A Portable Monitoring and Evaluation System for Traffic Signals

Texas Transportation Institute

September 16, 2011

Project Overview

- **Identification of operational problems at signalized intersections**
- **Typically signal controller is programmed to operate in an optimum manner**
  - ***No information is available to evaluate operations (complaints)***
- **AWEGS, PIA, D-CS systems monitor, use, and document intersection operations**
  - ***Will serve as the frame work for the development of maintenance/monitoring tool***

Project Objective

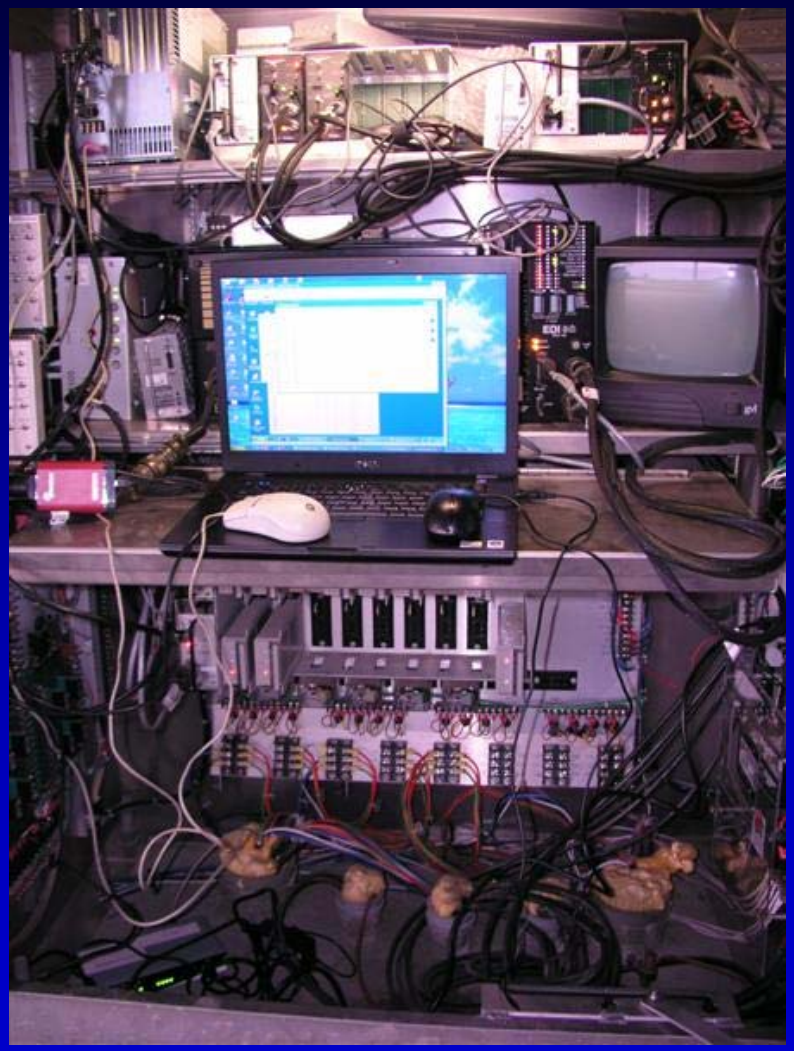
- **Develop a tool to monitor, log, analyze traffic signal operations**
  - ***TS2 Cabinet***
- **Portable and easy to install in a cabinet**
- **Configured using off the shelf hardware components**

Architecture Components

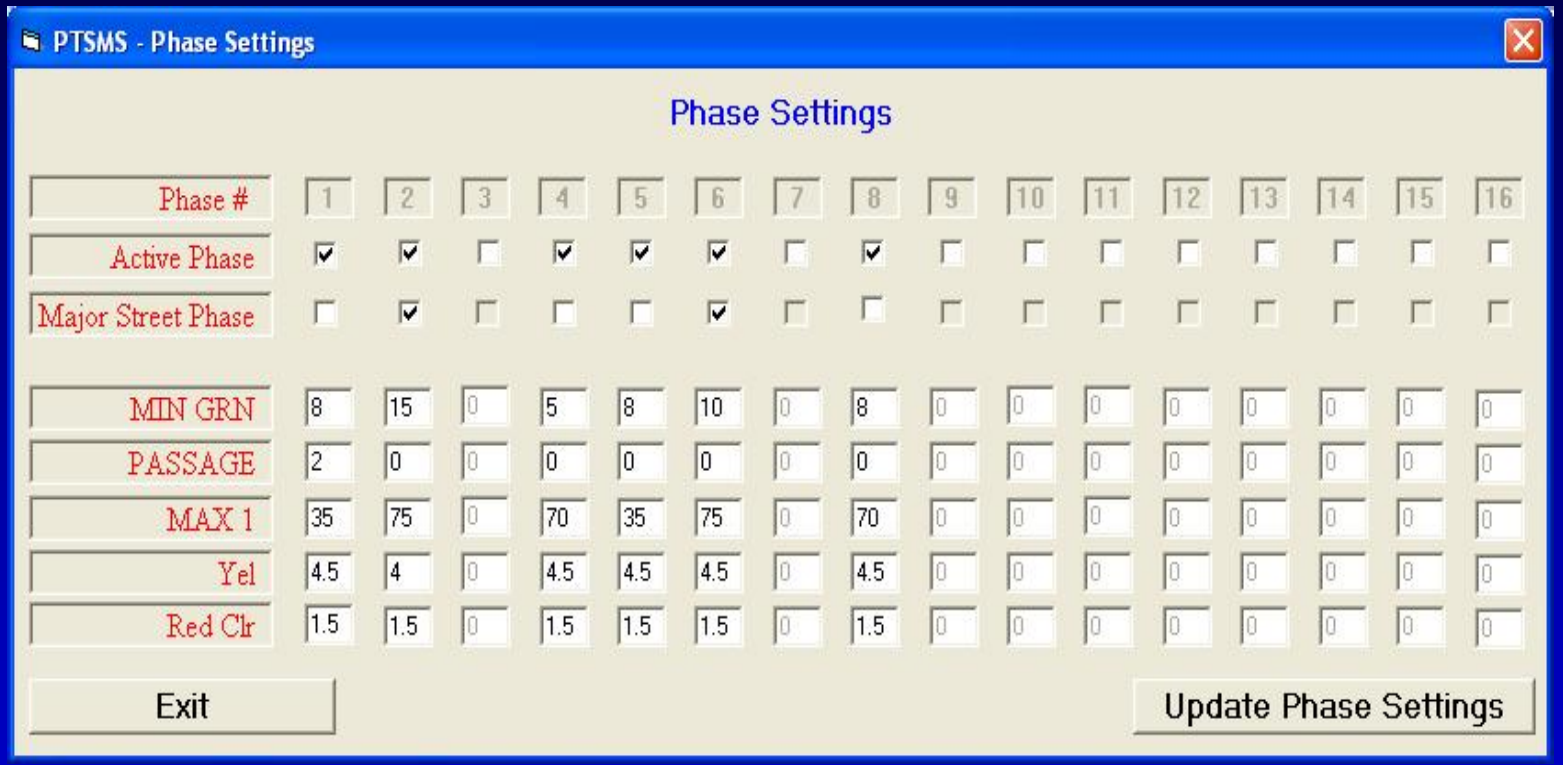
- **Hardware**
  - *Use of enhanced BIUs*
  - *Field hardened computer (compact)*
- **Software**
  - *User friendly GUI*
  - *Generate performance measures*
    - **Readily available results**
    - **Customizable results**

