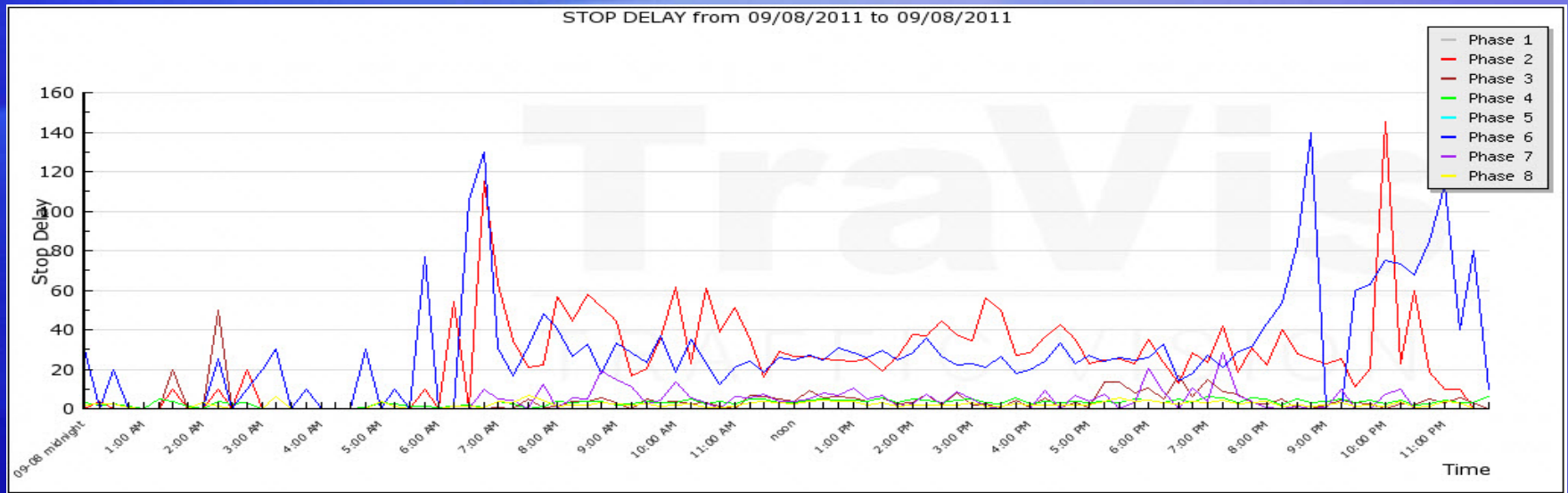


The screenshot shows an email client interface. The top part displays a list of emails with columns for 'Who', 'Subject', 'Date', and 'Size'. The bottom part shows the details of a selected email from 'campbell-glenville'.

Who	Subject	Date	Size
campbell-greenville	Campbell_Greenville No period	09/10/2011 11:59 PM	6K
campbell-lakeside	Campbell_Lakeside No period	09/10/2011 08:00 PM	6K
campbell-glenville	Campbell_Glenville, problem with West Bound__Campbell_Glenville camera	09/10/2011 08:37 AM	6K
campbell-lakeside	Campbell_Lakeside, problem with West Bound__Campbell_Lakeside camera	09/10/2011 08:37 AM	5K
campbell-glenville	Campbell_Glenville, problem with West Bound__Campbell_Glenville camera	09/10/2011 07:35 AM	4K
campbell-lakeside	Campbell_Lakeside, problem with West Bound__Campbell_Lakeside camera	09/10/2011 07:35 AM	4K
campbell-75	Campbell_US 75 No period	09/10/2011 05:30 AM	2K
campbell-glenville	Campbell_Glenville No period	09/09/2011 11:59 PM	2K
campbell-greenville	Campbell_Greenville No period	09/09/2011 11:59 PM	6K
campbell-lakeside	Campbell_Lakeside No period	09/09/2011 11:59 PM	2K
campbell-75	Campbell_US 75 No period	09/09/2011 05:30 PM	2K
campbell-plano	Campbell_Plano No period	09/09/2011 04:00 PM	2K
campbell-lakeside	Campbell_Lakeside Startup	09/09/2011 09:16 AM	1K
campbell-lakeside	Campbell_Lakeside, problem with West Bound__Campbell_Lakeside camera	09/09/2011 08:37 AM	6K
campbell-lakeside	Campbell_Lakeside, problem with West Bound__Campbell_Lakeside camera	09/09/2011 07:36 AM	4K
campbell-plano	Campbell_Plano No period	09/09/2011 07:15 AM	2K

