System Architecture and Design

Active Traffic Management Workshop

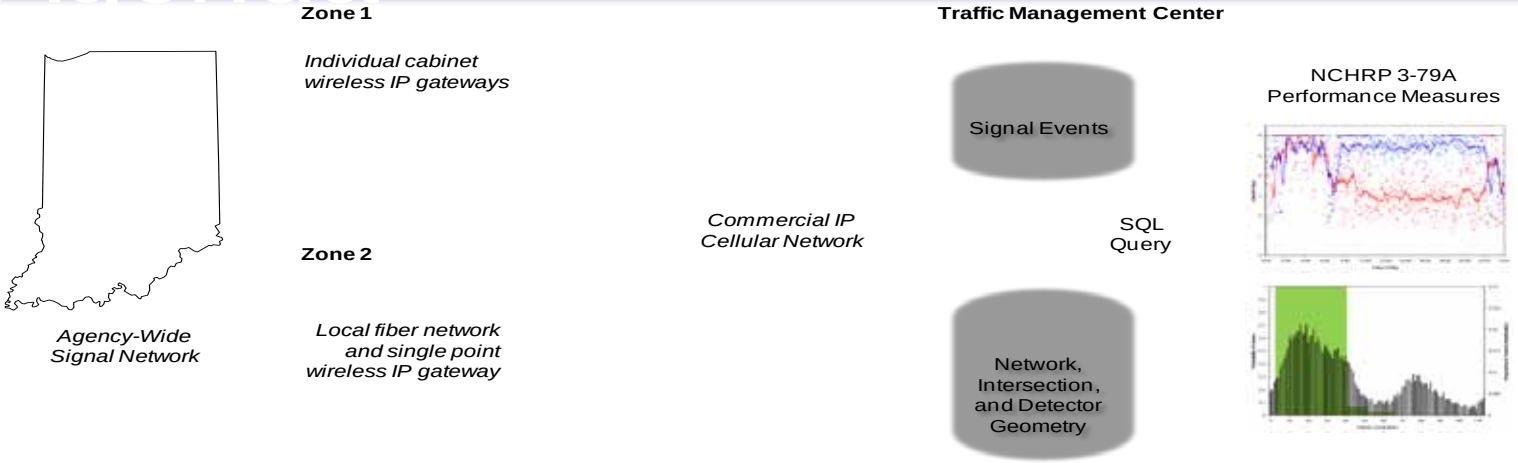
Merrillville, IN

Jim Sturdevant PE

INDOT

Dec 2011

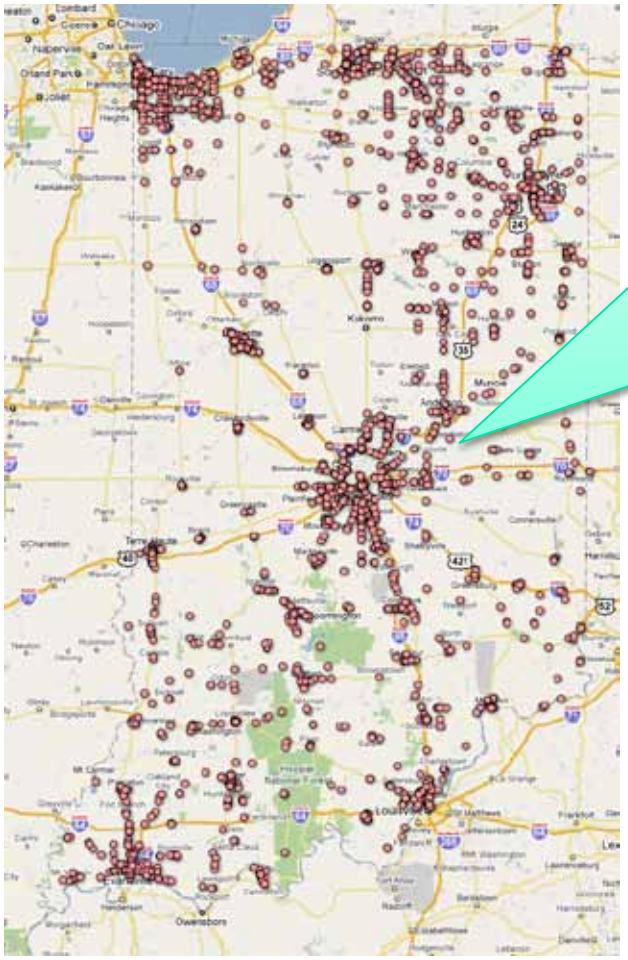
Agenda



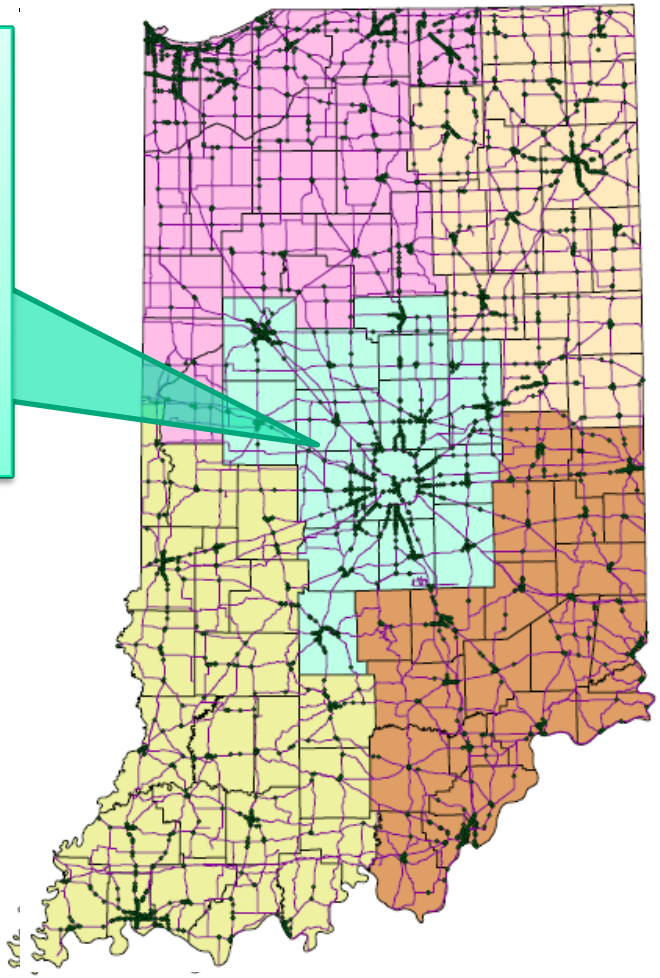
- Detection needs- Lane by lane and advance
- Controller features-Event Logging
- Communication requirements:
- Down in the weeds: Looking into performance & lessons learned…

Regional / Statewide Signal Management

Geographical / Organizational Challenges



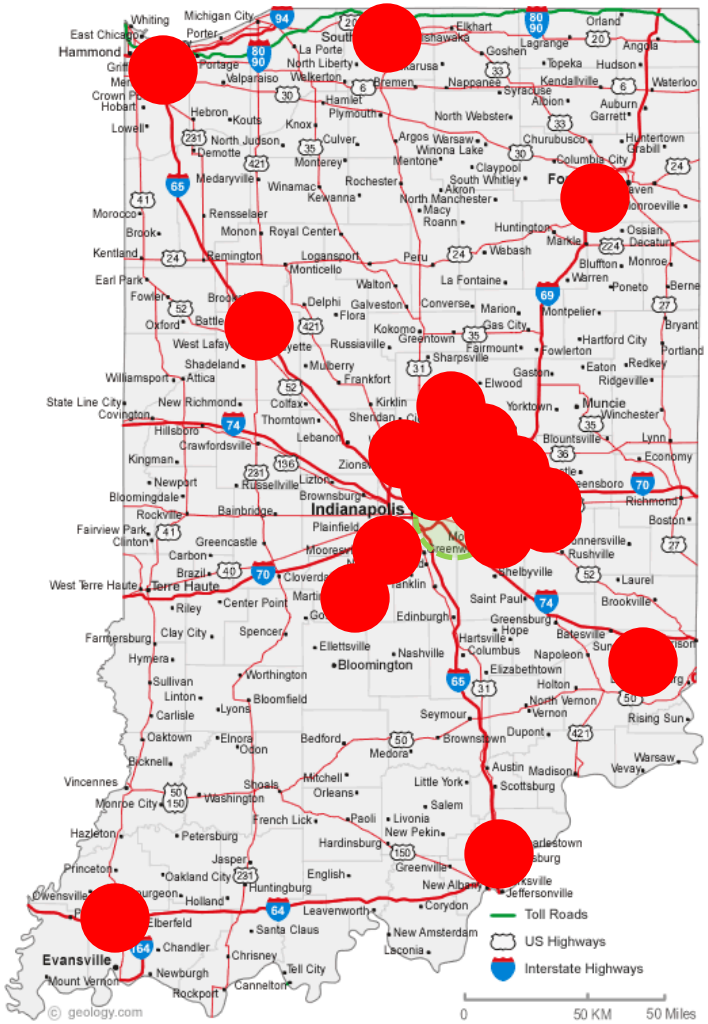
Large geographical areas increase the benefit of remote monitoring and traffic management



