Development of Intersection Performance Measures for Timing Plan Maintenance Using an Actuated Controller

Edward J. Smaglik, Ph.D.

Arizona Roads & Streets Conference

April 10th, 2009

ADOT

NORTHERN ARIZONA UNIVERSITY

Agenda

- Background
- Research Phases
  - Proof of Concept (in progress – ATRC)
  - Data Collection (future)
  - Data Management and Analysis (future)
- Questions

Background

- Traffic signal timing maintenance
  - Which location?
    - Phone calls
    - Engineering judgment
    - Length of time since previous retime
    - Local development
    - Traffic pattern shift
    - Highway Capacity Manual (HCM) Methodologies

Background

- HCM Methodologies
  - Arrival Type
  - Delay
  - Volume/Capacity (V/C) ratio
- Data collection issues
  - Time of Day / Day of Week
  - Labor intensive
  - Peak hours may not match staffing hours
  - Snapshot

Background

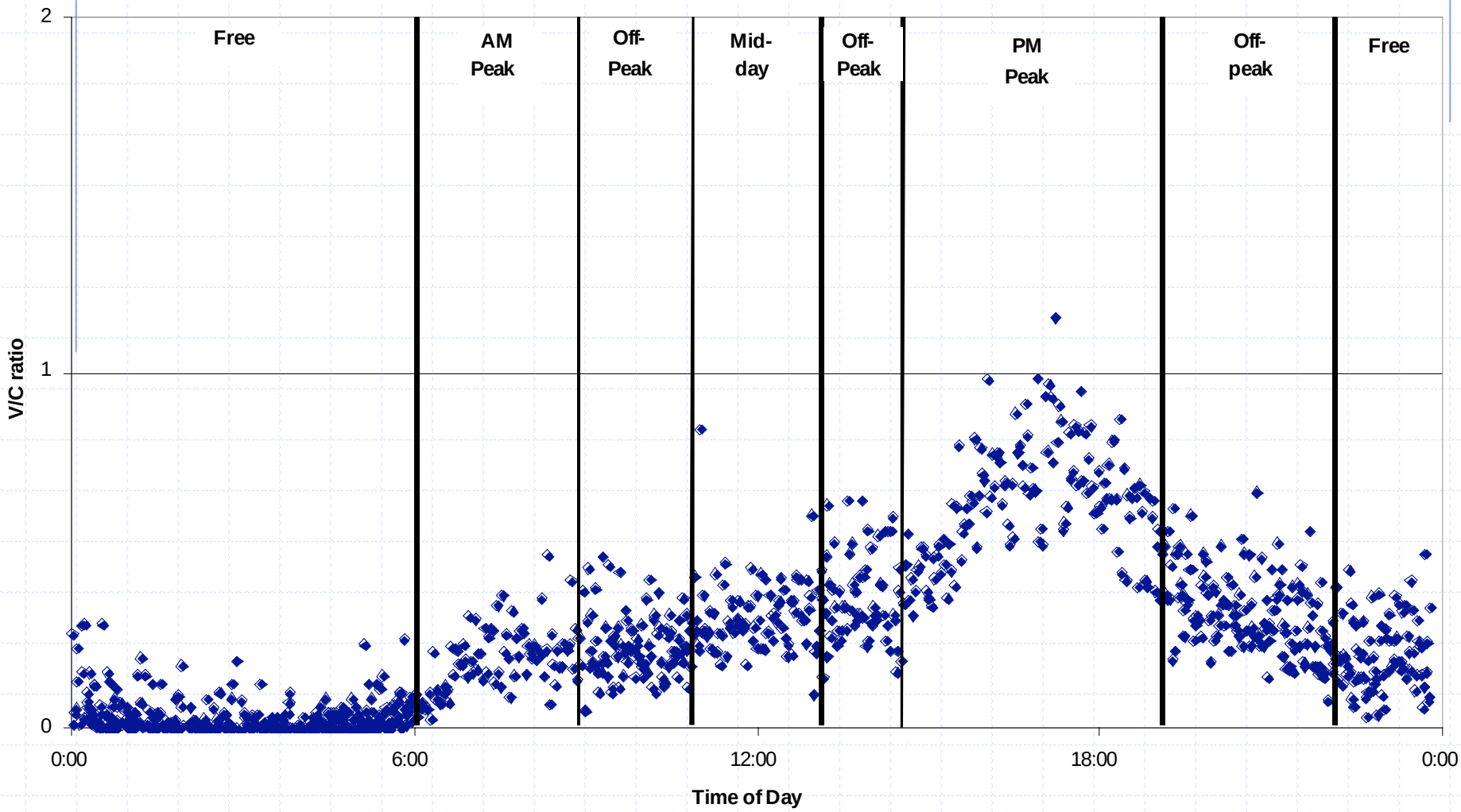
- Controller Enhancement
  - ASC/3 from Econolite Control Products
- Event data is recorded in binary on controller for all
  - Detectors in use (1-64)
  - Phases in use (1-16)
- Re-creation of field events from data log