Prototype Implementation

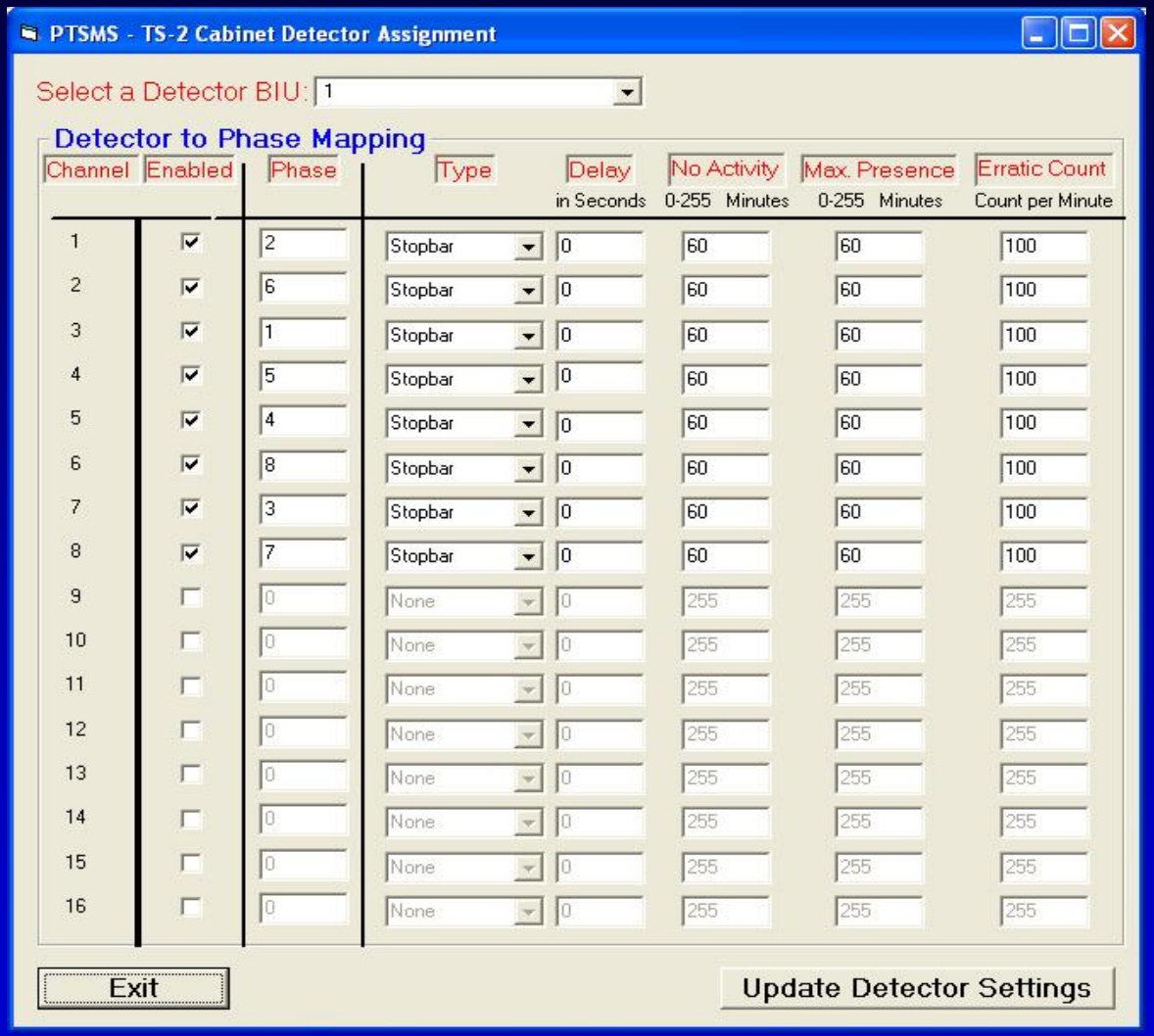
- **Installed a prototype in the field**
  - *SH 6 and SH 40*
  - *16 phases*
  - *Detectors up to 24*
  - *Four BIUs*