INDOT: ~2,600 signals in 300 systems

Progress towards Active Signal Management

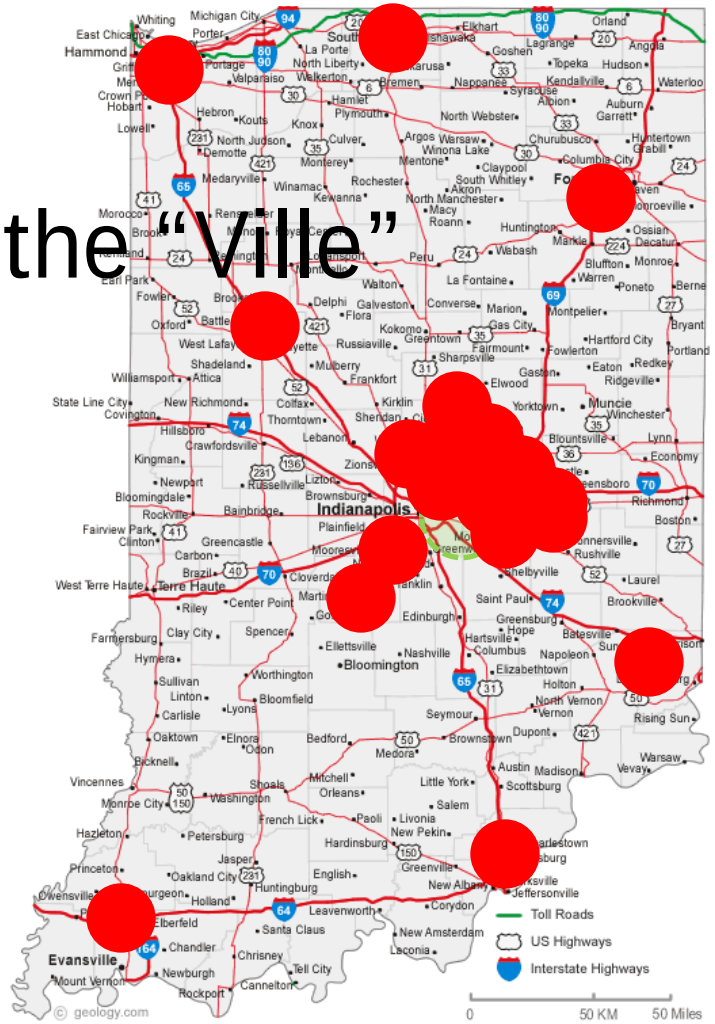
- 100 High Resolution Event Data controllers on line
- ITS Fiber, Commercial Cellular, FHSS Radio, Broadband Radio
- Peek, Econolite, Seimens (soon)
- 4.5 Billion Event Data Records (400 million/month)



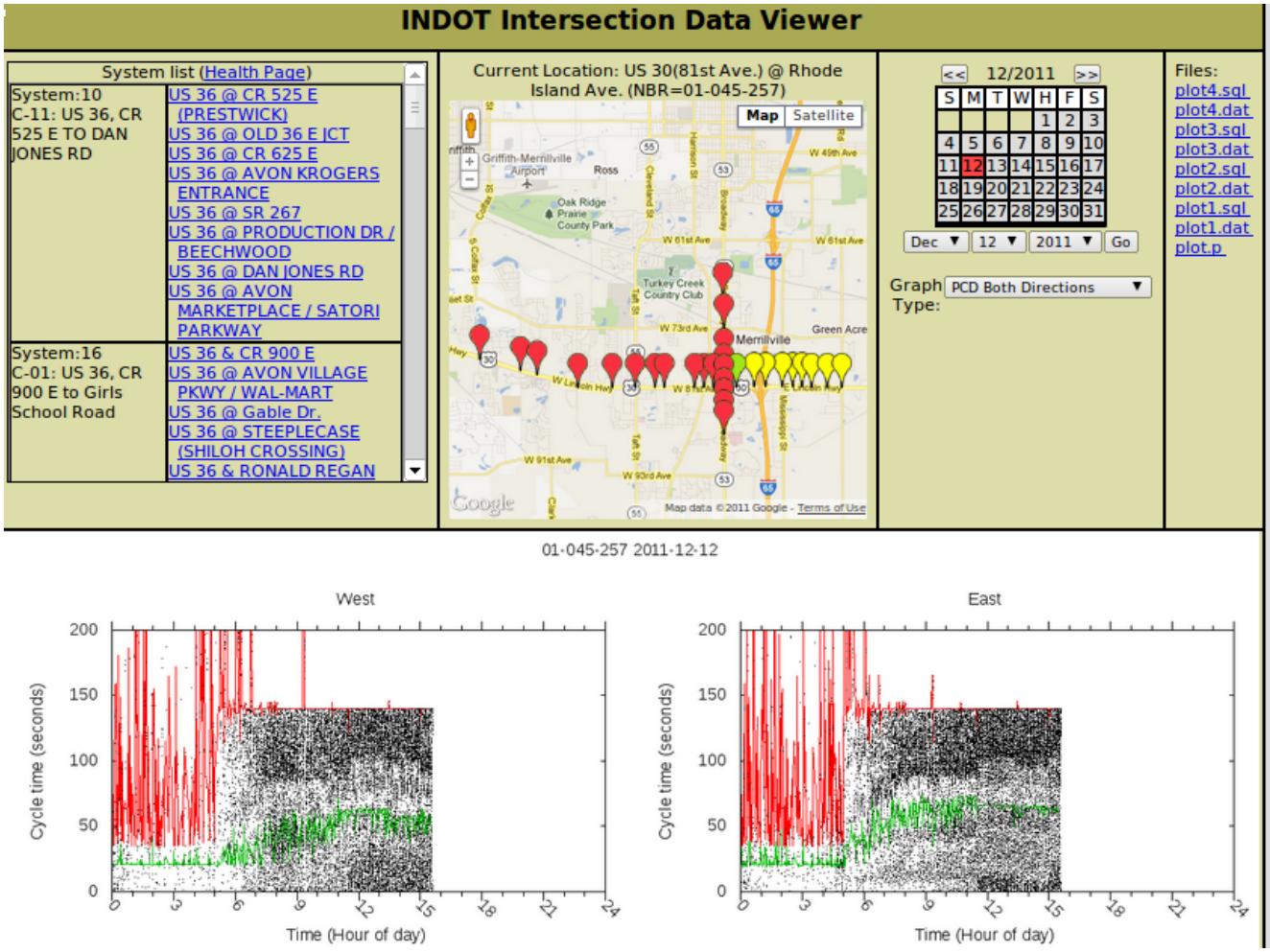
Progress towards Active Signal Management

- 1 32/37 –Noblesville
- 2 +1 Pleasant St
- 4 +2 System --Completing the "Ville"
- 8 +4 Fishers
- 16 +8 US31
- 32 +16 SR37 S
- 64 +32 Ft Wayne, NW IN
- 2011 and beyond…

All new contracts

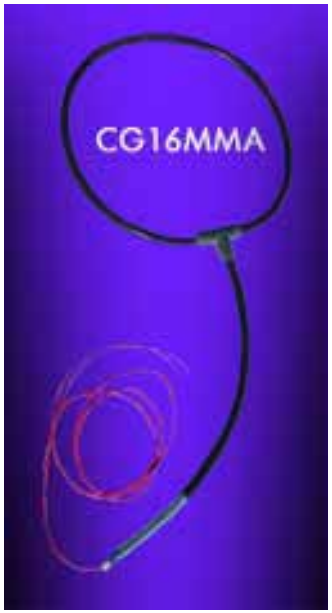


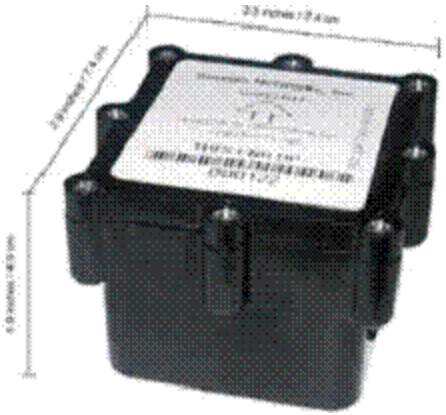
The other “Ville’s”- Merrillville (31)



The other “Ville’s”- Louisville (9) Area

Eyes and Ears- Communications and Detection

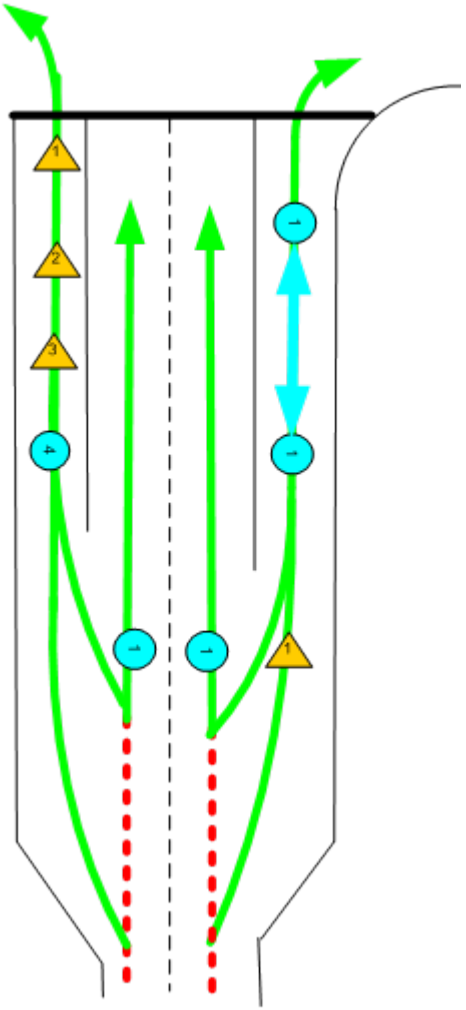




Lane by lane, advance, count capable

Loop Tagging Table

Ref #	Loop No	-	Direction	Lane	Phase	-	Loops	C	-	C #	Lead-in and Rack Labels
1	1	-	N	L	5	-	4	C	-	3	1-NL5-4 C-3
2	2	-	N	A	2	-	1	C	-	4	2-NA2-1 C-4
3	5	-	N	B	2	-	1	C	-	7	5-NB2-1 C-7
4	6	-	E	L	7	-	4	C	-	8	6-EL7-4 C-8
5	9	-	E	A	4	-	4	C	-	11	9-EA4-4 C-11
6	10	-	E	B	4	-	4	C	-	12	10-EB4-4 C-12
7	13	-	S	L	1	-	4	C	-	15	13-SL1-4 C-15
8	14	-	S	A	6	-	1	C	-	16	14-SA6-1 C-16
9	17	-	S	B	6	-	1	C	-	19	17-SB6-1 C-19
10	18	-	W	L	3	-	4	C	-	20	18-WL3-4 C-20
11	21	-	W	A	8	-	4	C	-	23	21-WA8-4 C-23
12	22	-	W	B	8	-	4	C	-	24	22-WB8-4 C-24
13	25	-	N	L	5	-	1,2,3				25-NL5-1,2,3
14	26	-	E	L	7	-	1,2,3				26-EL7-1,2,3
15	27	-	E	A	4	-	1,2,3				27-EA4-1,2,3
16	28	-	E	B	4	-	1,2,3				28-EB4-1,2,3
17	29	-	S	L	1	-	1,2,3				29-SL1-1,2,3
18	30	-	W	L	3	-	1,2,3				30-WL3-1,2,3
19	31	-	W	A	8	-	1,2,3				31-WA8-1,2,3
20	32	-	W	B	8	-	1,2,3				32-WB8-1,2,3
21											