Campbell_Glenville, problem with West Bound__Campbell_Glenville camera	
campbell-glenville	to: trafficalarms
09/10/2011 08:37 AM	
Show Details	
9/10/2011 7:40:47 AM	- Has been in fog mode for 634.109375 seconds.
9/10/2011 7:40:46 AM	- Has been in fog mode for 633.109375 seconds.
9/10/2011 7:40:45 AM	- Has been in fog mode for 632.109375 seconds.
9/10/2011 7:40:44 AM	- Has been in fog mode for 631.109375 seconds.
9/10/2011 7:40:43 AM	- Has been in fog mode for 630.109375 seconds.

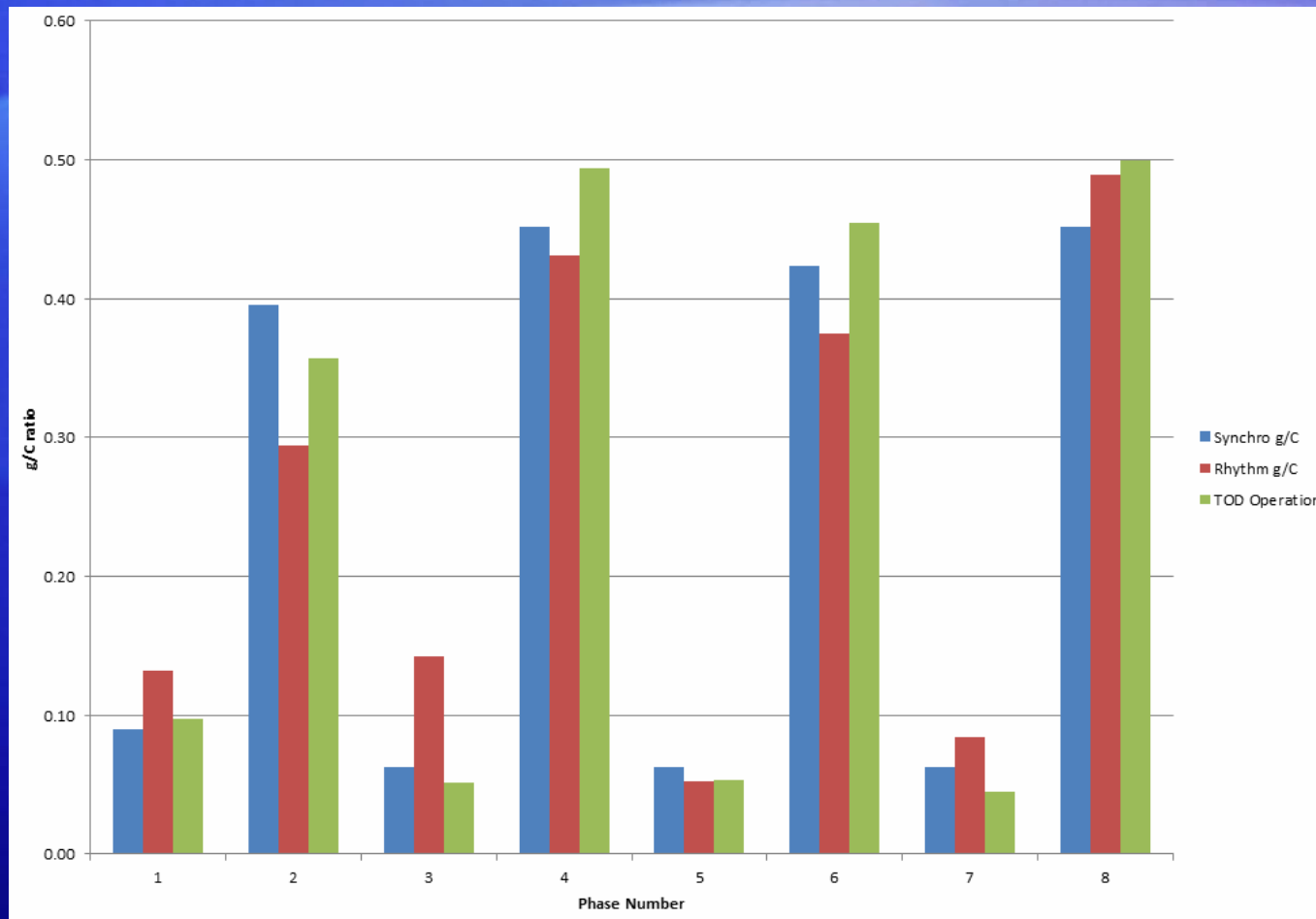
Measures of Effectiveness



- Real-time MoE (volume, delay and LOS), for a single measurement period, may be viewed on each approach camera.
- No alarms for “bad” MoE conditions.
