An Operational Test of Adaptive Signal Control

Campbell Road Corridor Richardson, Texas

September 2011

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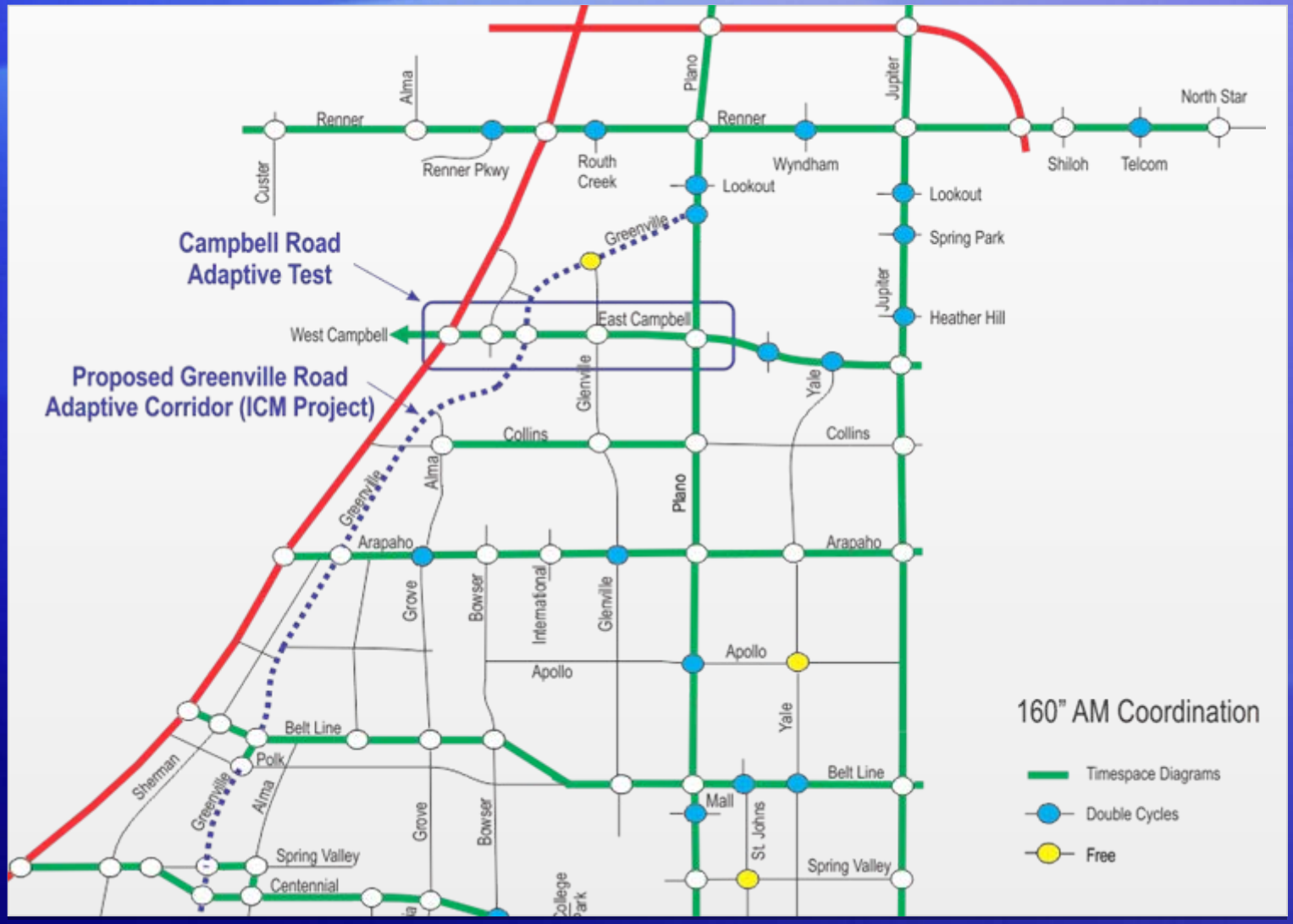
Operational Test Objectives

- 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

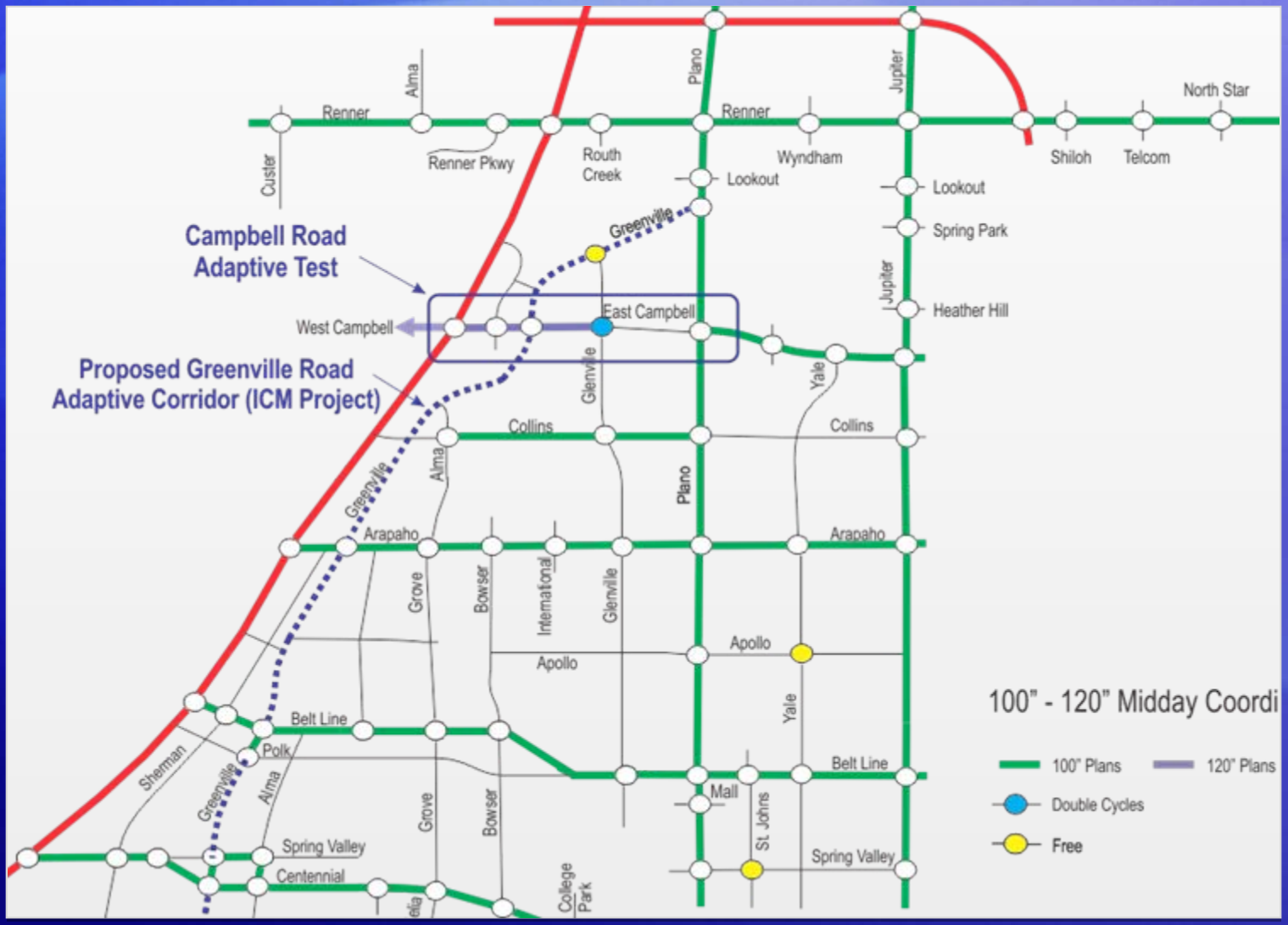
The following slides describe the existing signal system coordination prior to the operational test