Controller Capabilities for event logging

Log Events

Standard Enumerations

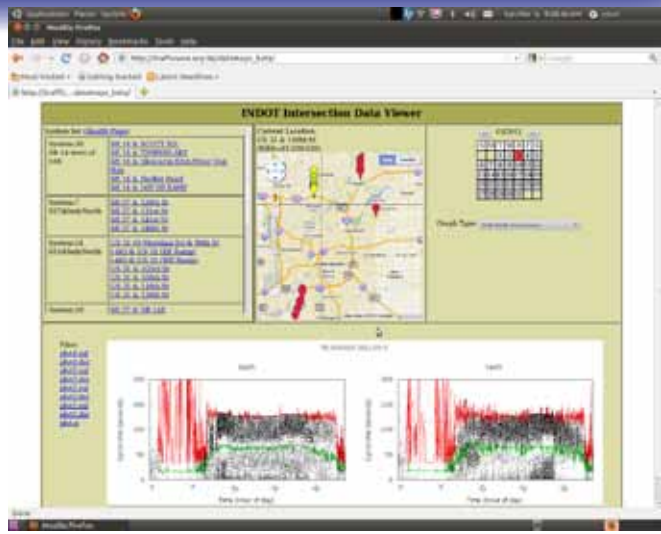
100 ms

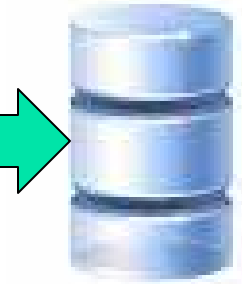
30 hours storage

Ethernet

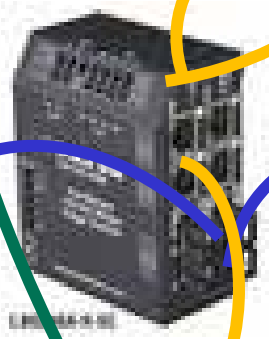
FTP Protocol

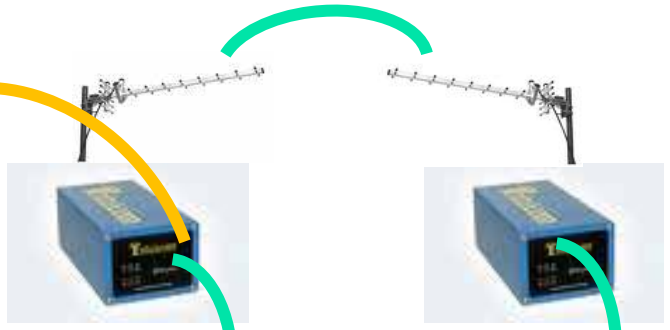
Translate to CSV





Communications Migration

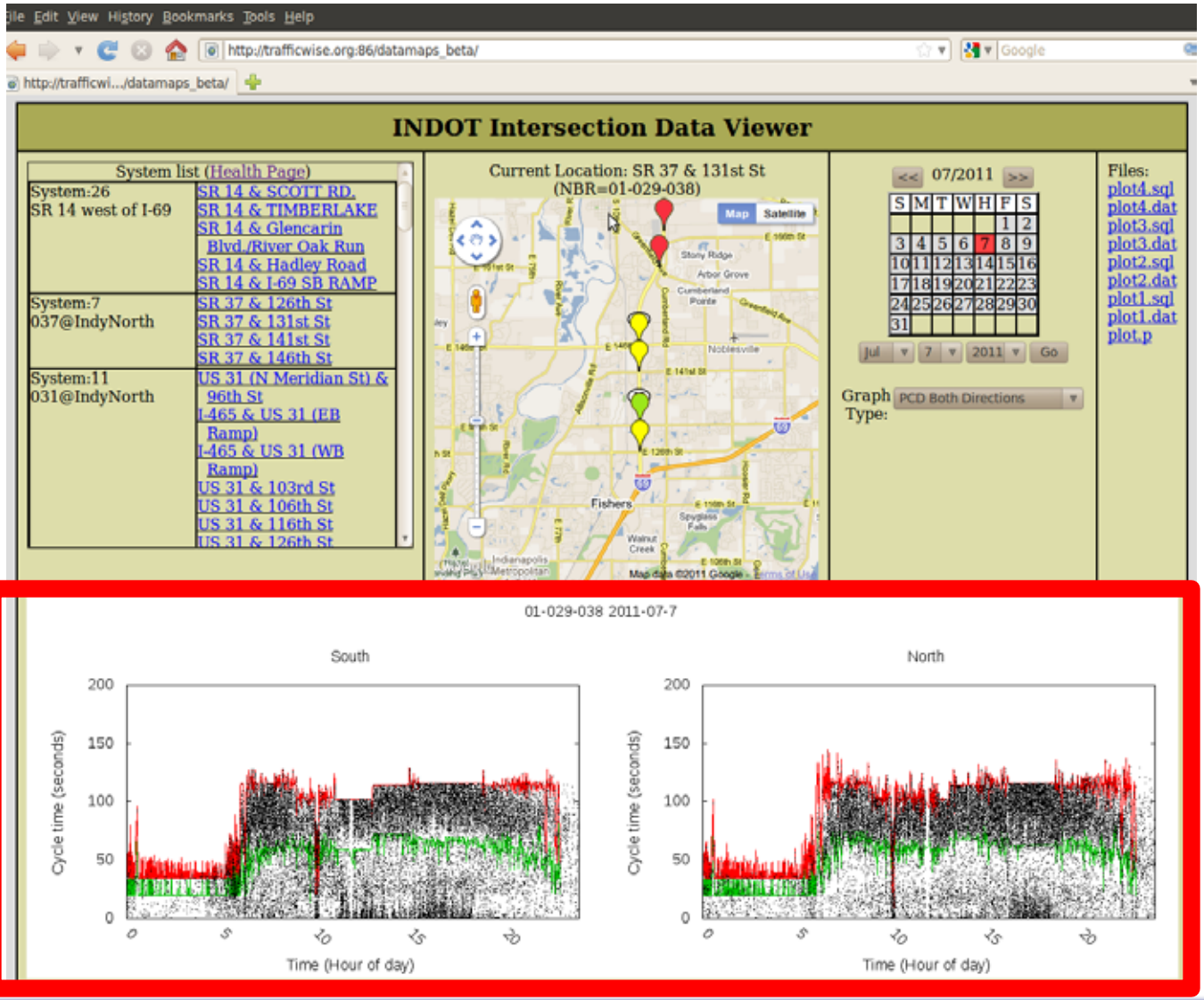


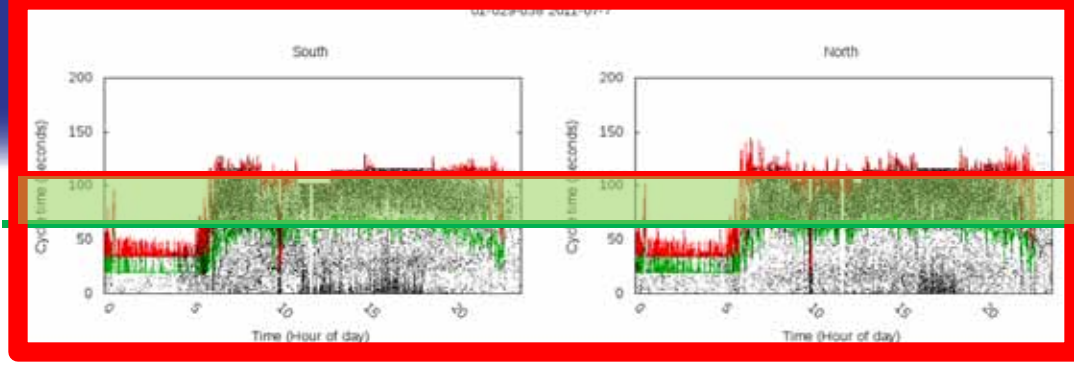


Communications Security

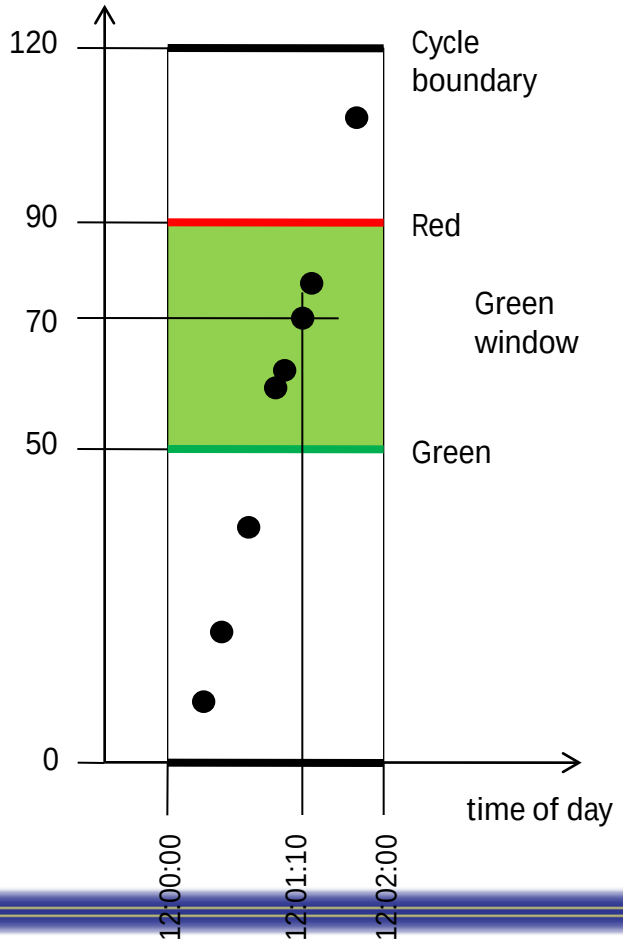
- Friends List
- VPN's
- Private IPs
- ...#2 key?