Event Based Data

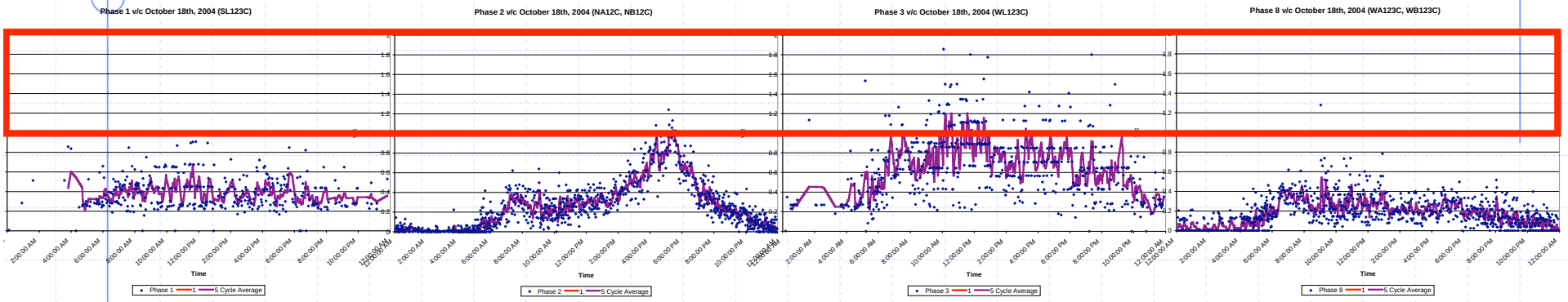
Percent Arrival on Green
60%
20%
80%

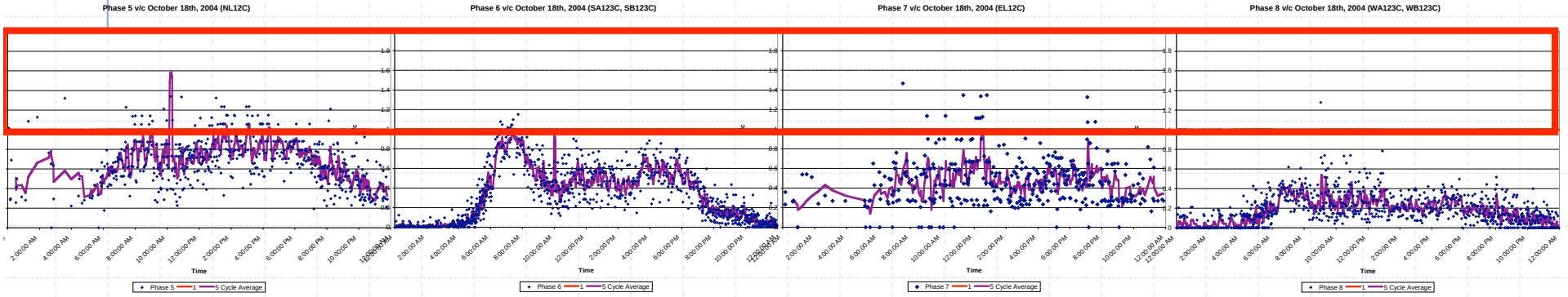
- Fidelity of measurements lost when binned together
- Ex:
  - Avg: 53.3%

V/C Ratio


Free
AM Peak
Off-Peak
Mid-day
Off-Peak
PM Peak
Off-peak
Free
2
1
0
V/C ratio
0:00
6:00
12:00
18:00
0:00
Time of Day