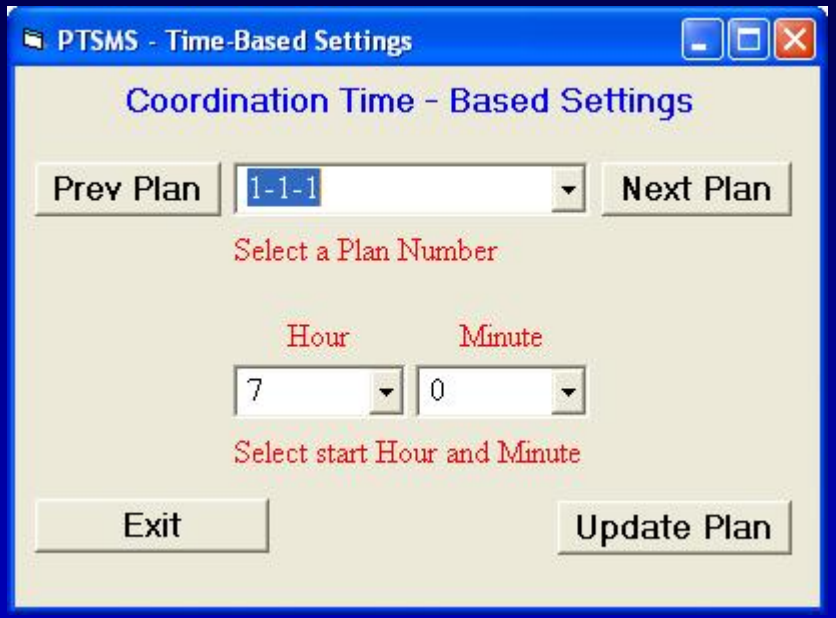
Phase Settings



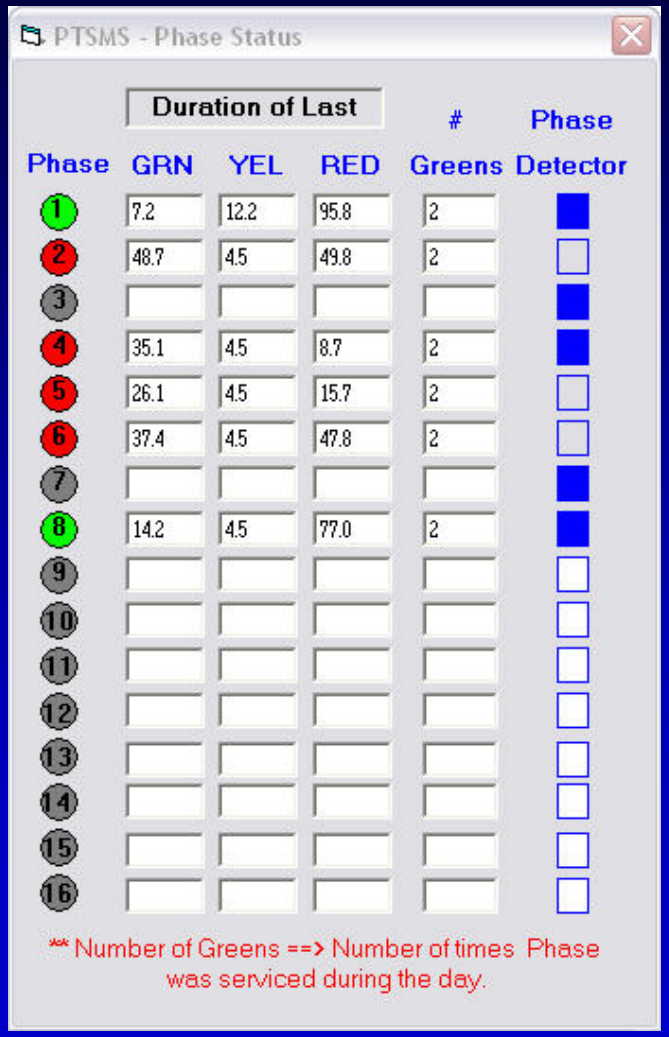
Detector Assignment



Coordination Settings



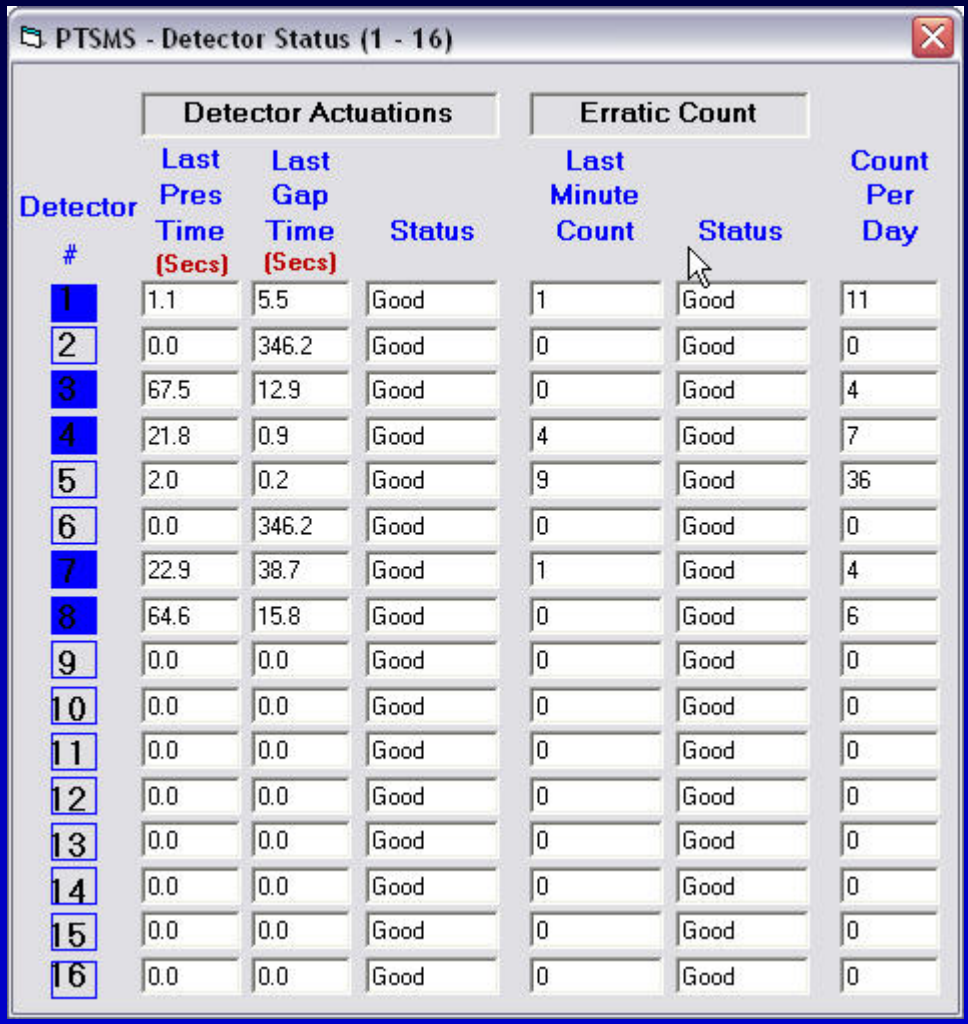
Signal Operations



PTSMS - Phase Status

Phase	Duration of Last GRN	Duration of Last YEL	Duration of Last RED	# Greens	Phase Detector
1	7.2	12.2	95.8	2	■
2	48.7	4.5	49.8	2	□
3					■
4	35.1	4.5	8.7	2	■
5	26.1	4.5	15.7	2	□
6	37.4	4.5	47.8	2	□
7					■
8	14.2	4.5	77.0	2	■
9					□
10					□
11					□
12					□
13					□
14					□
15					□
16					□