Weekday AM Period



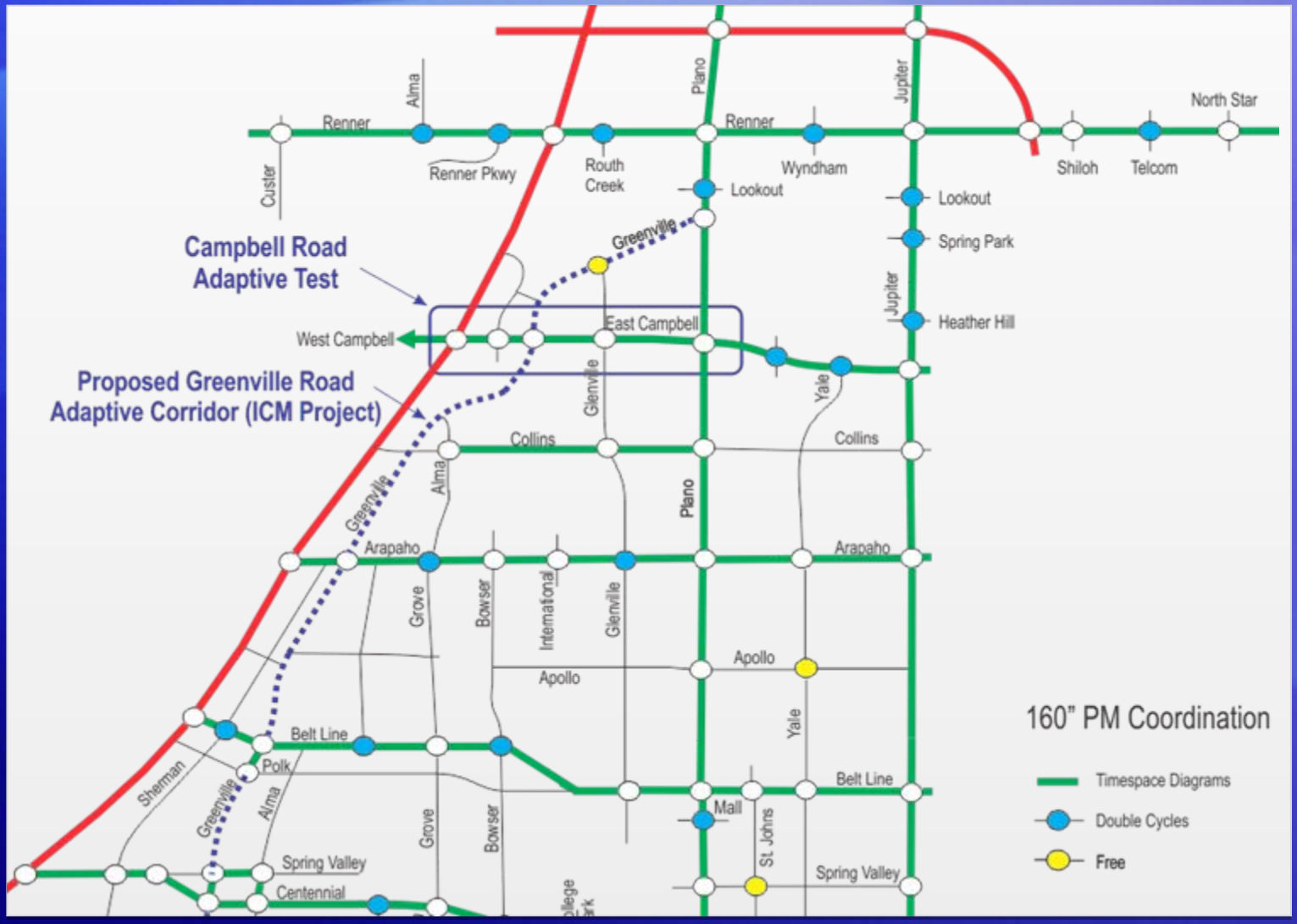
East Richardson Signal System Network

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/

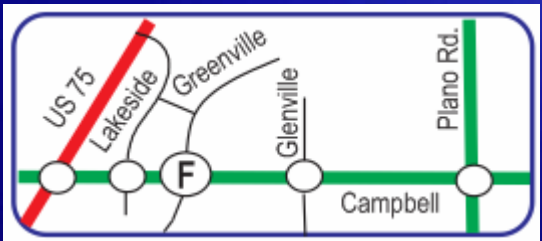
- Insync provides two modes of operation:

  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)