V/C Plots for all phases

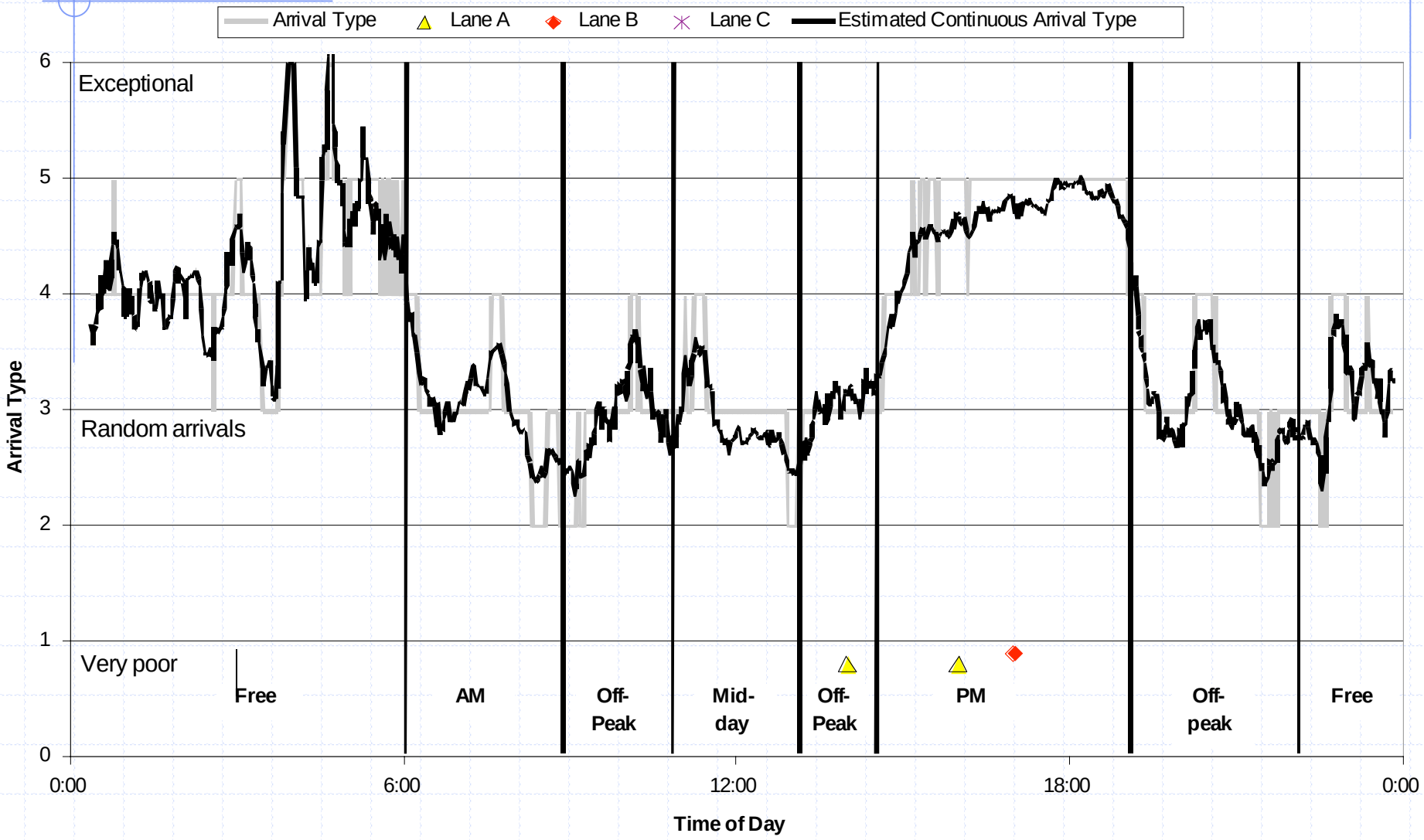




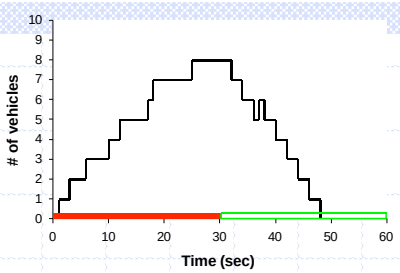
Problems?