** Number of Greens ==> Number of times Phase was serviced during the day.

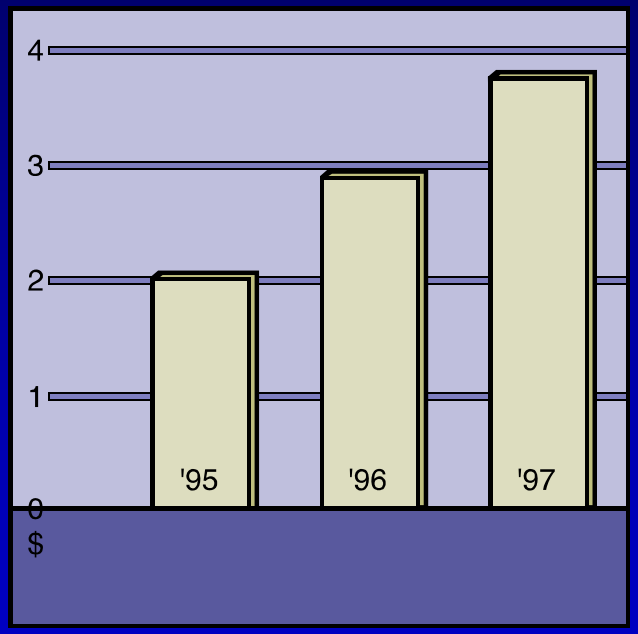


PTSMS - Detector Status (1 - 16)

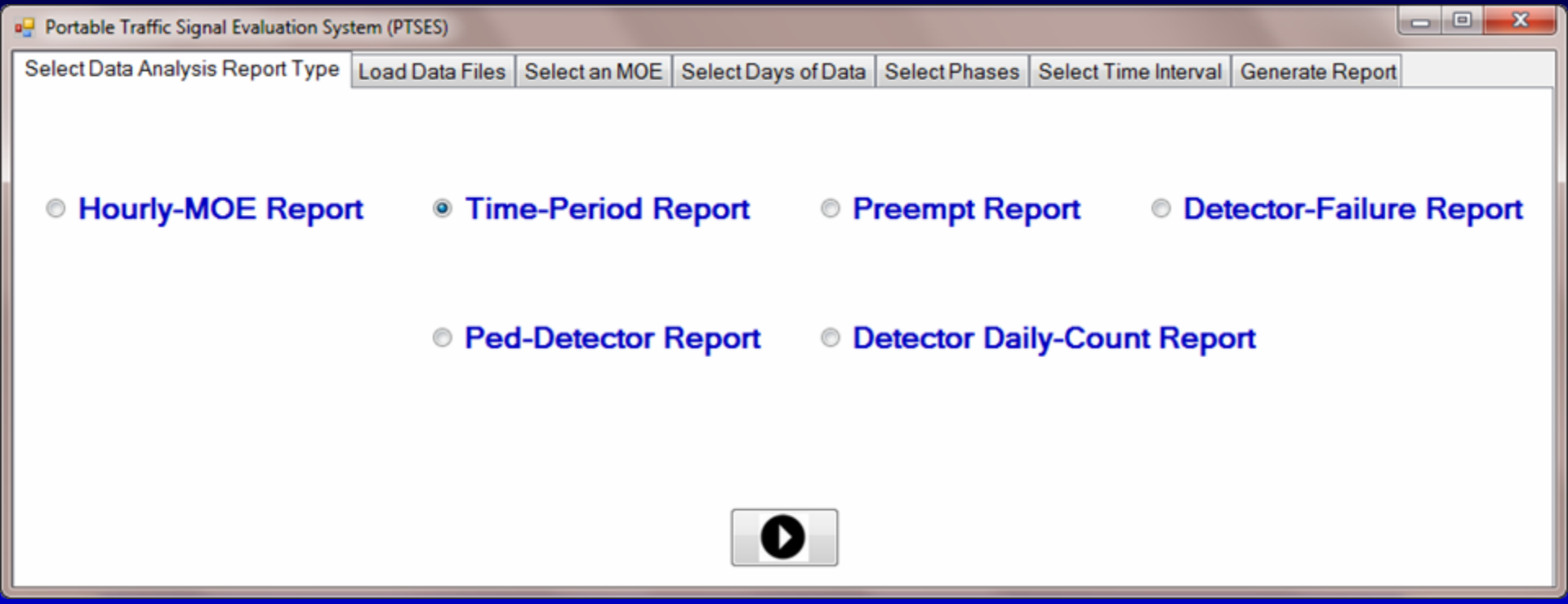
Detector #	Detector Actuations Last Pres Time (Secs)	Detector Actuations Last Gap Time (Secs)	Detector Actuations Status	Erratic Count Last Minute Count	Erratic Count Status	Count Per Day
1	1.1	5.5	Good	1	Good	11
2	0.0	346.2	Good	0	Good	0
3	67.5	12.9	Good	0	Good	4
4	21.8	0.9	Good	4	Good	7
5	2.0	0.2	Good	9	Good	36
6	0.0	346.2	Good	0	Good	0
7	22.9	38.7	Good	1	Good	4
8	64.6	15.8	Good	0	Good	6
9	0.0	0.0	Good	0	Good	0
10	0.0	0.0	Good	0	Good	0
11	0.0	0.0	Good	0	Good	0
12	0.0	0.0	Good	0	Good	0
13	0.0	0.0	Good	0	Good	0
14	0.0	0.0	Good	0	Good	0
15	0.0	0.0	Good	0	Good	0
16	0.0	0.0	Good	0	Good	0

Monitoring System

- **Signal Operations**
  - *Coordination Operations*
- **Preemption Activity**
- **Pedestrian Activity**
- **Average Hourly Report**
- **Cycle by Cycle Report**