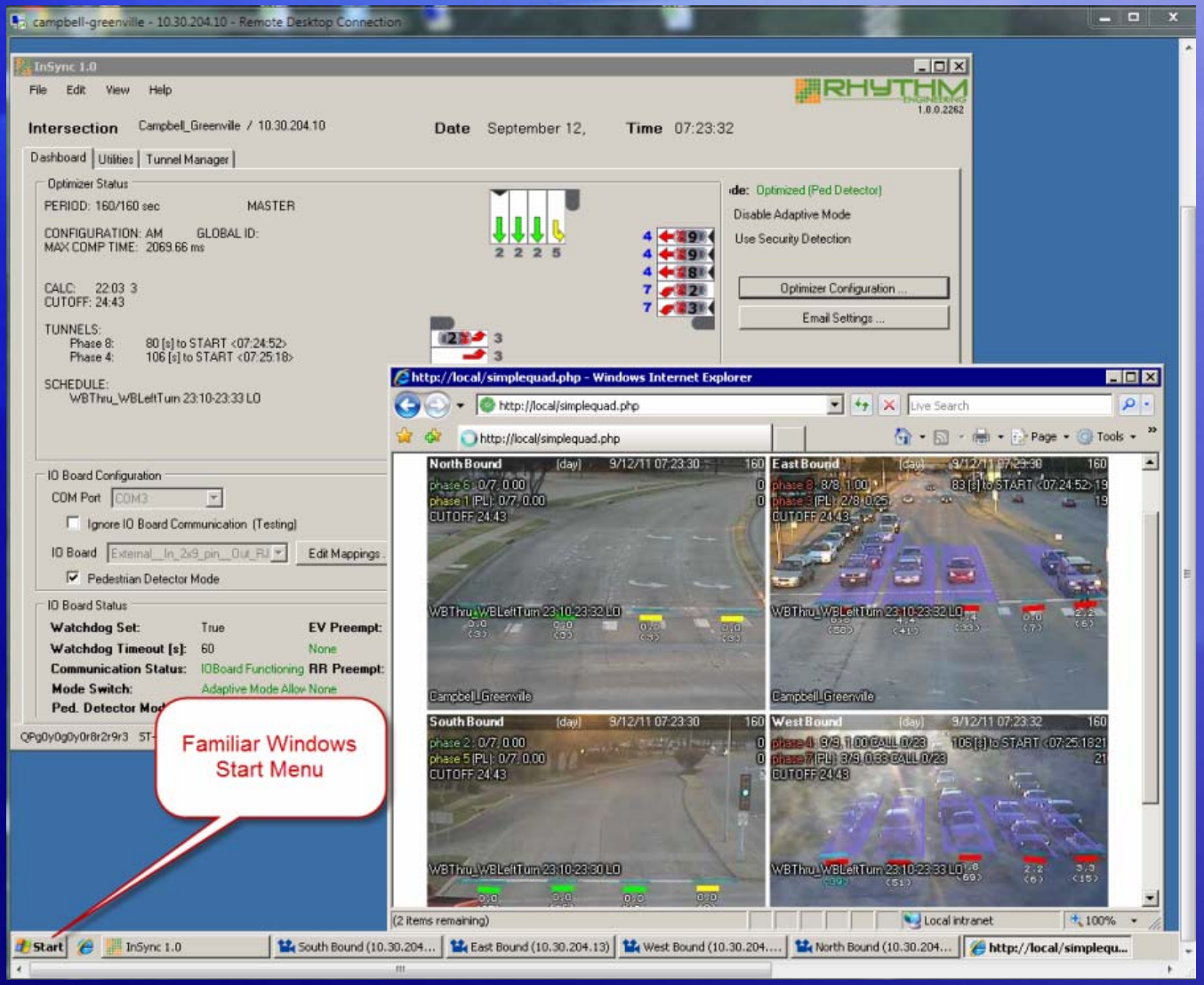
Insync Hardware Overview

- 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

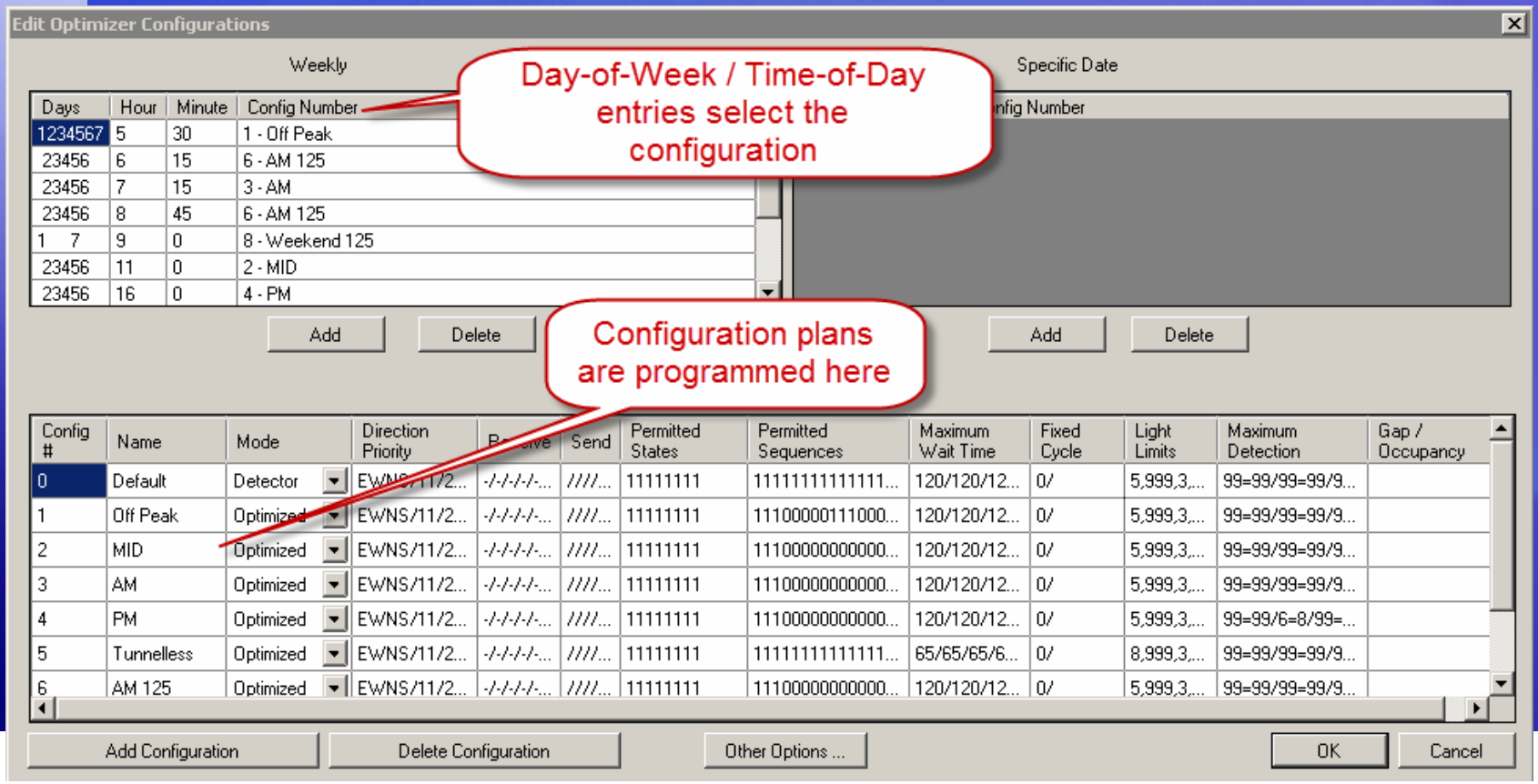
“Travis Box” Windows Remote Desktop



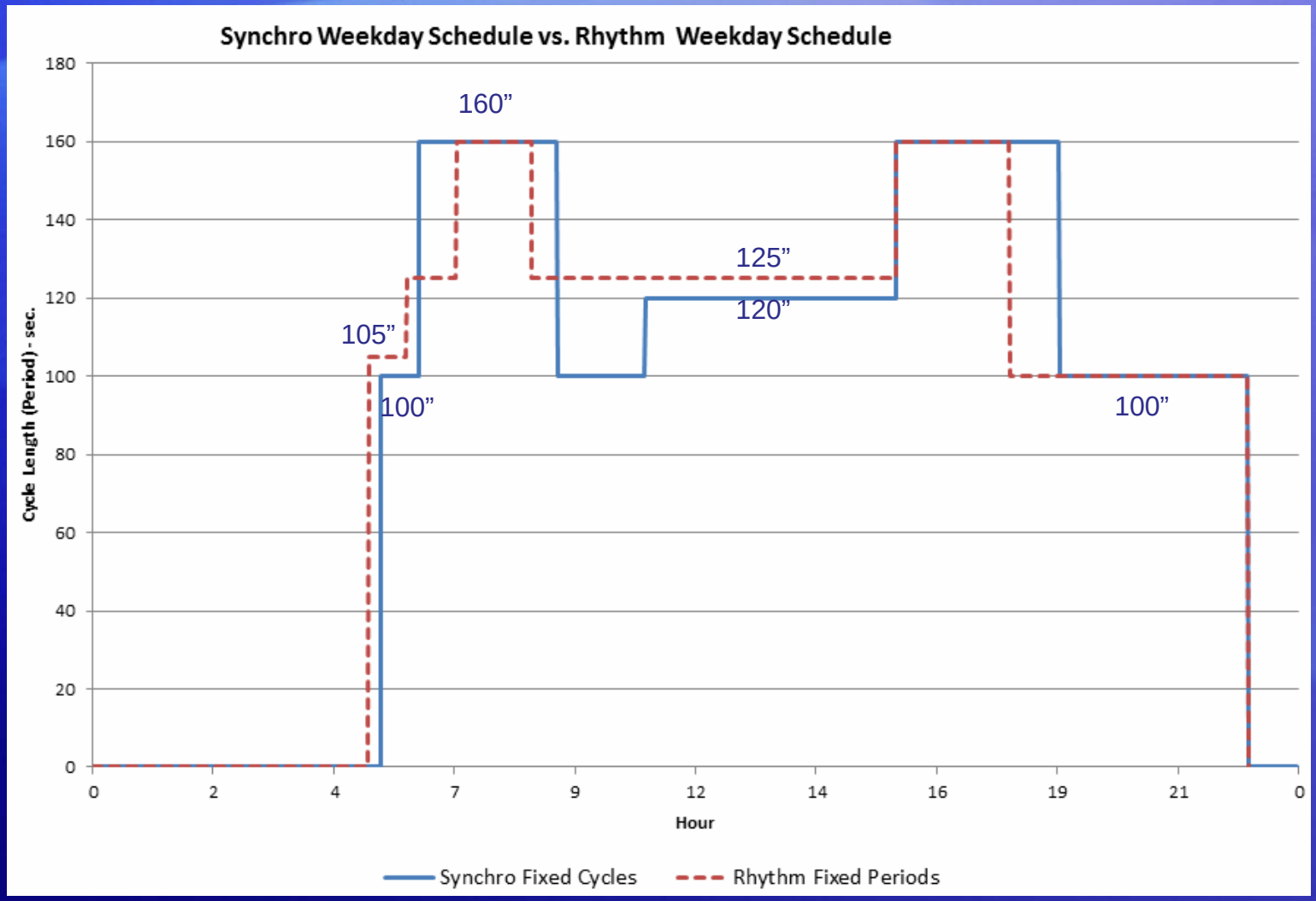
- Insync app provides local status and control at each signal
- Insync provides supervisor control at the signal designated as the facilitator master
- Embedded web server provides a web interface to program, monitor and query the VIVDS system at each intersection