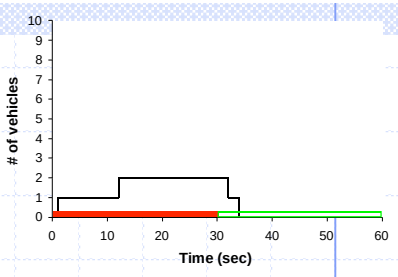
1	2	3	4
5	6	7	8

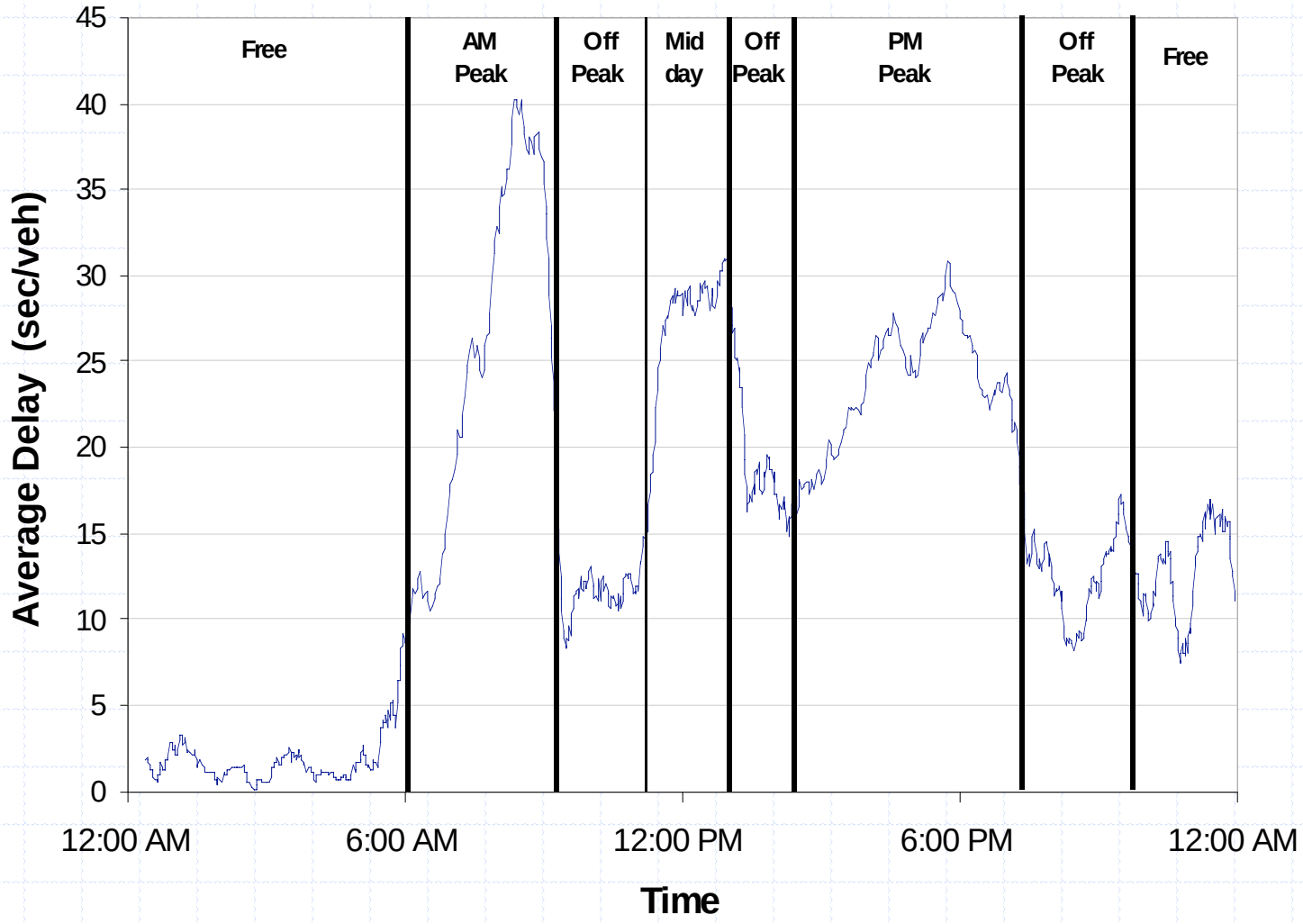
MOEs – Arrival Type (P2)



MOEs - Delay


# of vehicles
Time (sec)


# of vehicles
Time (sec)

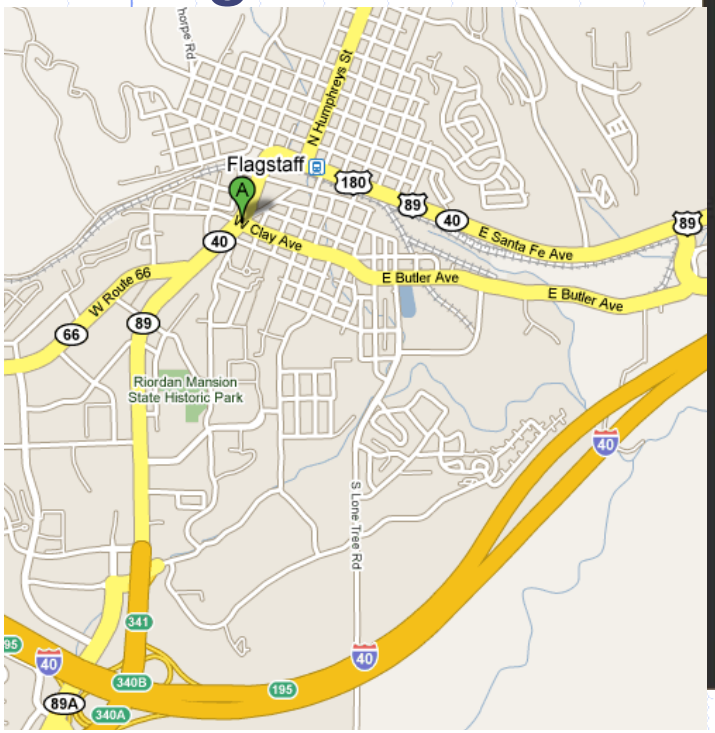

Free
AM Peak
Off Peak
Mid day
Off Peak
PM Peak
Off Peak
Free
Average Delay (sec/veh)
0
5
10
15
20
25
30
35
40
45
12:00 AM
6:00 AM
12:00 PM
6:00 PM
12:00 AM
Time