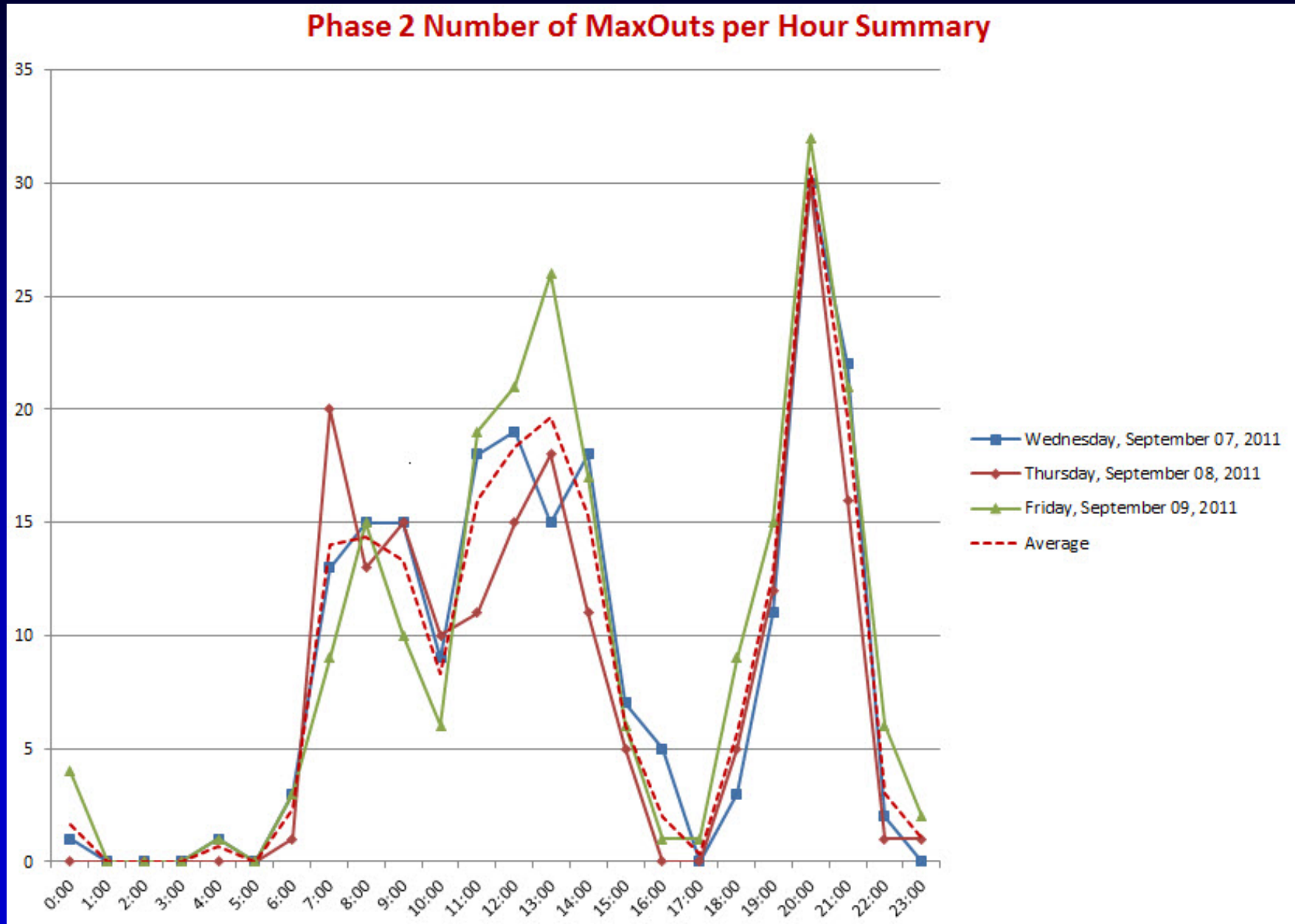
Data Analysis



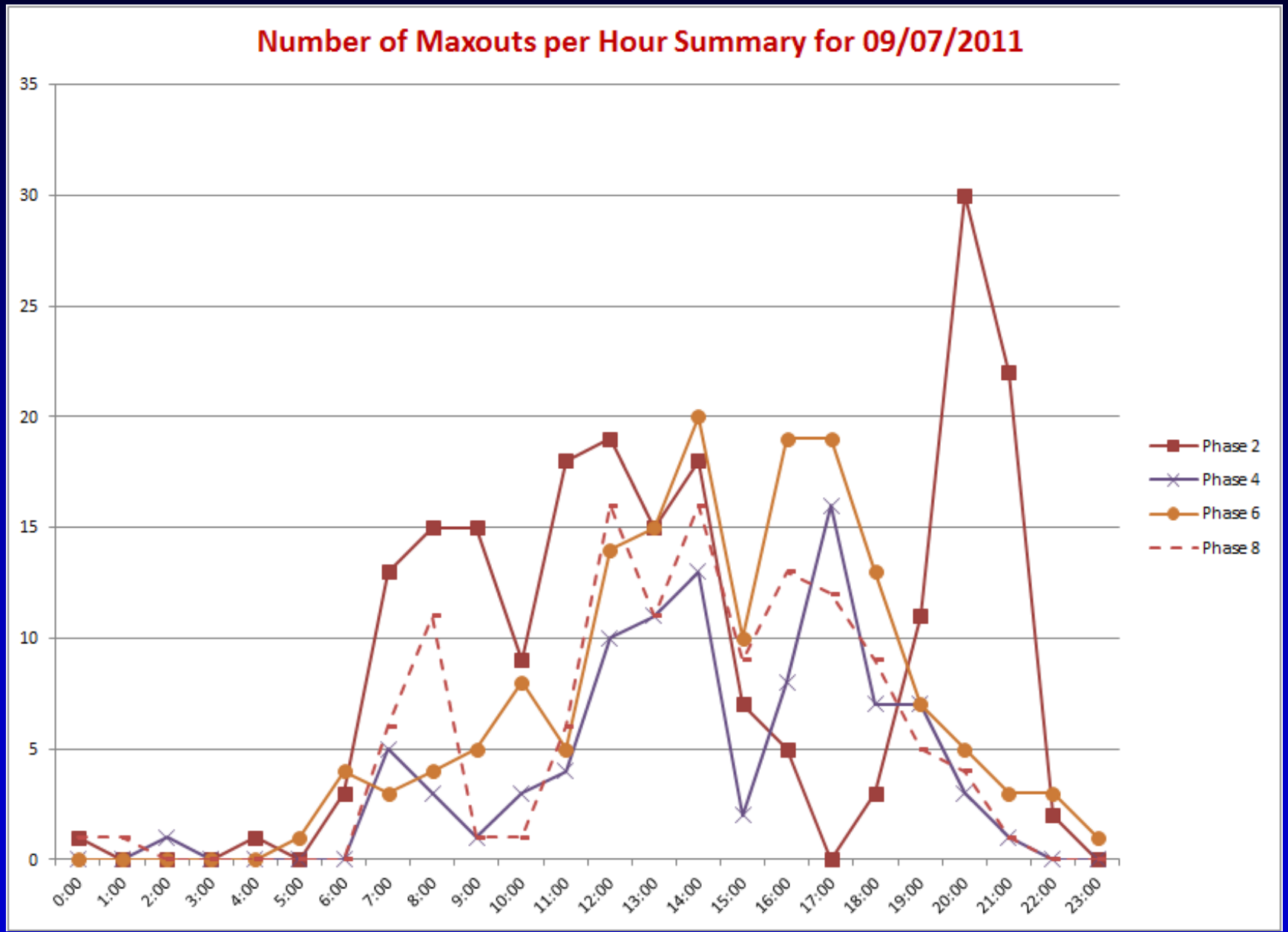
Measures of Effectiveness

- Number of Minimum Greens
- Number of Max-outs
- Average Phase Lengths
- Time to Service
- Queue Service Time
- Detector Occupancy
- Actuations