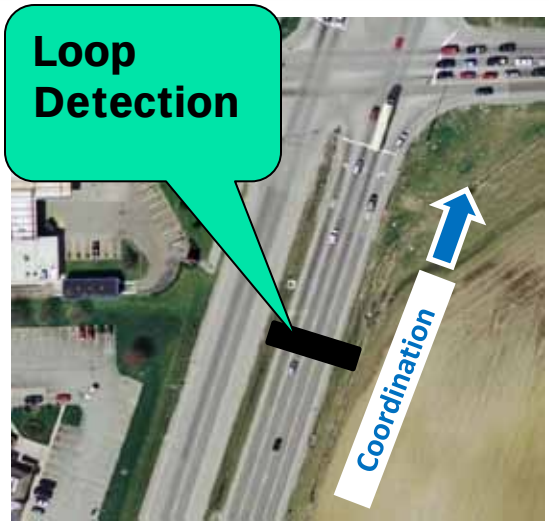
PCD Overview

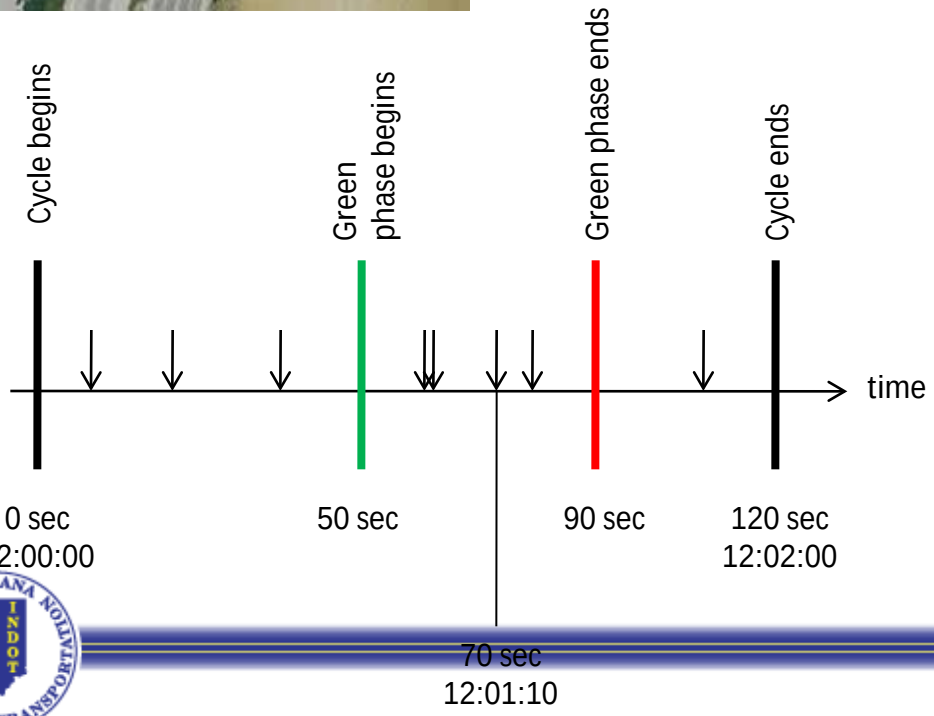


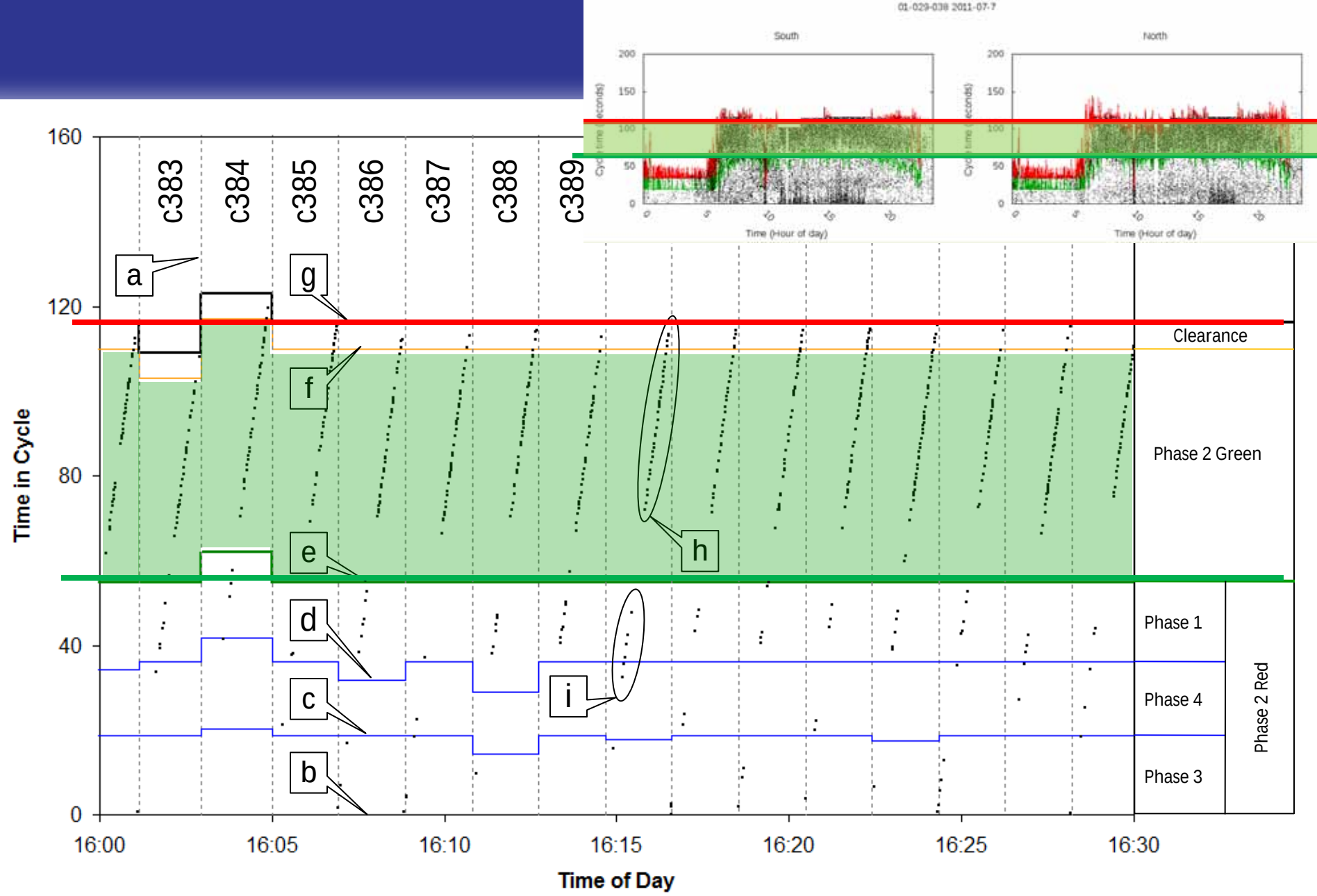


Time in cycle

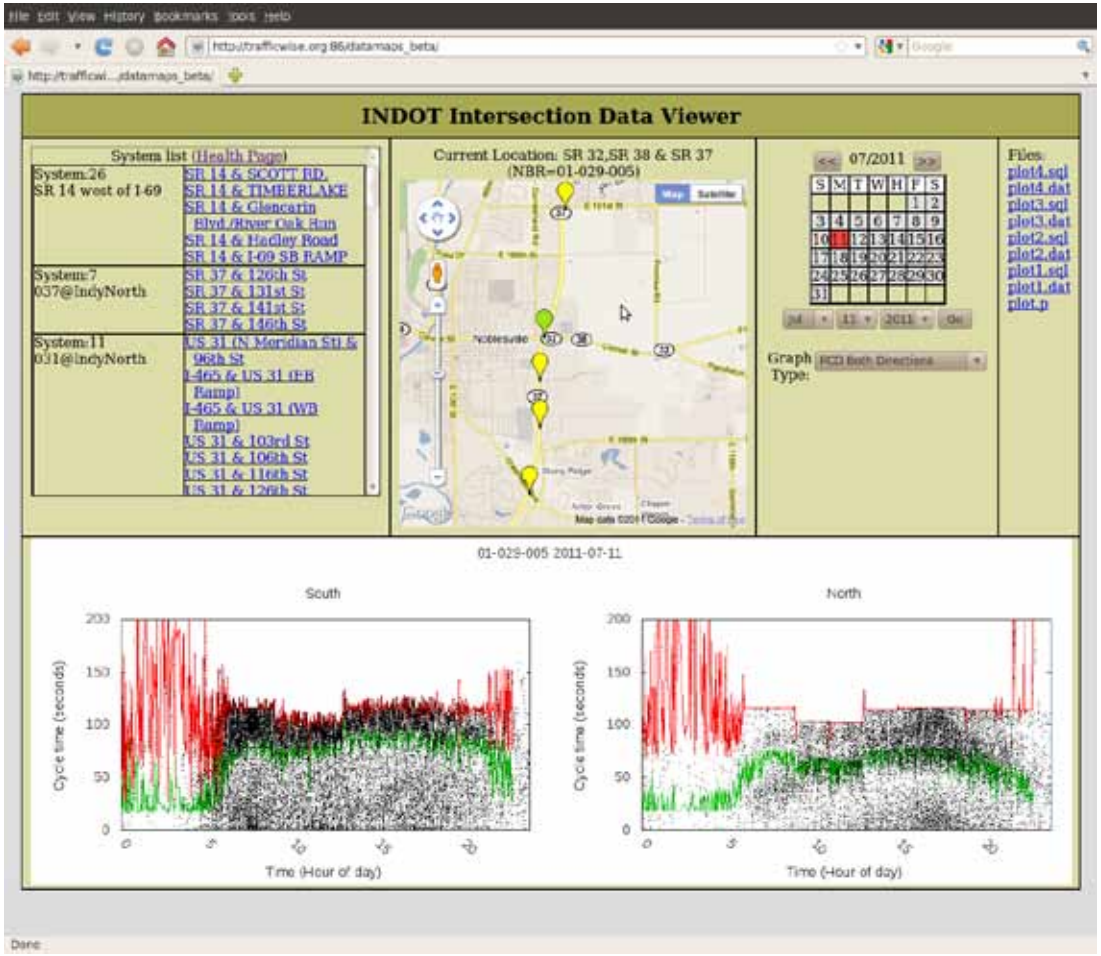




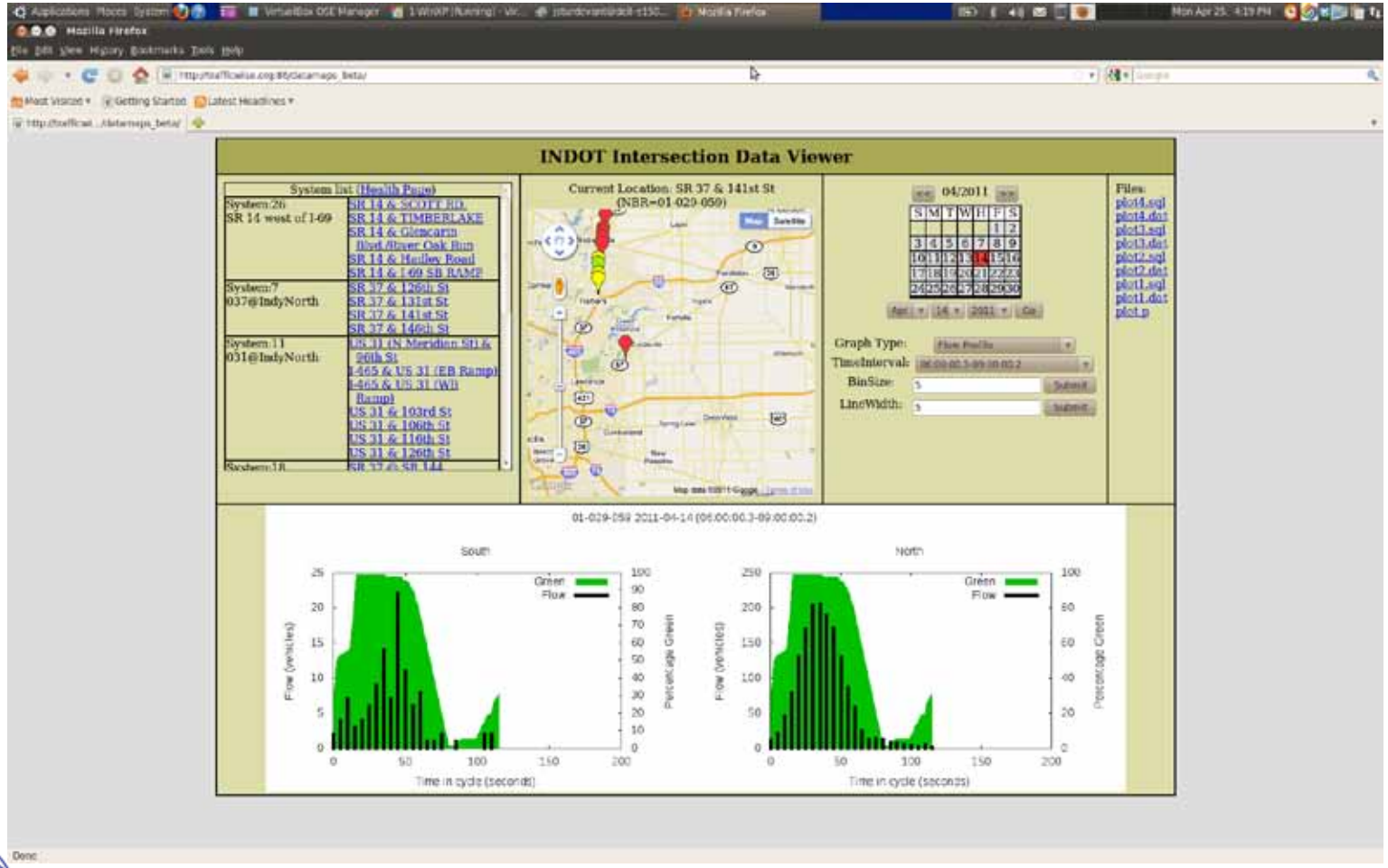



01-029-038 2011-07-7
South
North
Time (Hour of day)
c383
c384
c385
c386
c387
c388
c389
a
b
c
d
e
f
g
h
i
Clearance
Phase 2 Green
Phase 1
Phase 4
Phase 3
Phase 2 Red
Time in Cycle
Time of Day
160
120
80
40
0
16:00
16:05
16:10
16:15
16:20
16:25
16:30

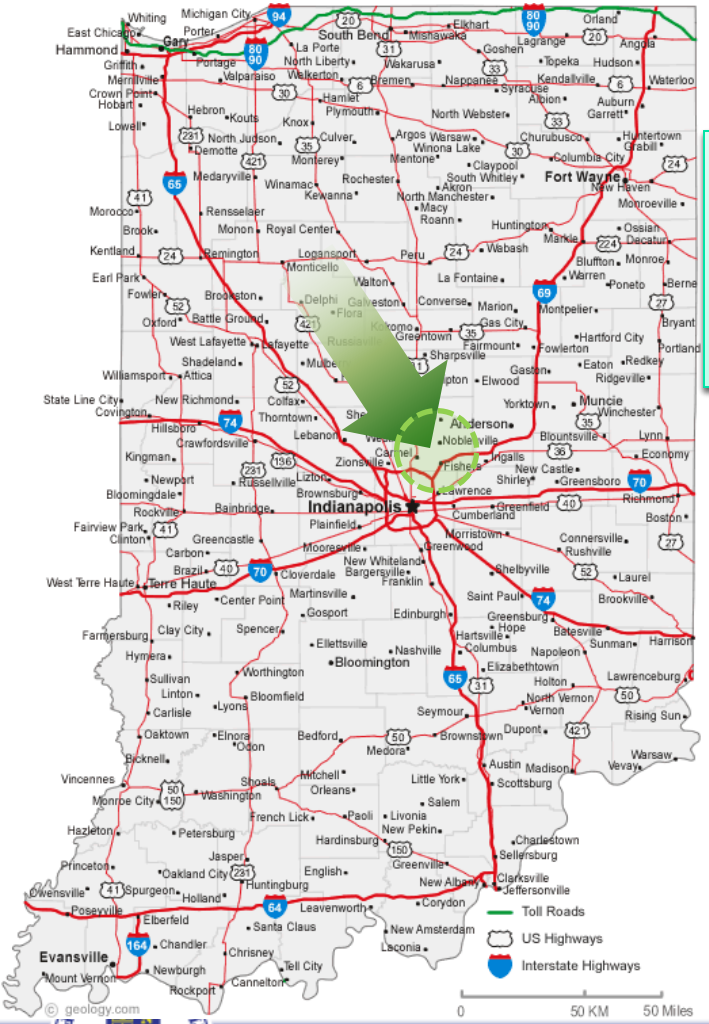
Original Instrumented Intersection SR37/SR32