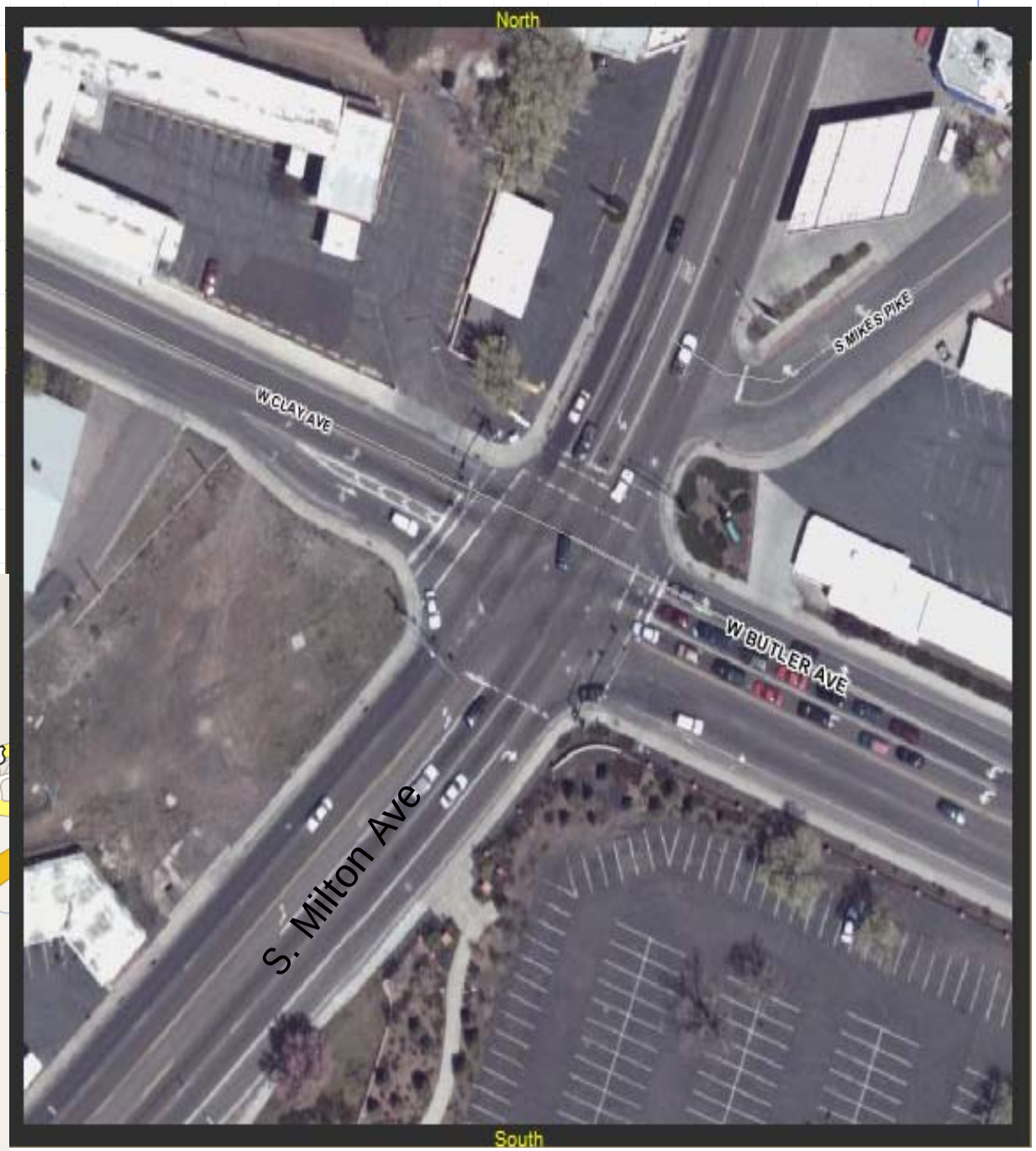
Proof of Concept

- Pick a location within ADOT system
- Enhance cabinet to produce Measures of Effectiveness (MOEs), using ASC/3 as data collector
  - Leverage as much existing equipment as possible
- Produce MOEs (V/C)
- Ground truth with manual counts to assess performance