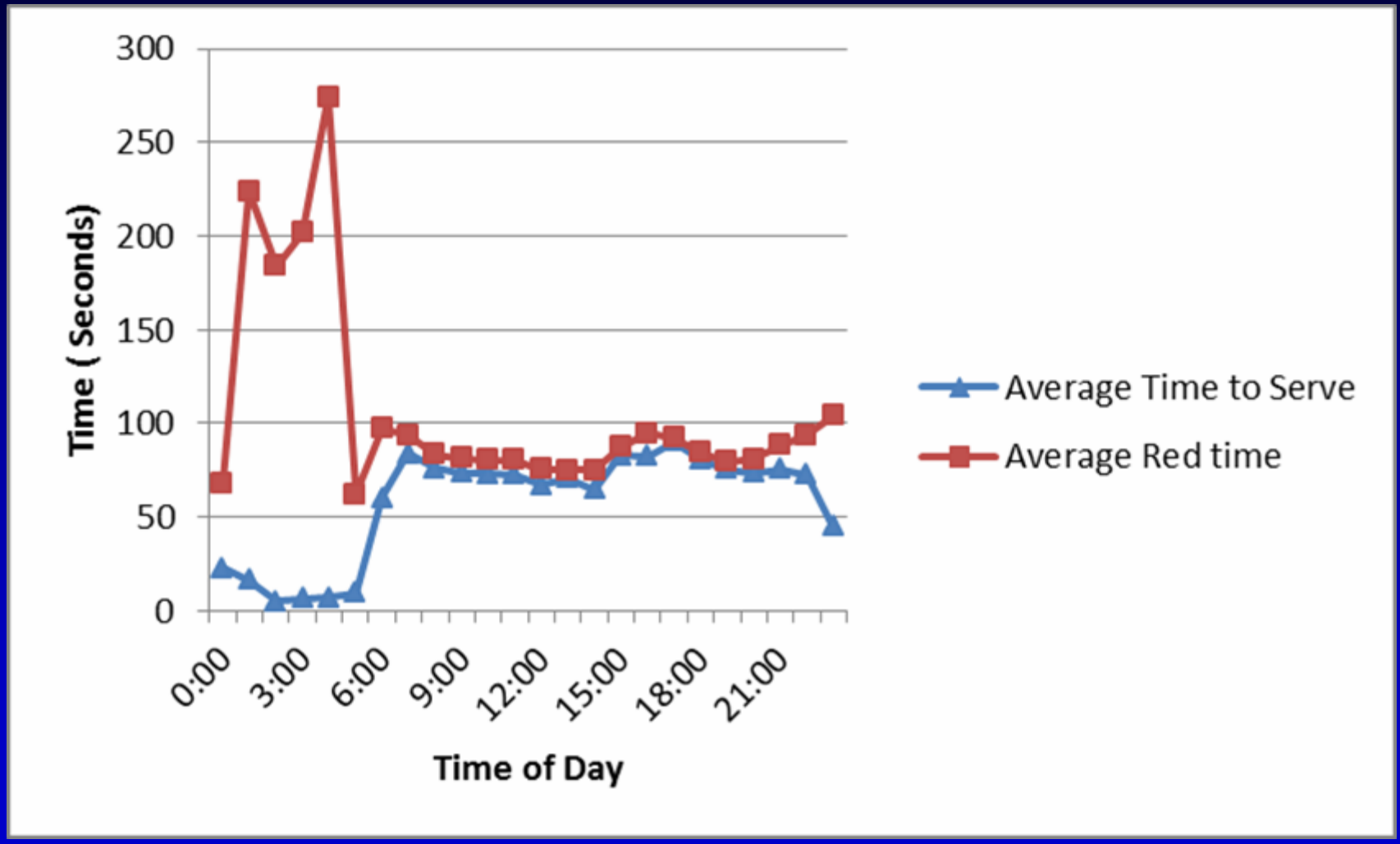
Max-Outs Phase 2



Max-out Behavior



Delay Experienced (Phase 4)



Cycle by Cycle Data (Phase 4)

Phase	CycleNo	Green Start	Green	MinGrn	Max1	Coordination Status
4	179	07:01:03	00:17	00:05	01:10	Coord
4	180	07:02:45	00:23	00:05	01:10	Coord
4	181	07:04:25	00:18	00:05	01:10	Coord
4	182	07:06:23	00:17	00:05	01:10	Coord
4	183	07:08:23	00:23	00:05	01:10	Coord
4	184	07:10:23	00:11	00:05	01:10	Coord
4	185	07:12:23	00:40	00:05	01:10	Coord
4	186	07:14:23	00:40	00:05	01:10	Coord
4	187	07:16:23	00:40	00:05	01:10	Coord
4	188	07:18:23	00:40	00:05	01:10	Coord
4	189	07:20:23	00:40	00:05	01:10	Coord
4	190	07:22:23	00:40	00:05	01:10	Coord
4	191	07:24:23	00:40	00:05	01:10	Coord
4	192	07:26:23	00:15	00:05	01:10	Coord

Phase	CycleNo	G S	ed	Occupancy on Red	Time to Service	Count on Green	Count on Yellow	Count on Red
4	179	07	1:21	00:01:09	00:01:09	0	0	1
4	180	07	1:12	00:01:12	00:01:12	0	1	0
4	181	07	1:36	00:01:27	00:01:27	0	0	1
4	182	07	1:38	00:01:37	00:01:37	0	0	1
4	183	07	1:33	00:01:17	00:01:17	0	0	1
4	184	07	1:45	00:01:14	00:01:14	0	0	1
4	185	07	1:15	00:01:15	00:01:15	0	0	0
4	186	07	1:15	00:01:15	00:01:15	0	0	0
4	187	07	1:15	00:01:15	00:01:15	0	0	0
4	188	07	1:15	00:01:15	00:01:15	0	0	0
4	189	07	1:15	00:01:15	00:01:15	0	0	0
4	190	07	1:15	00:01:15	00:01:15	0	0	0
4	191	07	1:15	00:01:15	00:01:15	0	0	0
4	192	07	1:40	00:01:40	00:01:40	0	1	0
4	193	07	1:31	00:01:24	00:01:24	0	0	1
4	194	07	1:39	00:01:39	00:01:39	0	1	0
4	195	07	1:38	00:01:30	00:01:30	0	0	1
4	196	07	1:31	00:01:26	00:01:26	0	1	1
4	197	07	1:38	00:01:30	00:01:30	0	0	1
4	198	07	1:37	00:01:19	00:01:19	0	0	1
4	199	07	1:40	00:01:12	00:01:12	0	0	1
4	200	07	1:39	00:01:33	00:01:33	0	0	1
4	201	07	1:33	00:01:28	00:01:28	0	0	1
4	202	07	1:29	00:01:01	00:01:01	1	1	1
4	203	07	1:45	00:01:29	00:01:29	0	0	1
4	204	07	1:21	00:01:20	00:01:20	2	0	1