Insync Time-of-Day Schedule

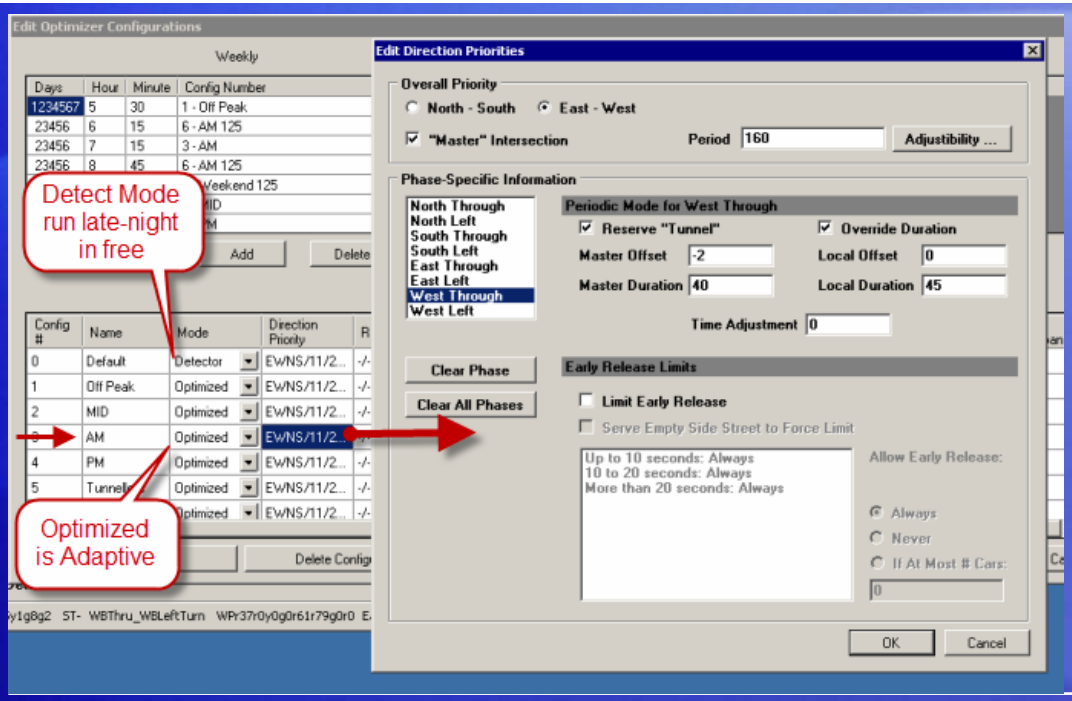
Insync selects Detector Mode or Adaptive Mode (Optimized) from a user specified time-of-day schedule programmed from Remote Desktop in each “Travis Box”



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

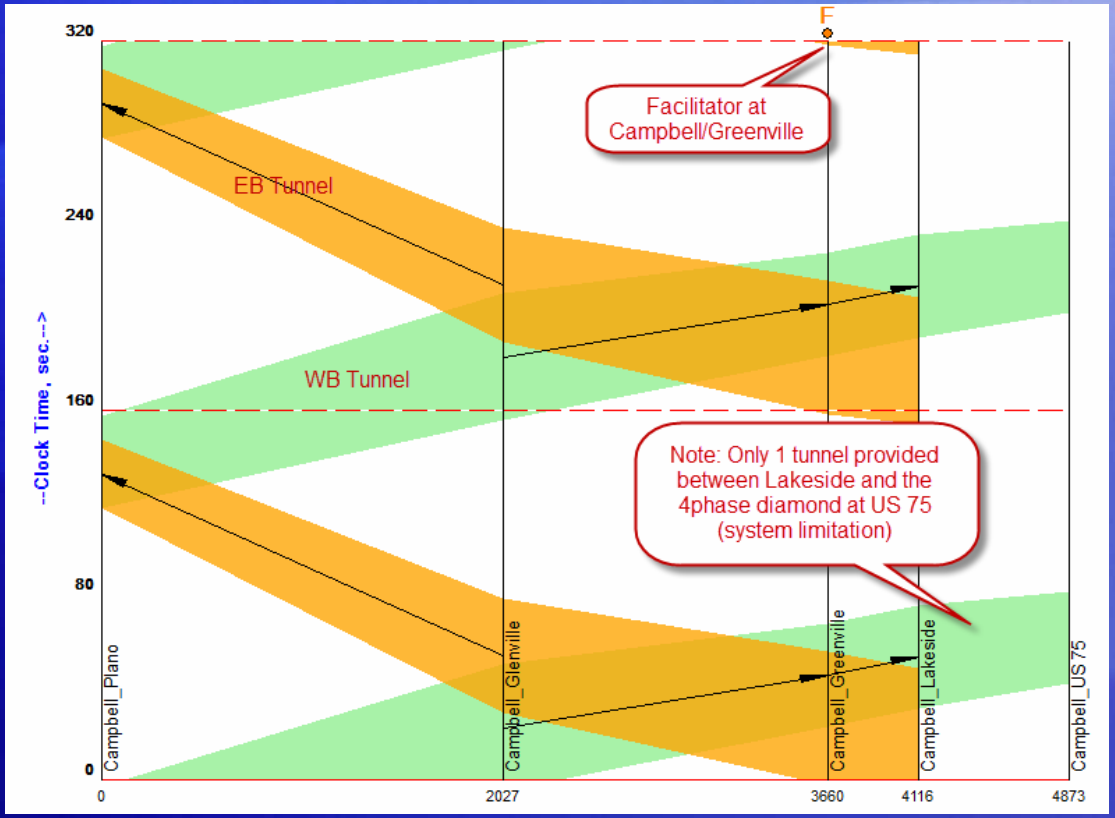
The user specifies a NS or EW direction priority for the corridor (Insync cannot optimize a grid network). One intersection is specified as the “Master” (Facilitator)