Location

- Butler/Clay & Milton, Flagstaff, AZ



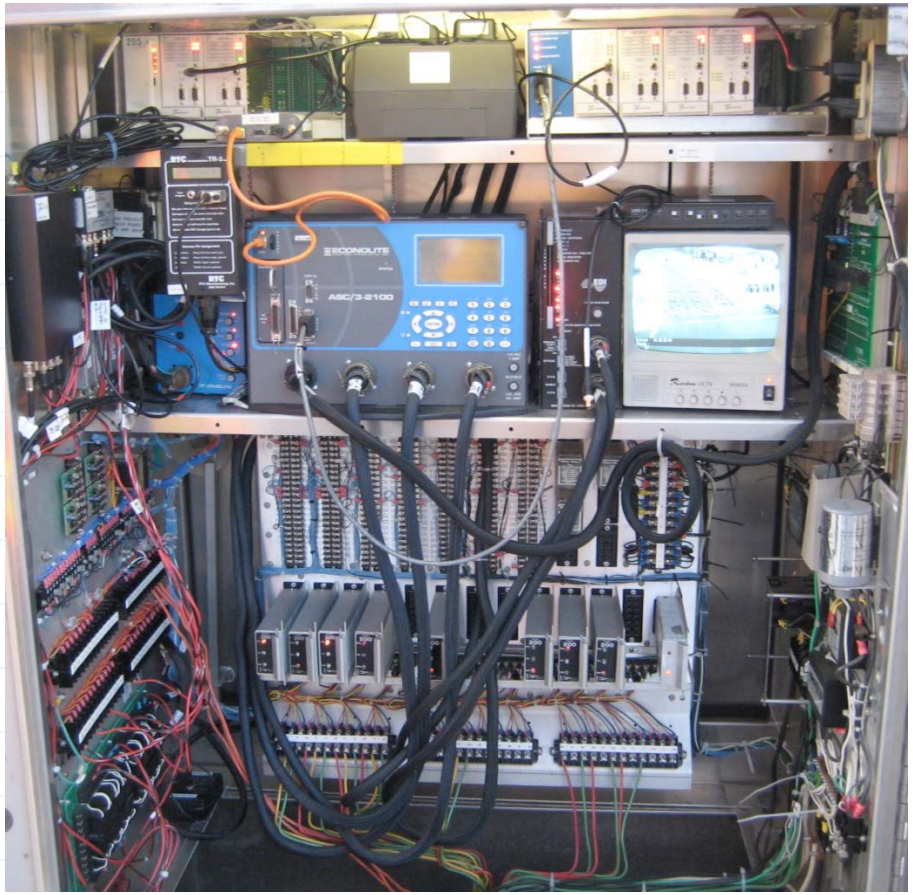



AAA
Show Your Card
Approved Lodging

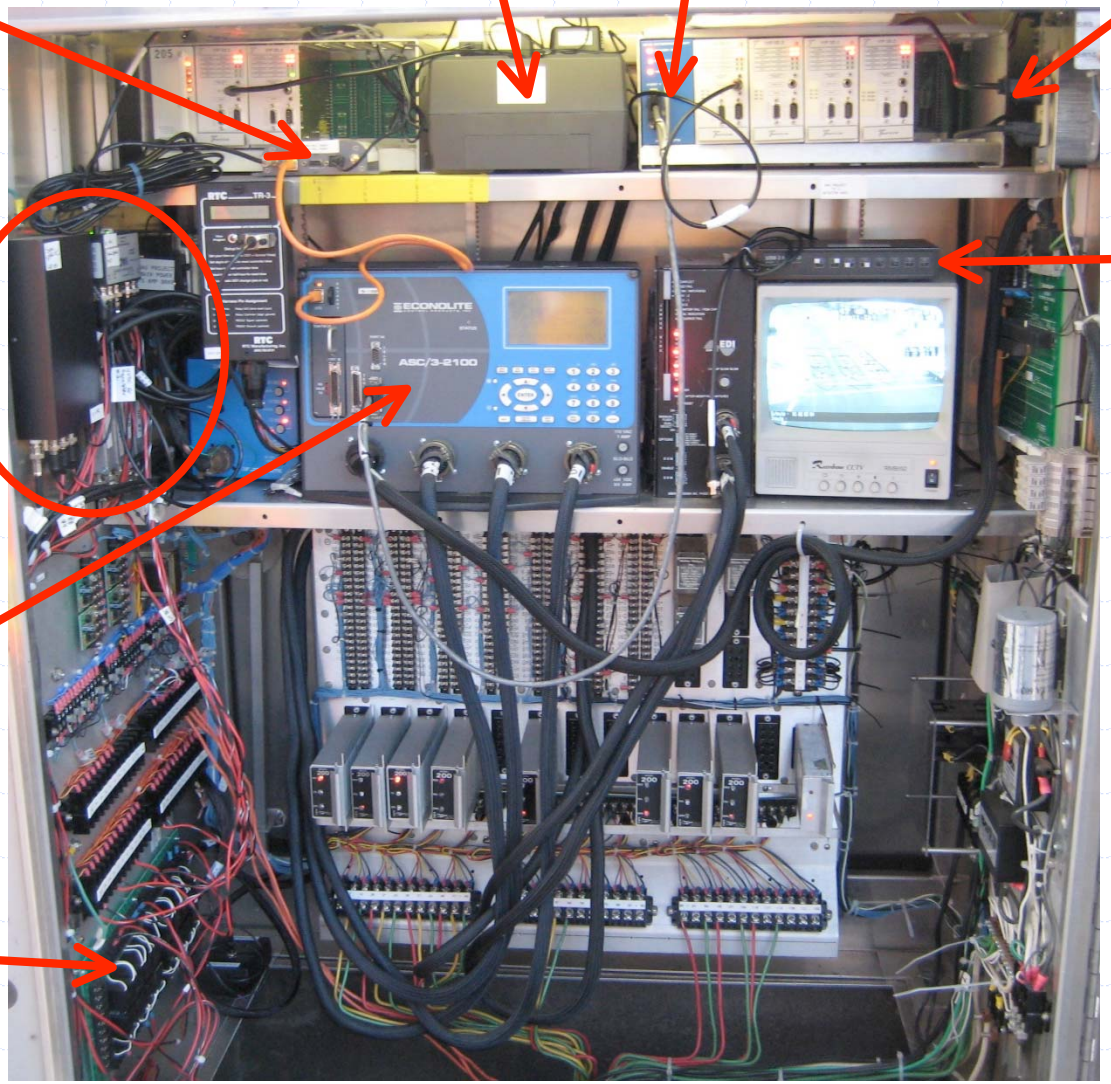
Cabinet Enhancements

Before