Diagnostics

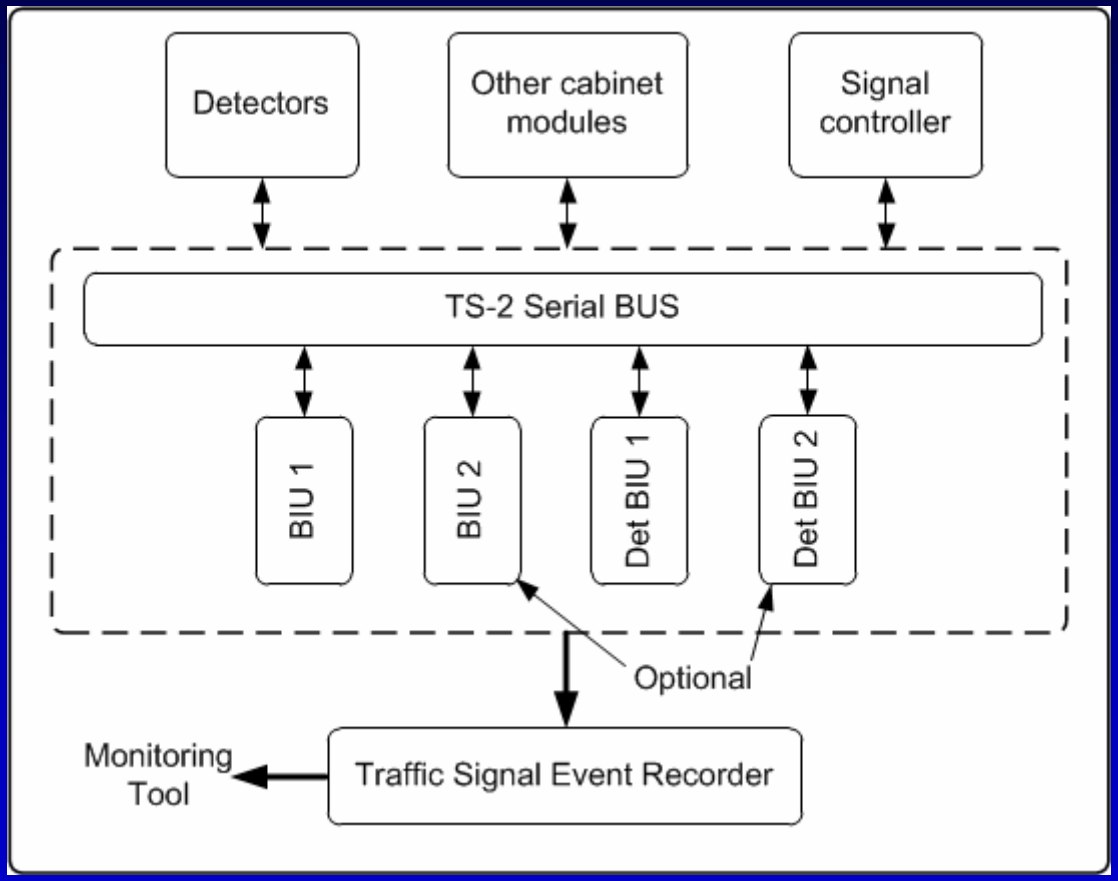
	Indicators	Possible Causes	Potential Actions
Number of Minimum Greens	• High number of minimum greens. • Relative low occupancy on green at the same time.	• The phase may be on min recall. • The demand on the phase is light but fairly uniform.	• Check if the minimum green is too long. • Check if the right-turn-on-red vehicles can be sufficiently serviced with detector delay.
	• Low number of minimum greens.	• Moderate to heavy traffic demand on that phase. • The arrival pattern is consistent.	• No action required.
Occupancy on Green	• High occupancy on green (near 100%) only at a certain time of day.	• Heavy traffic demand on that phase.	• If the occupancy on green on the conflict phase is below 100%, max time for this phase may be increased.
	• High occupancy on green (near 100%) constantly throughout the day.	• Malfunctioned detector is placing a constant call.	• Check the phase detector.

Limitations and Future Work

- Use of detector BIUs that do not have a serial port
- Requires data to be input
- Modify it for NTCIP controllers