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



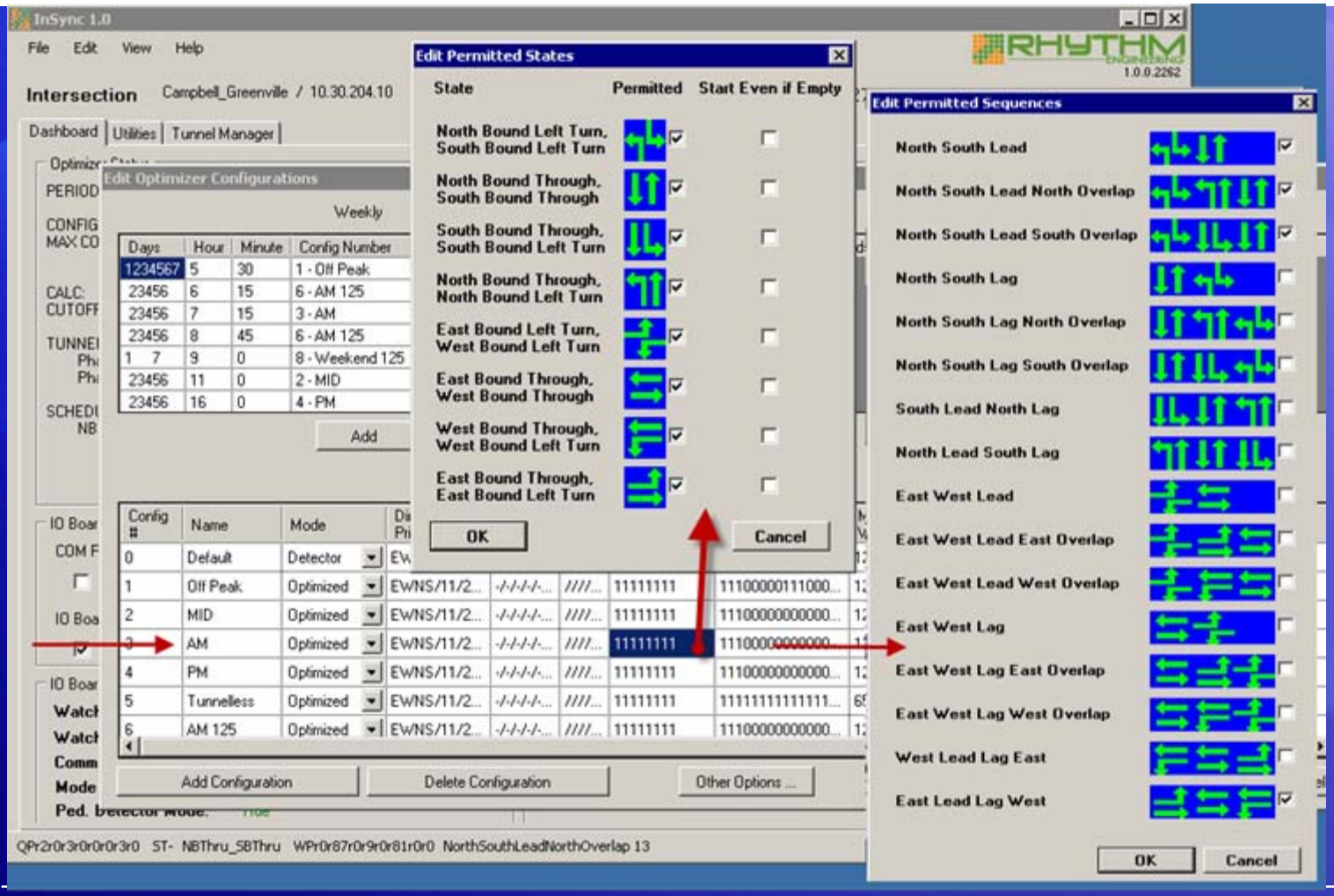
CentralSync is Rhythm's offline program that models time-space relationships for the adaptive plan.

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.

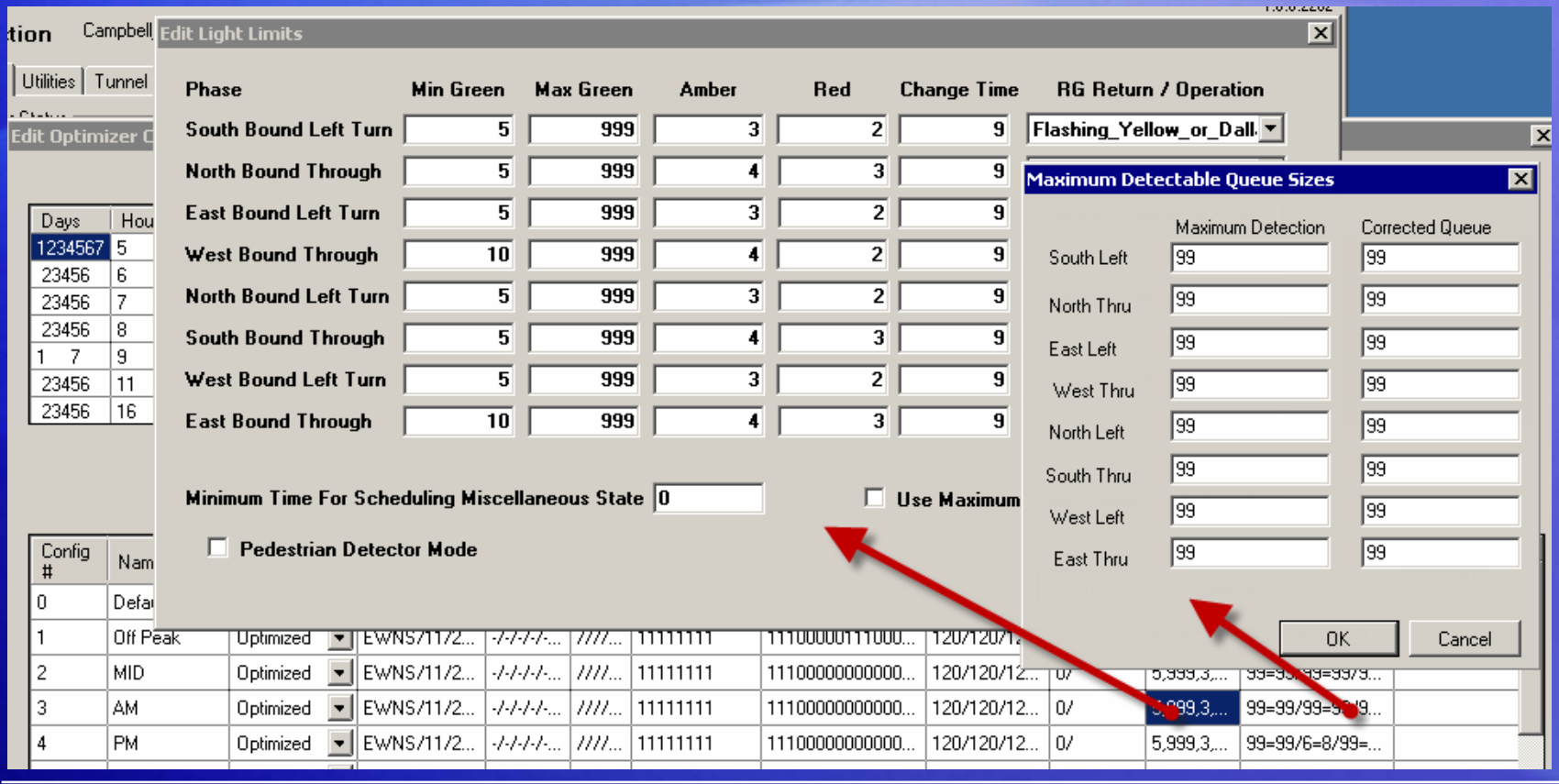
The user is responsible for leaving enough time outside of the tunnels to service the demand for the non-coordinated phases. Rhythm has recently implemented a "watchdog feature" to kick the intersection free if phases are skipped for 2+ periods.

Insync TOD Configuration Walk-Thru (Cont.)



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

Insync TOD Configuration Walk-Thru (Cont.)