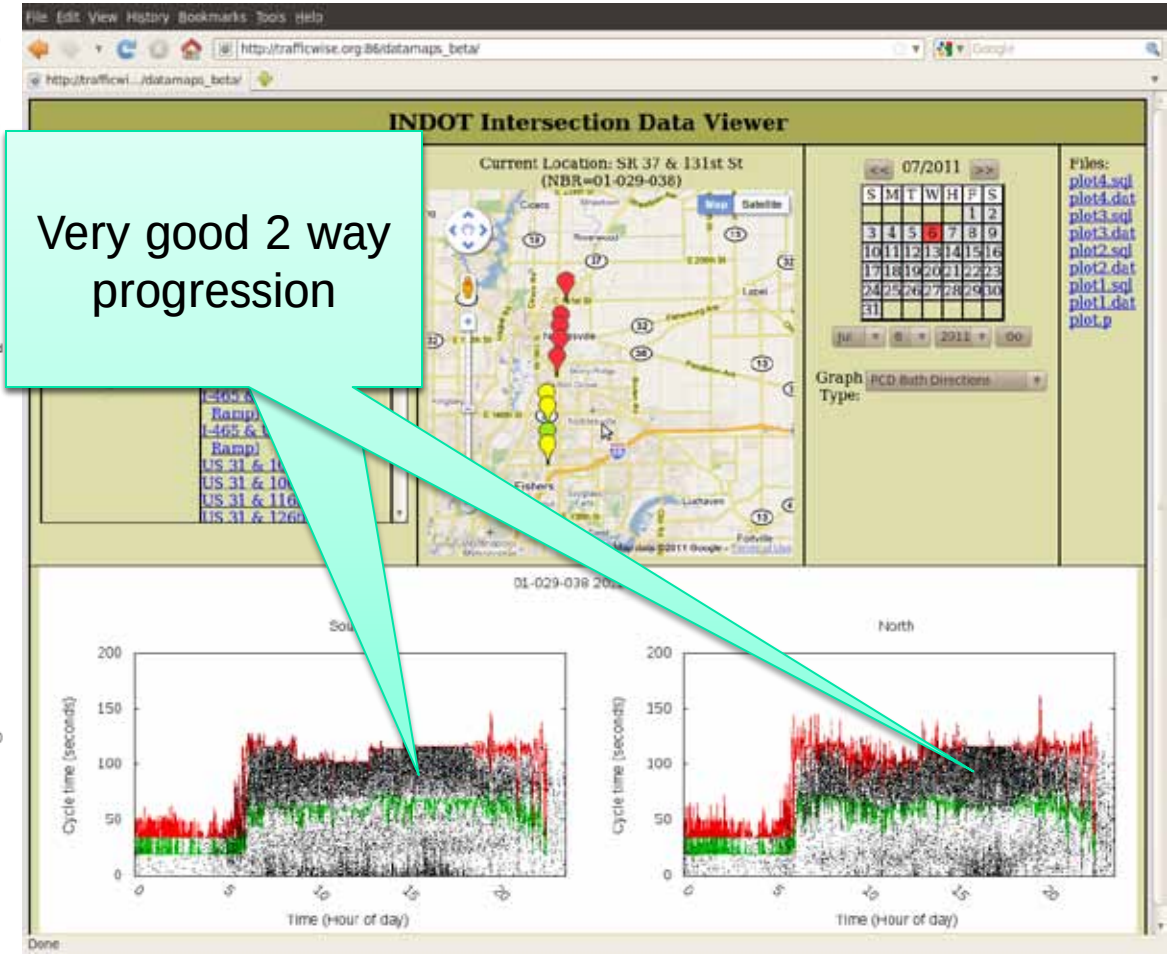


Flow Profiles Overview



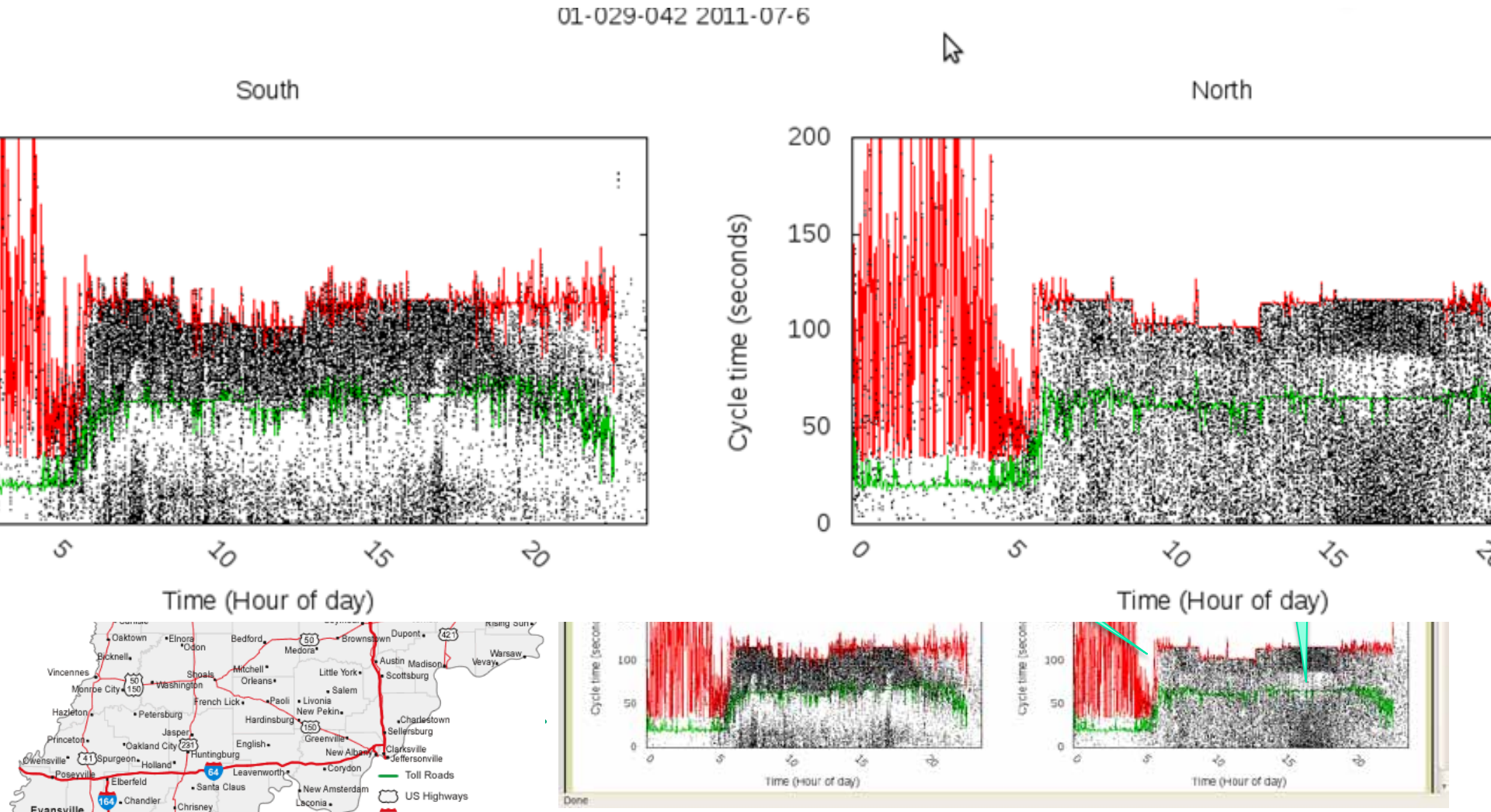
SR37 Fishers/Noblesville- (9)