- Cumulative, historical MoE may be retrieved and viewed as a graph or table, or exported.



Split Utilization – Adaptive vs. Time-of-Day



Phase utilization at Campbell/Plano for 2 Thursday morning periods 7:15-8:30AM.
9/1/11 (160" Period / Insync adaptive); 9/8/11 (160" Cycle / Synchro TOD plan)
Phase times captured from Insync history logs (CSV data) imported to Excel

Results of Floating Car Runs

Floating Car Comparison Before and After Rhythm Adaptive Implementation

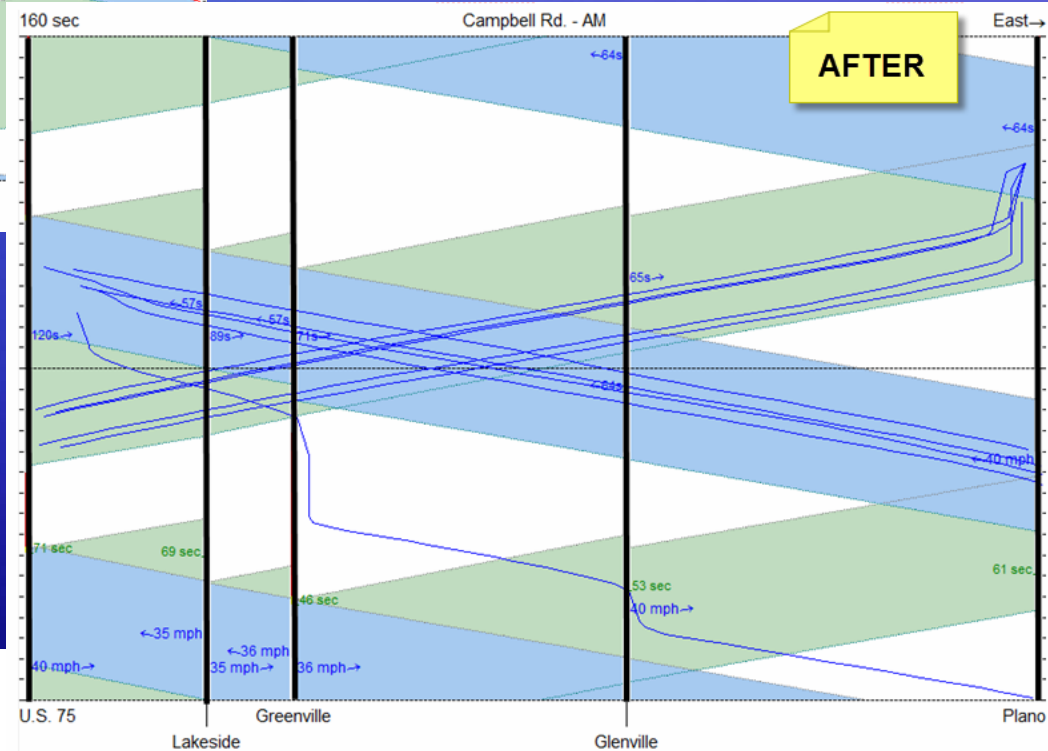
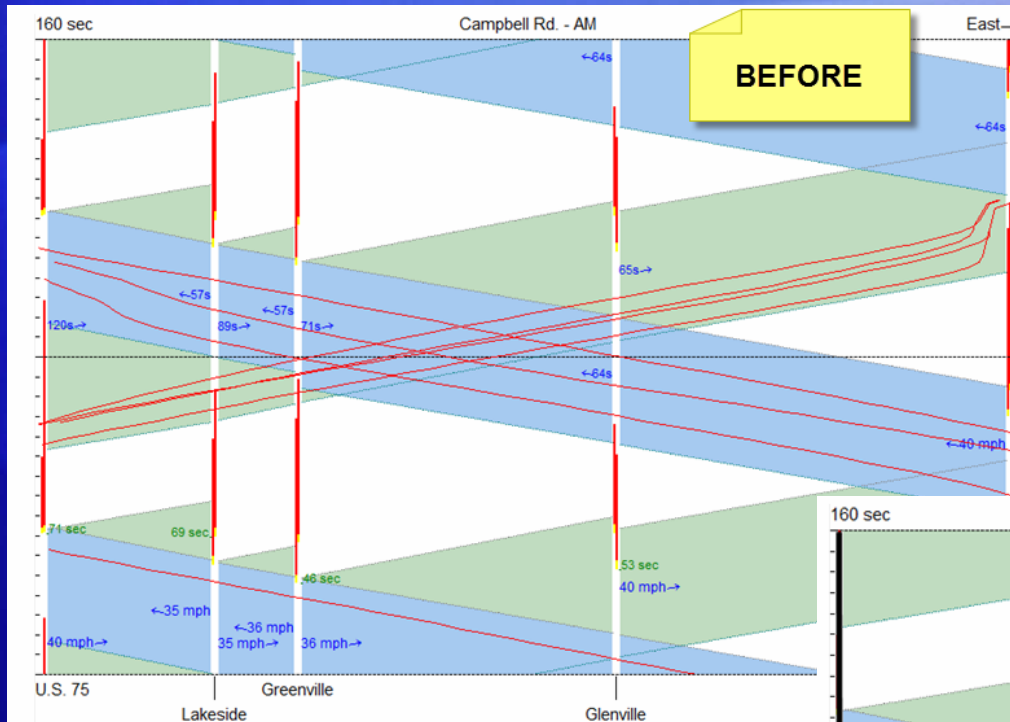
Period	Arterial	Direction	Before		After		% Change	
			Stops	Delay	Stops	Delay	Stops	Delay
AM	Campbell	EB	1	31	1	28	0%	-10%
		WB	0	3	0	3	0%	0%
PM	Campbell	EB	0	2	0	1	0%	0%
		WB	1	61	1	68	0%	11%