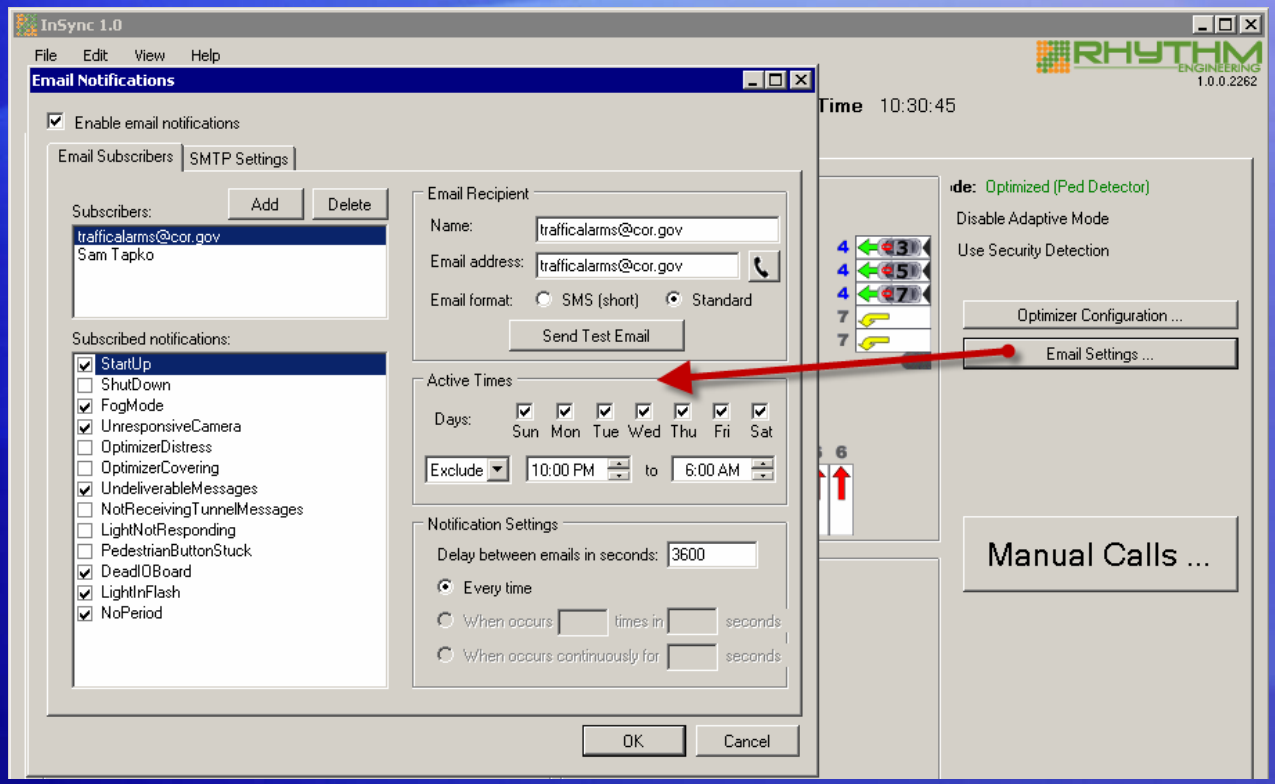


Min/Max times and MaxDetect/Corrected Queue values are set for each movement

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

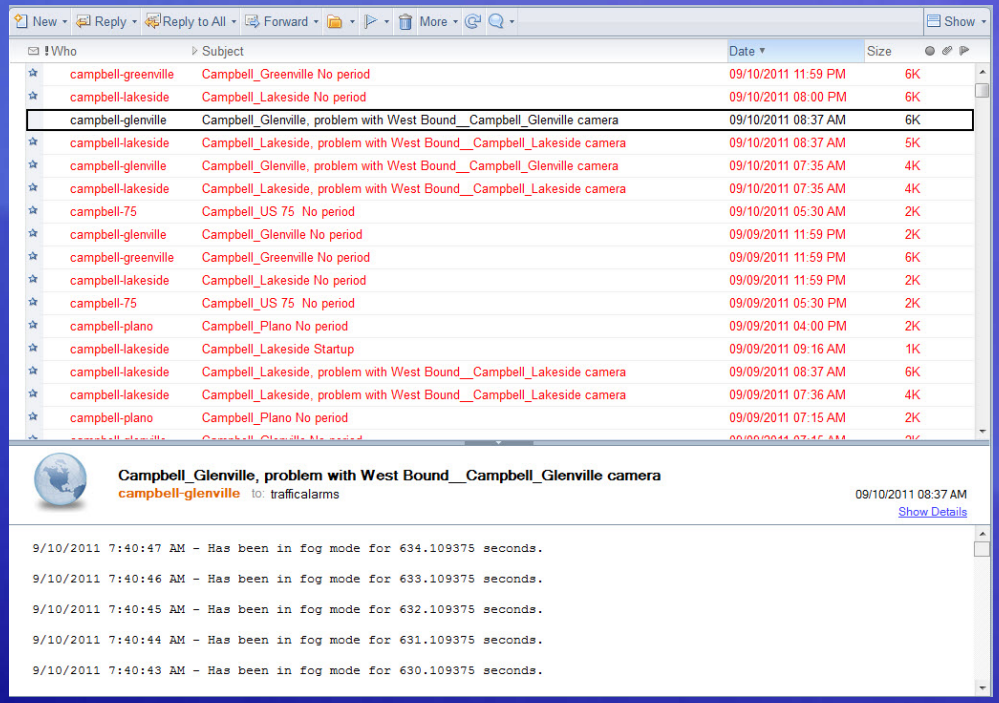
Status may be turned off by TOD to mask bogus messages – i.e., “NoPeriod” during free

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

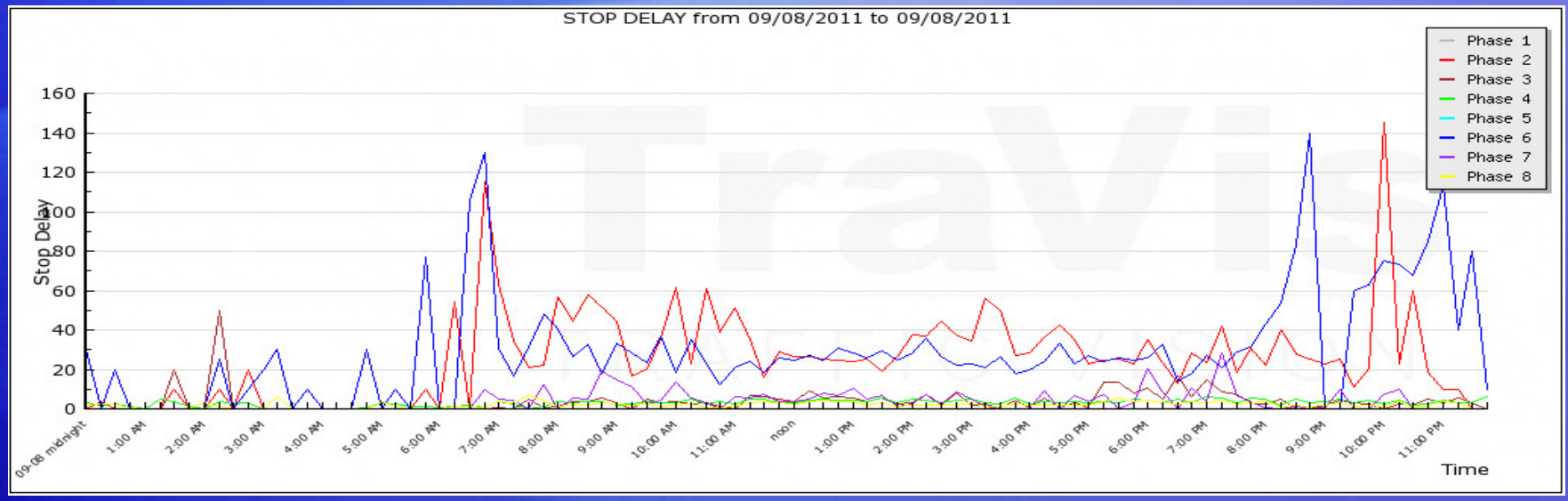
At present you need to access and program Insync for each “Travis Box” using Windows Remote Desktop