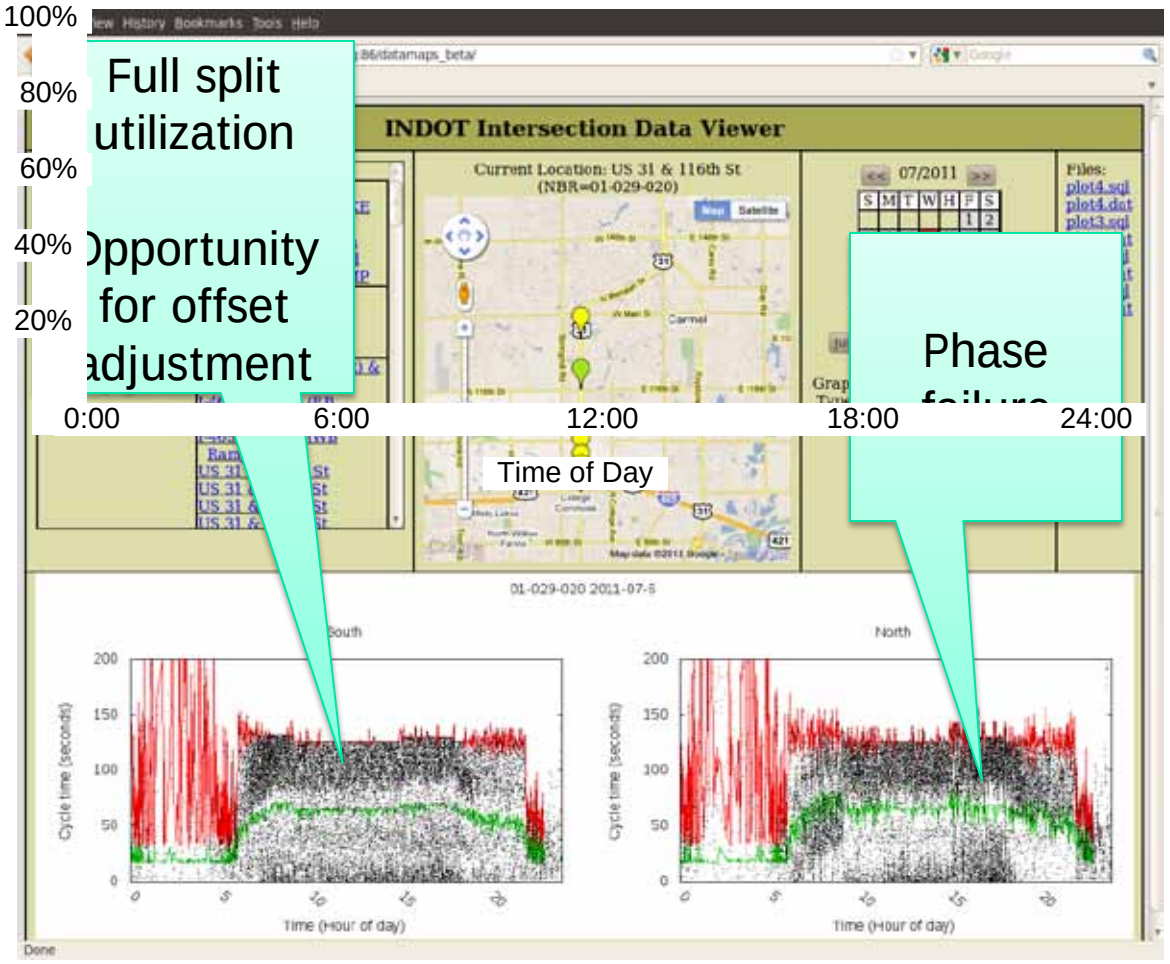
Very good 2 way progression

SR-37 & 126th adiacent to I-69

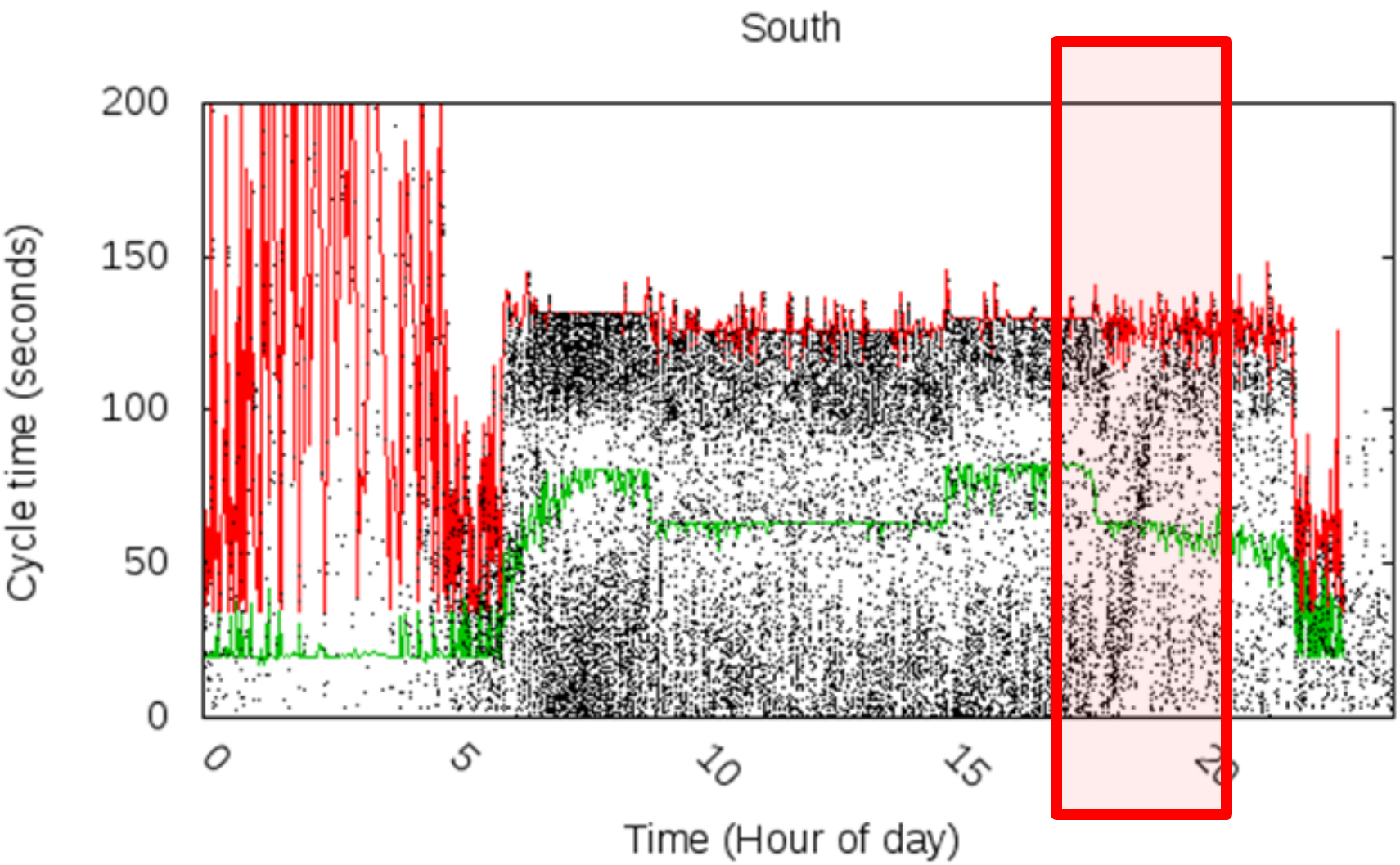


US31 N @ 116th

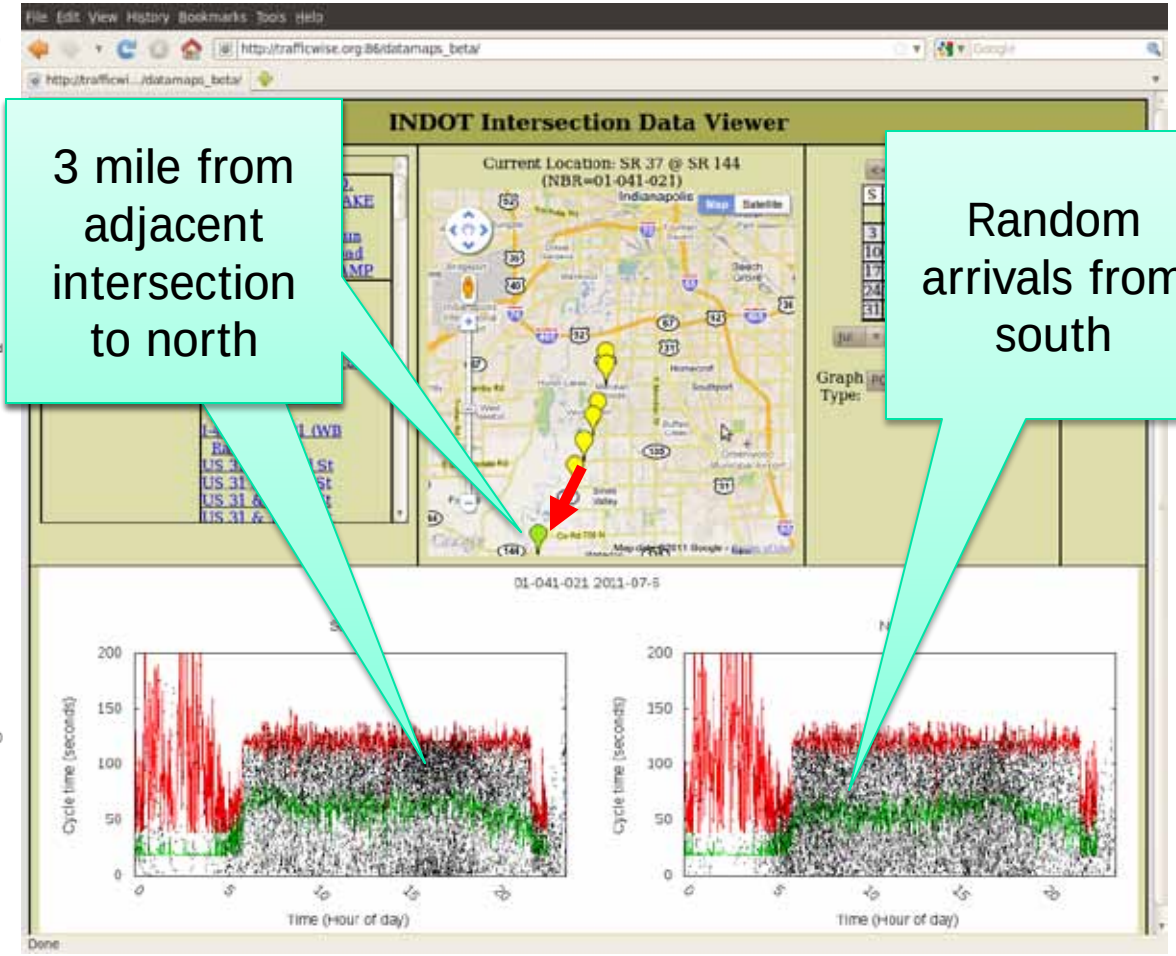

Indianapolis
Bloomington
Evansville
Fort Wayne
South Bend
Anderson
Toll Roads
US Highways
Interstate Highways
0
50 KM
50 Miles
© geology.com


100%
80%
60%
40%
20%
Occupancy
Full split utilization
Opportunity for offset adjustment