Questions

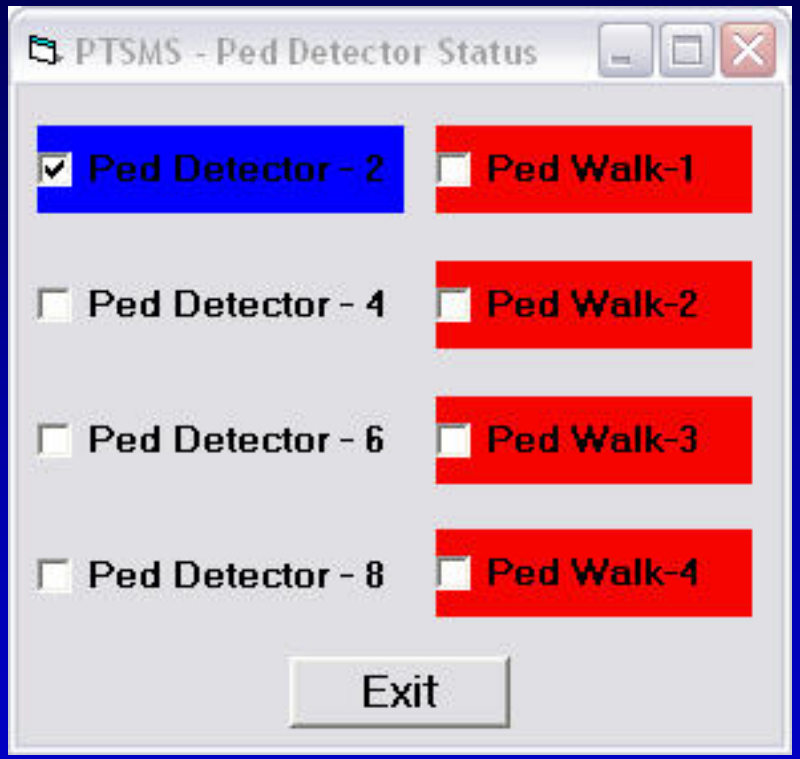
System Architecture

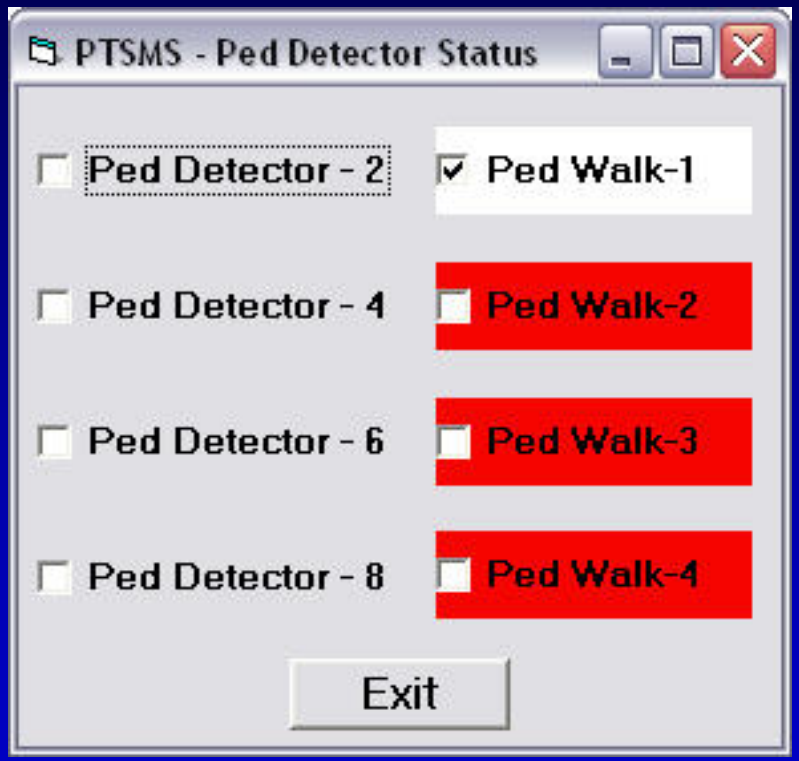


Prototype Development

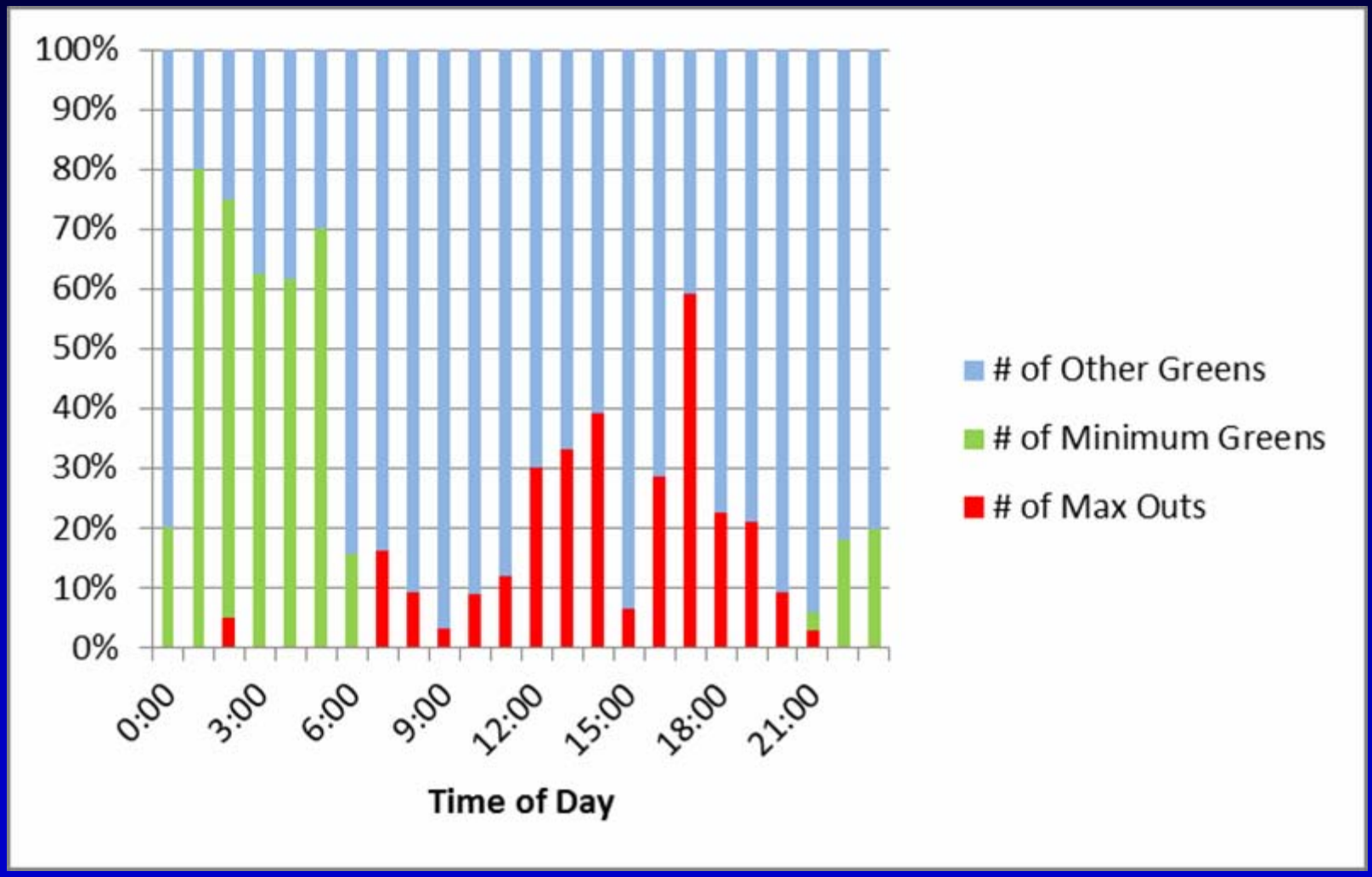
- **Implemented the prototype system in TransLink laboratory**
  - *Eight phases*
  - *Eight detectors*
  - *Two BIUs*

Pedestrian Operations





Phase Utilization – Phase 4



Max-Outs Phase 4