Central System Monitoring and Control

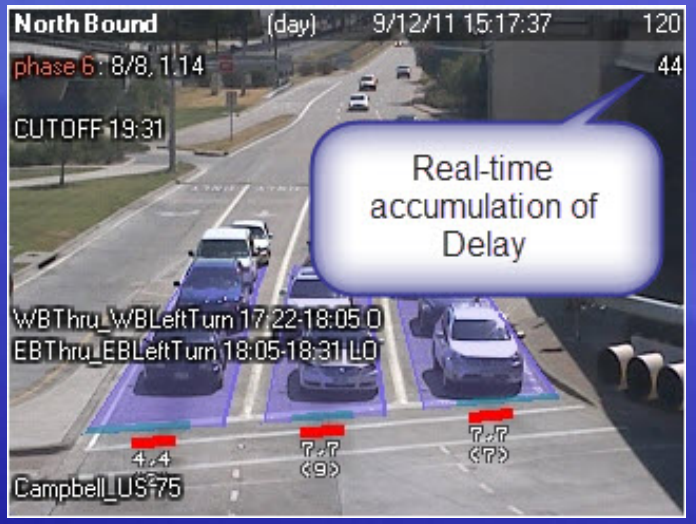
- All alarms arrive via email direct from each TraVis Box
- No MoE alarms
- No aggregate alarms or commands to multiple intersections
- System needs manuals and documentation for advanced users



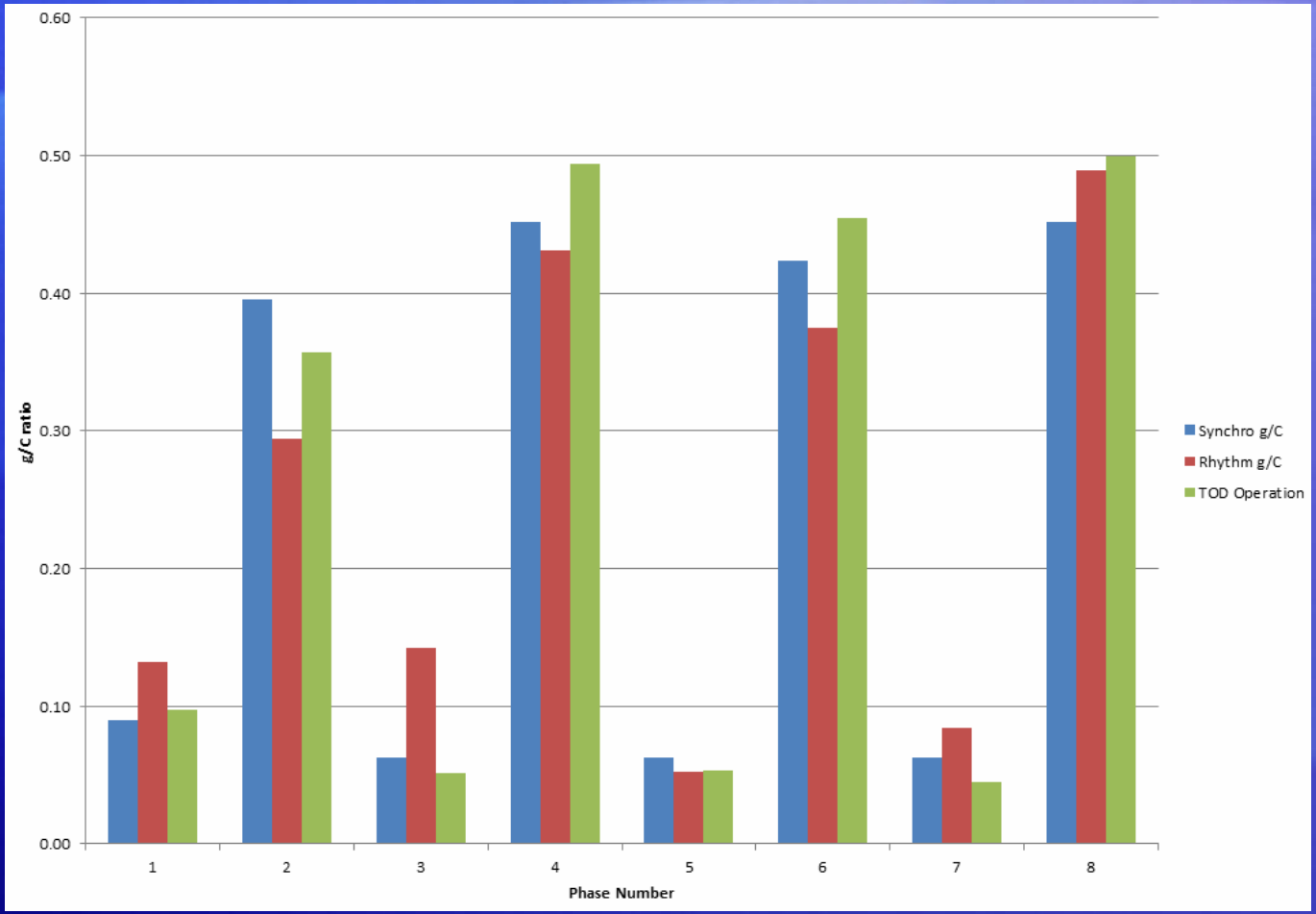
Measures of Effectiveness



- 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

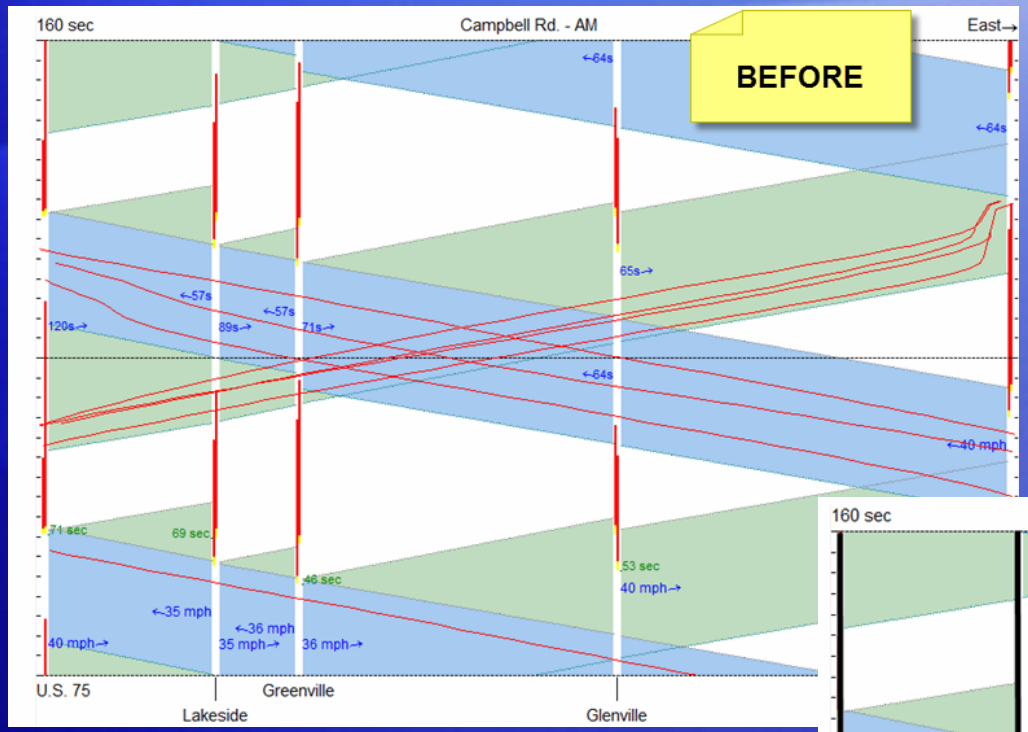
Floating Car Comparison Before and After Rhythm Adaptive Implementation