Phase failure
0:00
6:00
12:00
18:00
24:00
Time of Day
INDOT Intersection Data Viewer
Current Location: US 31 & 116th St
(NBR=01-029-020)
07/2011
Files:
plot4.sql
plot4.dat
plot3.sql
01-029-020 2011-07-5
South
North
Cycle time (seconds)
Time (Hour of day)
Done

US 31 @ 126th (8 in system)



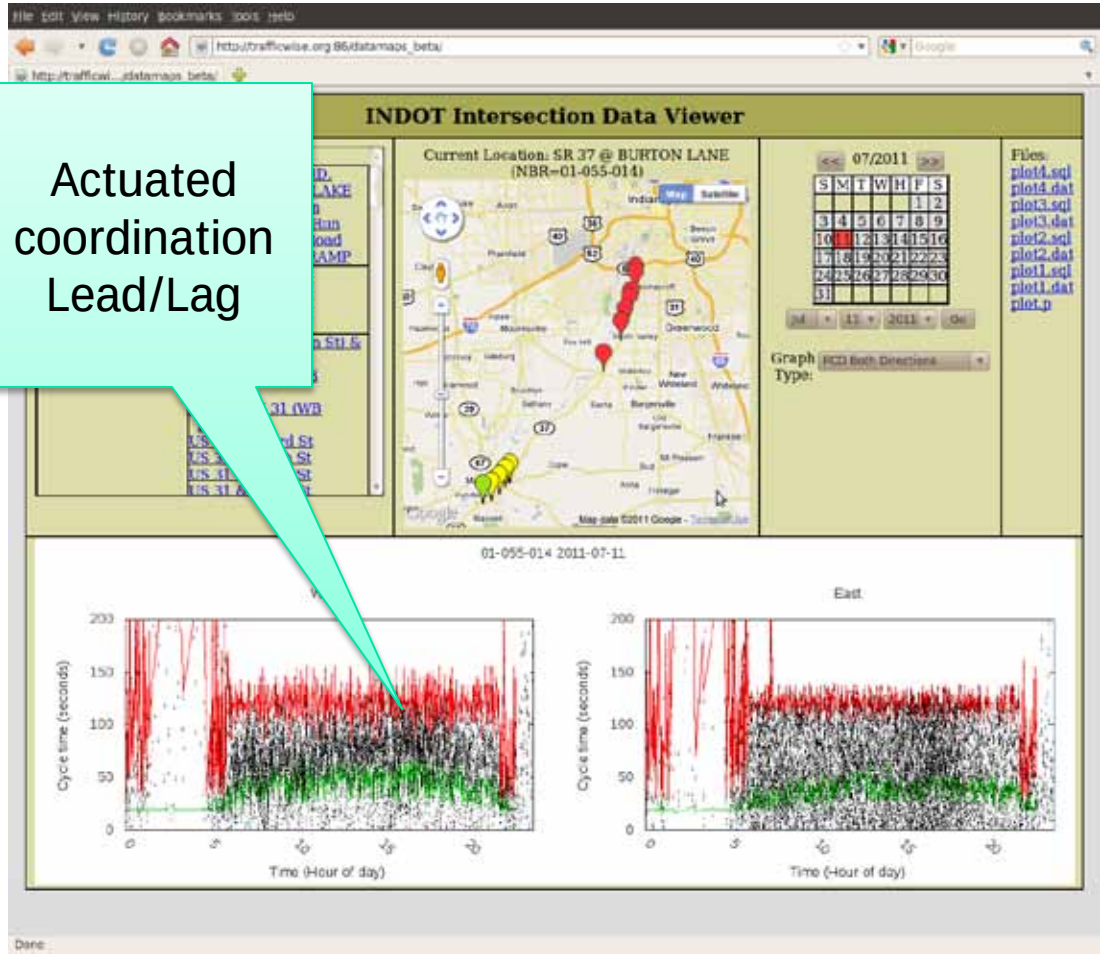
SR 37 South



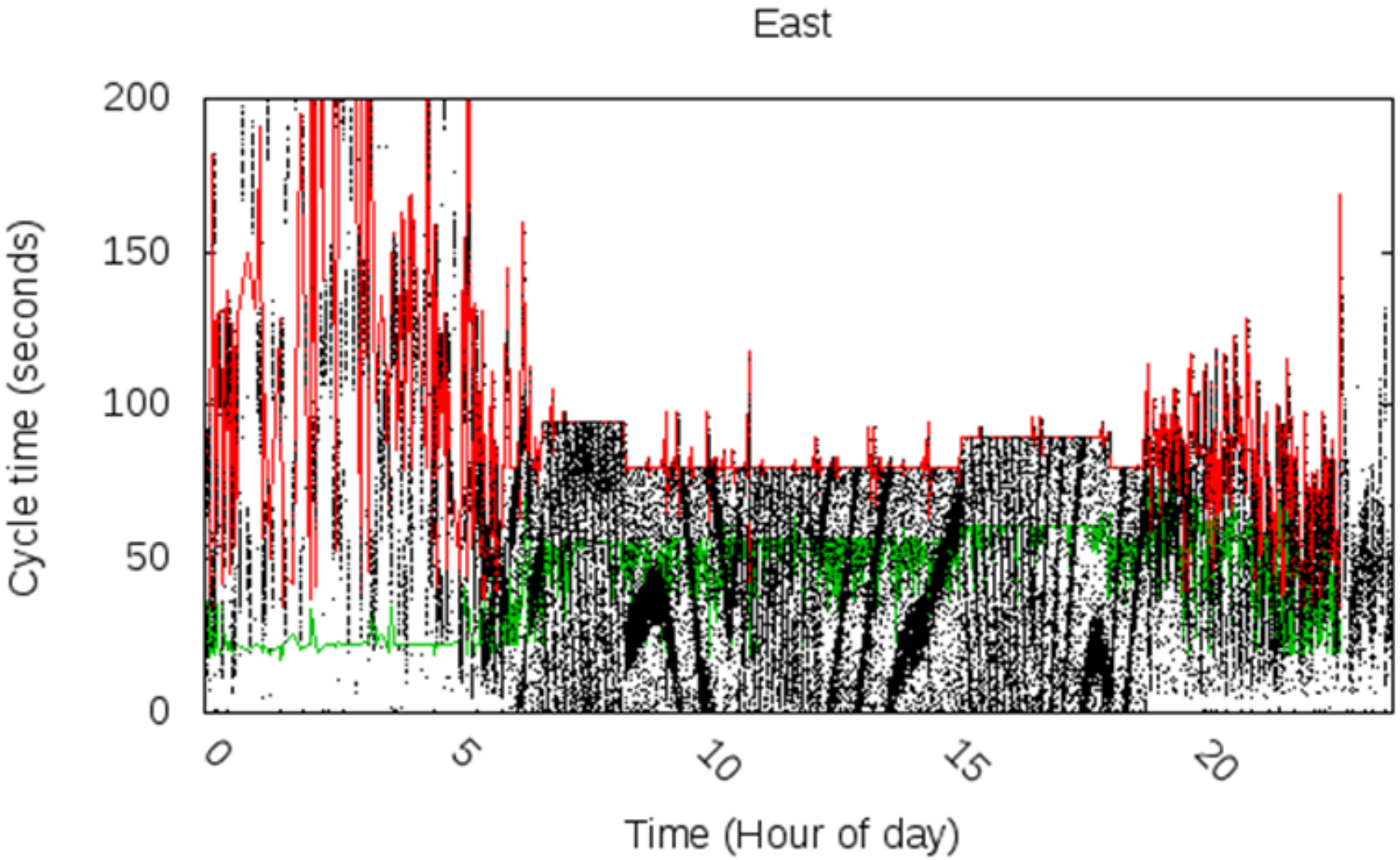
3 mile from adjacent intersection to north