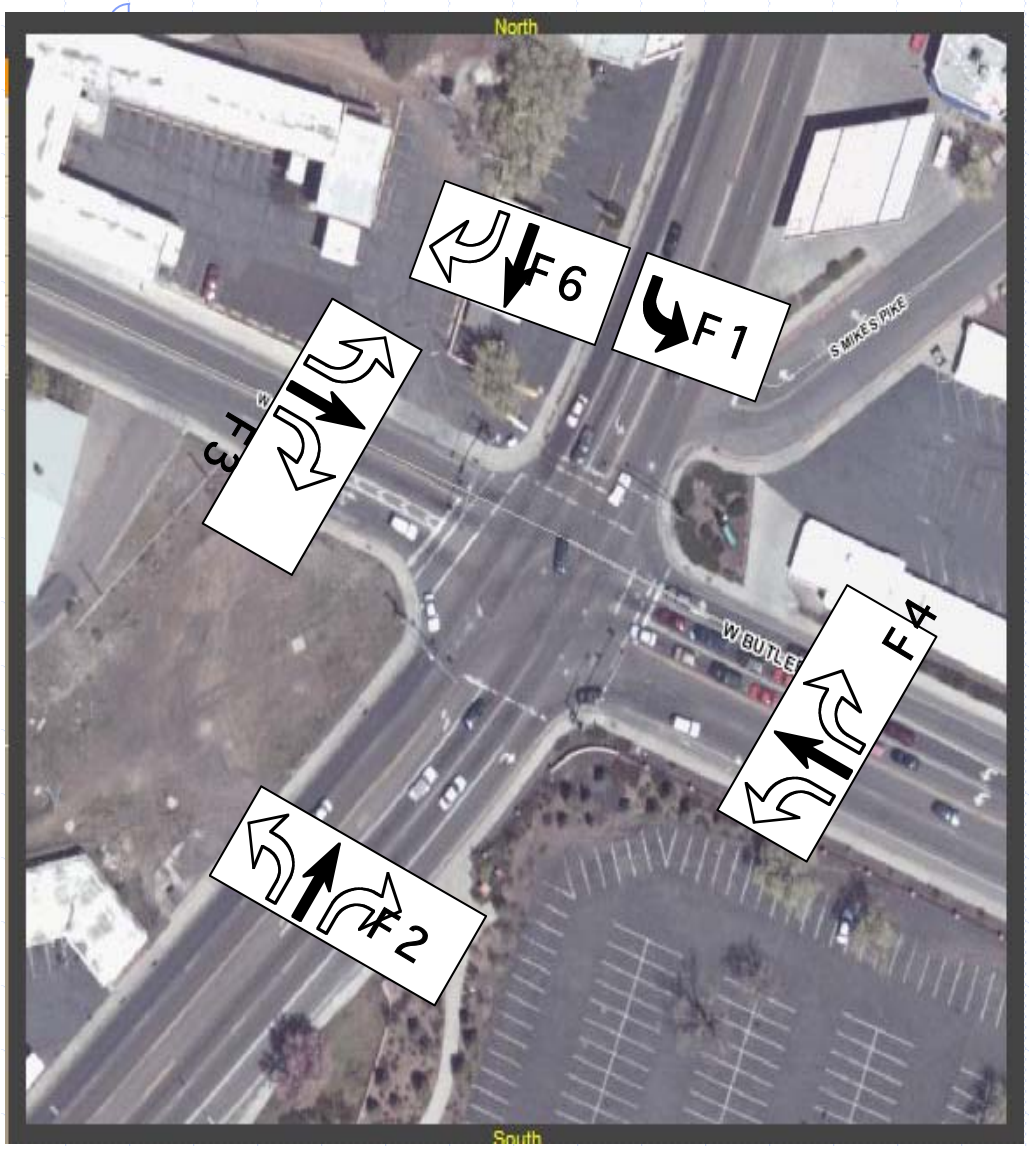
After



Added / Enhanced Equipment



V/C Ratio



$$\left(\frac{v}{c}\right)_l = \frac{q_g}{\left[s_l * \left(\frac{g_l}{C}\right)\right]} = \frac{(v_l * C)}{(s_l * g_l)}$$