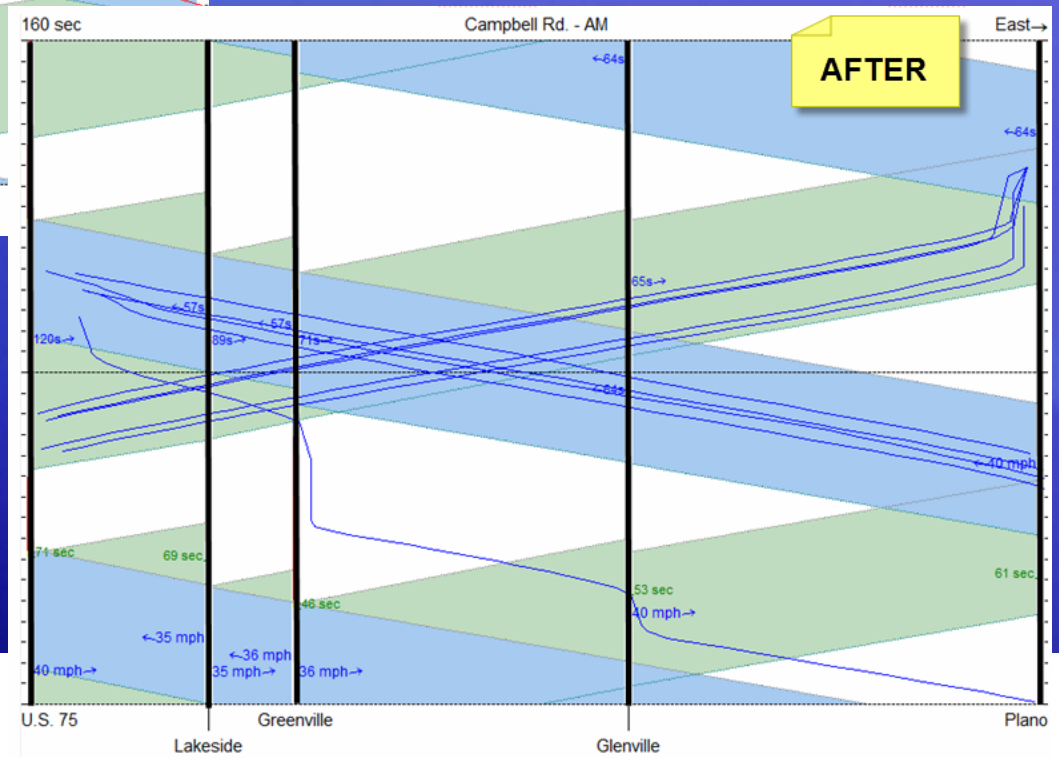
			Before		After		% Change	
Period	Arterial	Direction	Stops	Delay	Stops	Delay	Stops	Delay
AM	Campbell	EB	1	31	1	28	0%	-10%
		WB	0	3	0	3	0%	0%
PM	Campbell	EB	0	2	0	1	0%	0%
		WB	1	61	1	68	0%	11%

Stop = Cstops (Tru-Traffic), cumulative number of stops in run where speed drops below 15 MPH
Delay = SC (Tru-Traffic), cumulative delay since the begnning of the run (seconds)

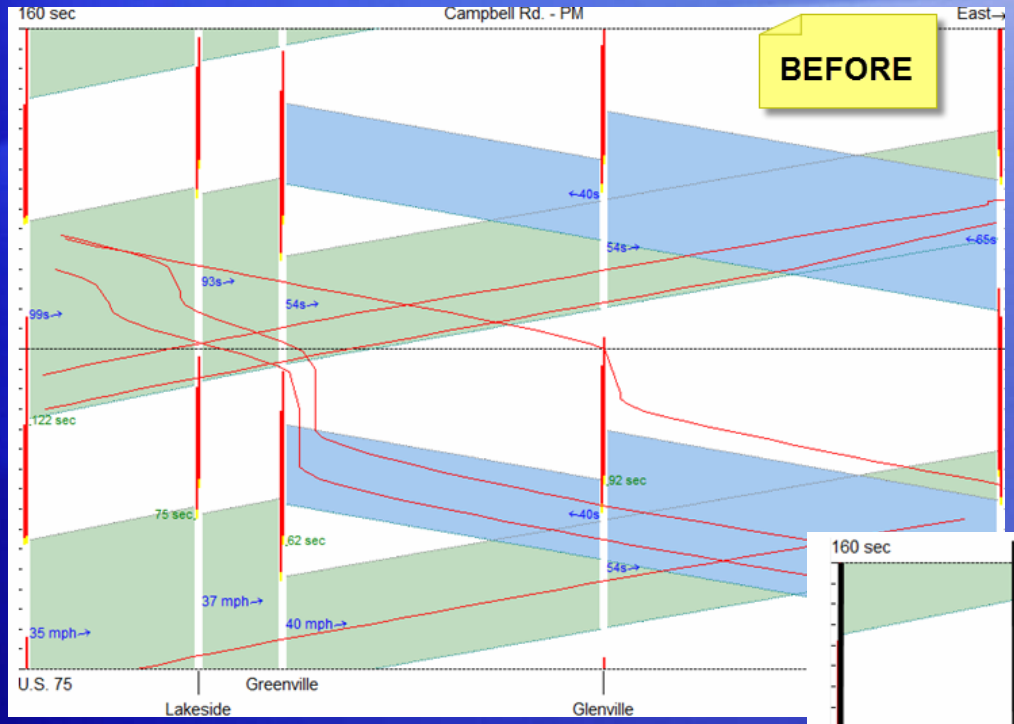
1. Stops and delay in the Campbell corridor essentially the same before and after Insync was implemented
2. Side street and left turn delay was not evaluated, however may have been significant.
3. Negative progression impact on Plano Road due to the inability of the system to operate in a grid
4. More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

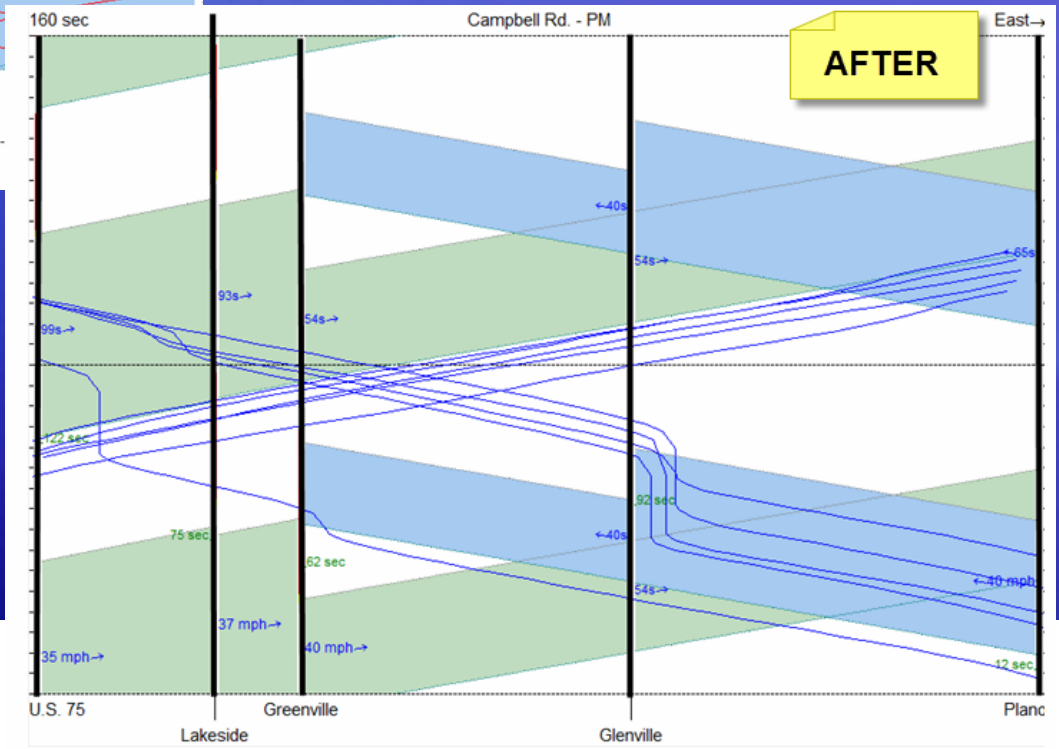
Comparison of Floating Car Data – AM Period





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 ?