Random arrivals from south

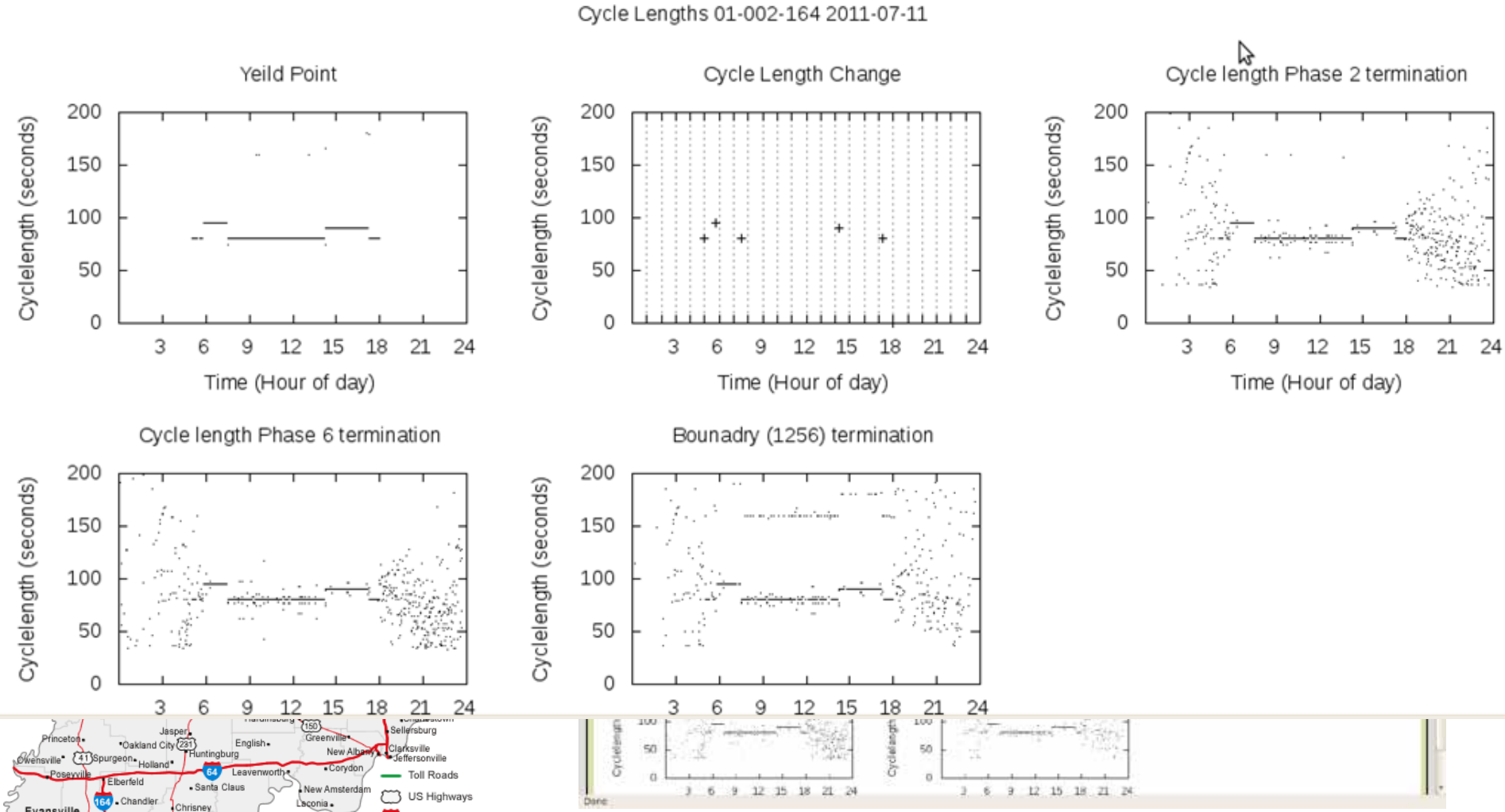
Indy-Bloomington
SR 37- Martinsville



SR 14- Ft Wayne



Remote Diagnostics-



Pooled Fund Study 1296

Architecture for Active Management of Geographically Distributed Signal Systems

THE NATIONAL TRANSPORTATION OPERATIONS COALITION (NTOC) IN ITS 2007 TRAFFIC SIGNAL REPORT CARD NOTED THAT, NATIONALLY, FIVE TO 10 PERCENT OF ALL TRAFFIC DELAY IS CAUSED BY IMPROPER TRAFFIC SIGNAL TIMINGS. THIS PAPER DESCRIBES OPPORTUNITIES TO MODERNIZE TRAFFIC SIGNAL MANAGEMENT ARCHITECTURES BY LEVERAGING COMMERCIAL

INTRODUCTION

Signalized arterials represent a substantial component of the highway transportation network in the United States. The National Transportation Operations Coalition (NTOC) in its 2007 Traffic Signal Report Card noted that, nationally, five to 10 percent of all traffic delay is caused by improper traffic signal timings along major roadways. In 2007, the National Report Card score for overall traffic signal systems operations was a D.

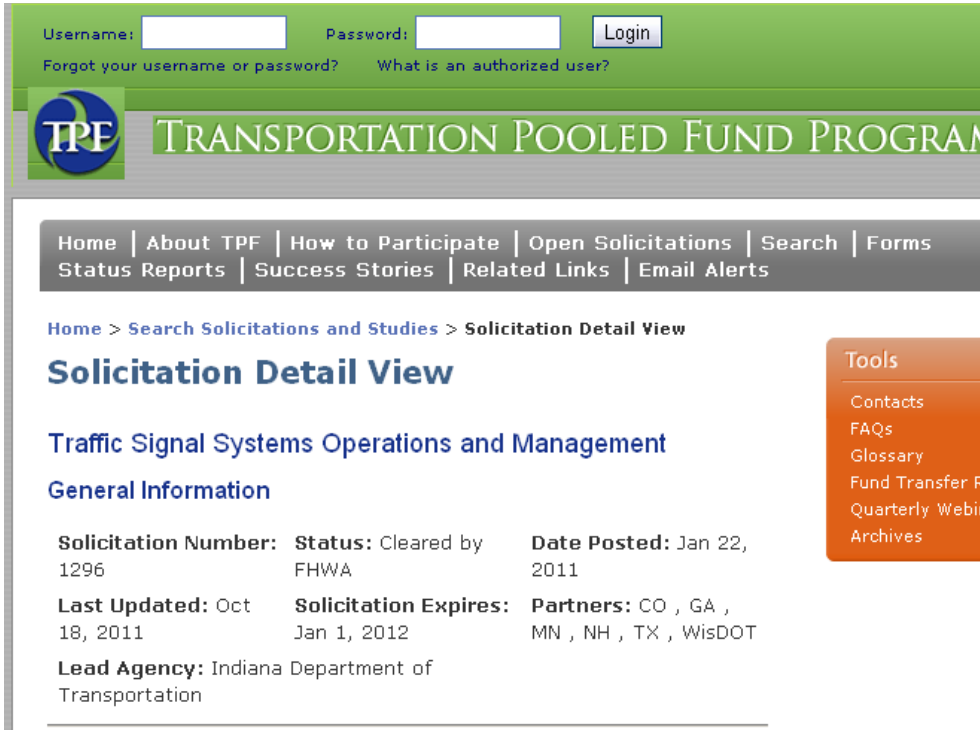
Upgraded intersection controllers, communication, detection equipment, closed loop systems, and/or central systems can provide modest improvements.[1,2] However, there are more significant improvement opportunities for traffic operations and agency manpower efficiency by defining active management practices and implementing alternative traffic signal architectures that go beyond traditional closed loop and central system models. The following sections document the state of Indiana's vision and

green time to ensure that all movements have sufficient capacity. However, there are clearly other objectives that may or may not enter into consideration, such as pedestrian service, transit priority, and emergency vehicle operations. Although this is an obvious step, agency staff responsible for managing the system will not have clear guidance on how to prioritize competing demands unless there is clear consensus on an agency's priorities.

2. **Collect fundamental signal operations data.** Historically, central and closed-loop monitoring systems have displayed near real-time status of phase indications and detectors, but only archived five- or 15-minute flow rates. For any substantive analysis of the signals operation, high-resolution phase indication and detector status must be collected.[4, 5]
3. **Analyze data using theoretically**

Shameless Plug;
Pooled Fund Study 1296 Objectives

- Develop a network of transportation agencies to:
  - i) **Performance Measures**: develop consensus on operational standards of performance,
  - ii) **Central System Architecture for Distributed Wide Area Systems** : define a central management model that can leverage commercial wireless IP offerings that can be competitively outsourced, and
  - iii) **Management Concepts and Guidelines** : for using a central system, identify when and where resources are most needed to maximize return on investment.



Wrapping up:

- Communications and Performance Measures Prototyping: Reliability and Scalability (Easy Button?)
- ~100 controllers by end of year is a start, but only a fraction of the whole.

Questions?

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- Thank you!!
- Contact: Jim Sturdevant
  jsturdevant@indot.in.gov