v_l= Served flow rate for lane group

c_l = Capacity of lane group

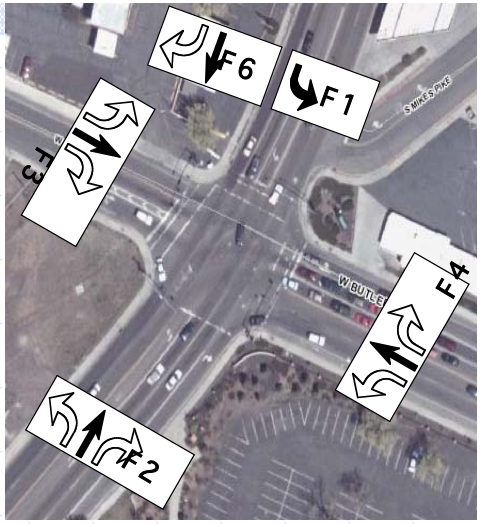
o_g = Flow rate observed for a green phase

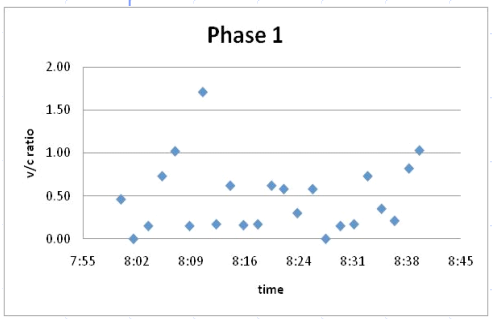
s_l= Observed lane saturation flow rate

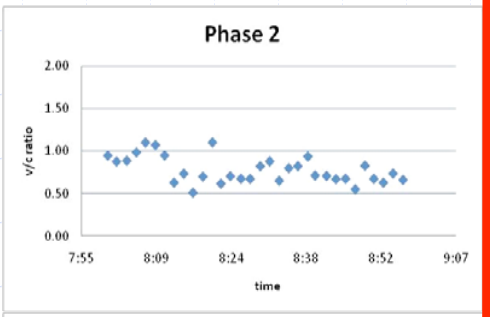
C = Cycle length

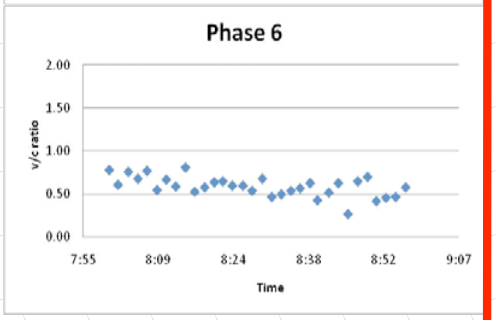
g_l = Length of green indication for movement

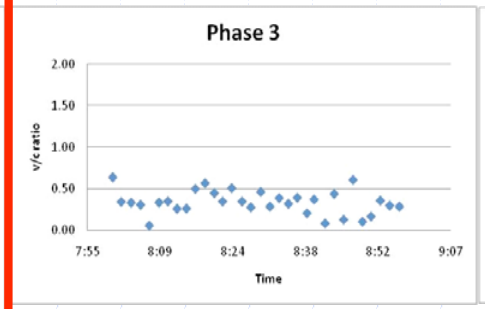
V/C Ratio
8 – 9 AM, 02.19.09

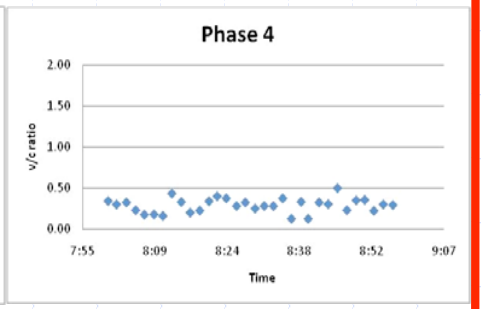












Proof of Concept

- Items to accomplish
  - Ground truth data with manual counts
  - Establish remote connection with cell modem (recently completed)
  - Submit final report to ATRC in Summer 2009

Future work

- Phase II – Data Collection
  - Develop and deploy prototype data collection module
  - Develop standards to enable data collection at new and rehabilitated locations
- Phase III ? – Data Management and Analysis
  - Desktop computer data storage and management system
  - User friendly interface to provide input data for software modules
    - Synchro
    - HCS+
    - Other

Questions?