Stop = Cstops (Tru-Traffic), cumulative number of stops in run where speed drops below 15 MPH

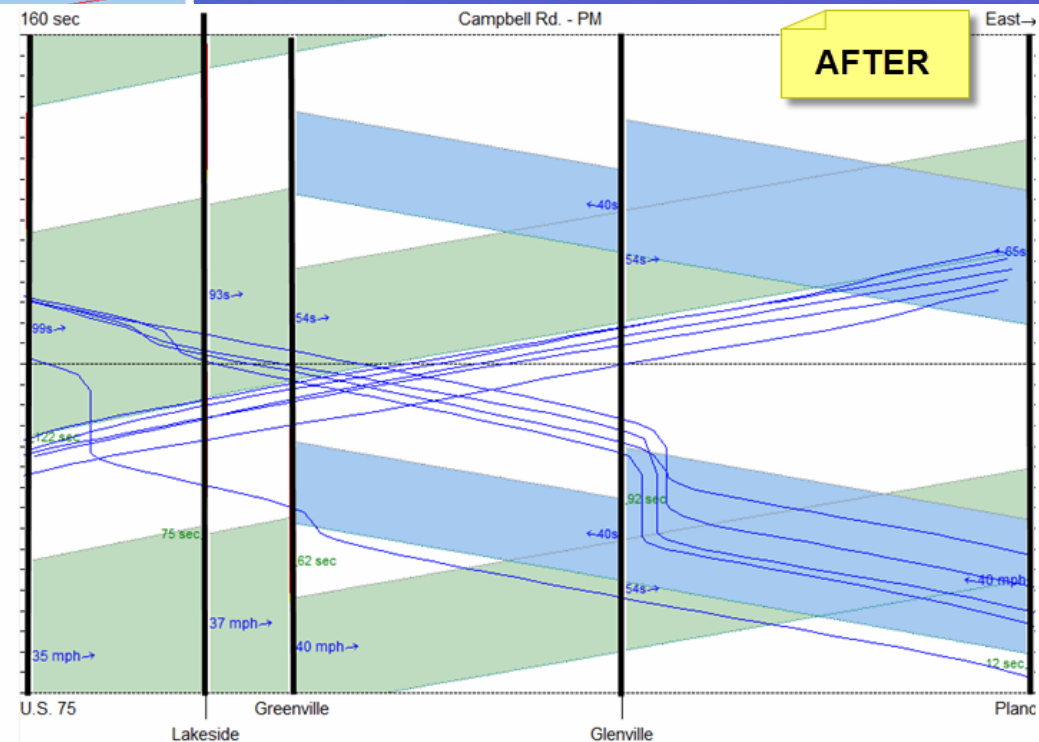
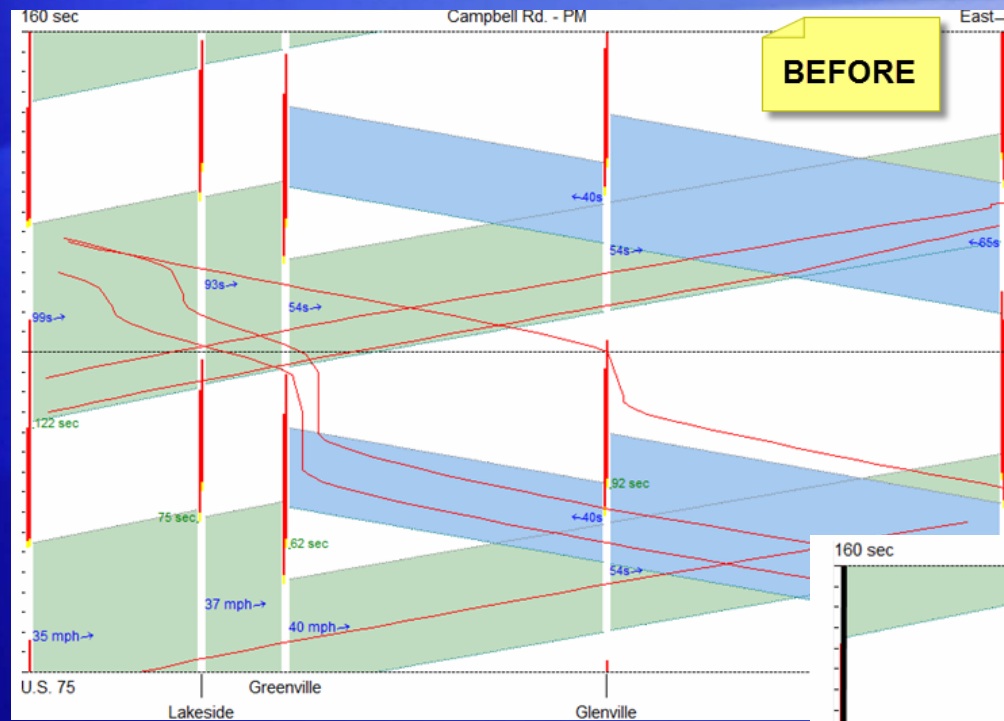
Delay = SC (Tru-Traffic), cumulative delay since the beginning of the run (seconds)

1. Stops and delay in the Campbell corridor essentially the same before and after Insync was implemented
2. Side street and left turn delay was not evaluated, however may have been significant.
3. Negative progression impact on Plano Road due to the inability of the system to operate in a grid
4. More work needed to resolve accuracy of Motion-X iPhone app used to gather GPS tracks for Tru-Traffic

Comparison of Floating Car Data – AM Period



Comparison of Floating Car Data – PM Period

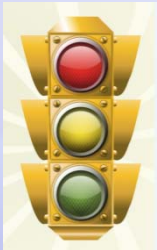


Final Deployment – Rhythm Adaptive System



East Richardson Signal System Network

Conclusions From the Operational Test



Insync adaptive system comparable to the well-tuned Synchro plans for Campbell Road in the before case

Campbell/Plano Road switched to detect mode to coordinate with the rest of the time base grid

Master offsets at the facilitator have been adjusted to coordinate with the rest of the time base grid

Rhythm plans to enhance Insync to provide 2 tunnels through the four phase diamond and also improve split adjustments with “Adjustability” turned on. This is needed for true cycle selection since the diamond will always be the critical intersection in this corridor.

Questions ?