

High-Fidelity Data at Signalized Intersections: A Research Approach

PROJECT:

**Improving Adaptive/Responsive Signal Control Performance:
Implications of Non-Invasive Detection and Legacy Timing Practices**

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Outline

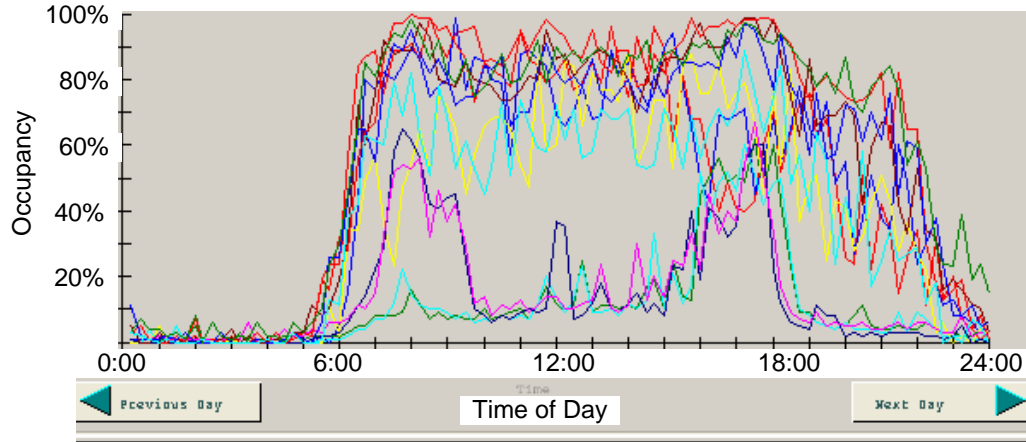
- Introduction
- Motivation
- Module Development
- Deployment Sites
- Data Collection
- Preliminary Results
- Next Steps

- Different detection sources provide varying levels of accuracy
- The impact of less than optimal detection on traditional call and extend operation is well known
- How does sub-optimal detection impact the operation of higher level control algorithms, such as adaptive and/or traffic responsive?

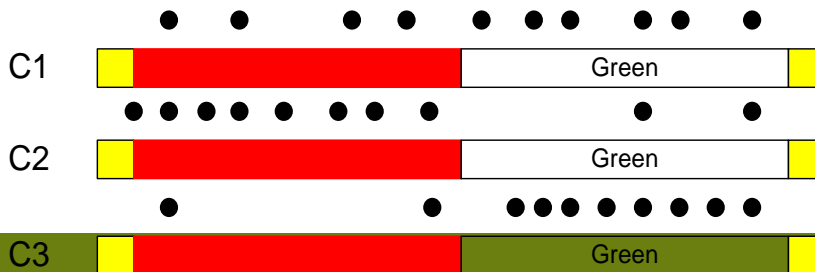
Motivation

- Desire to collect high resolution event based data from 2070 running Voyage (Northwest Signal / Peek)
- Inspiration taken from ASC/3 event based data logger worked on while at Purdue
- Desire to collect as large a sample as possible
- Need for portable event based data logger

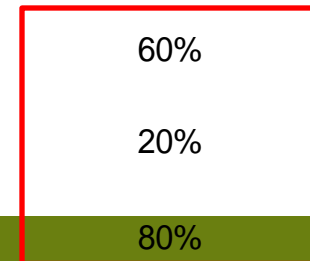
Event Based Data



- 4/12/2006 Zone 11 Intersection 6 Detector 1 Occupancy Data
- 4/12/2006 Zone 11 Intersection 6 Detector 2 Occupancy Data
- 4/12/2006 Zone 11 Intersection 6 Detector 3 Occupancy Data
- 4/12/2006 Zone 11 Intersection 6 Detector 4 Occupancy Data
- 4/12/2006 Zone 11 Intersection 6 Detector 5 Occupancy Data
- 4/12/2006 Zone 11 Intersection 6 Detector 6 Occupancy Data
- 4/12/2006 Zone 11 Intersection 6 Detector 7 Occupancy Data
- 4/12/2006 Zone 11 Intersection 6 Detector 8 Occupancy Data
- 4/12/2006 Zone 11 Intersection 6 Detector 9 Occupancy Data
- 4/12/2006 Zone 11 Intersection 6 Detector 10 Occupancy Data
- 4/12/2006 Zone 11 Intersection 6 Detector 11 Occupancy Data
- 4/12/2006 Zone 11 Intersection 6 Detector 12 Occupancy Data



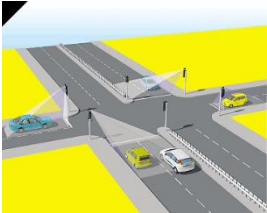
Percent Arrival on Green



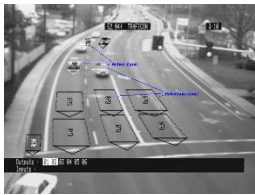
Average =
53.33%

Data Flow

Vehicle Detectors



Radar



Video



Loops

Detector Status

Detector Status

Detector Status

Traffic Controller

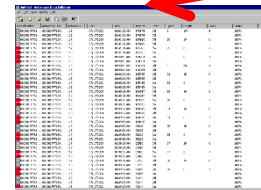


Event States

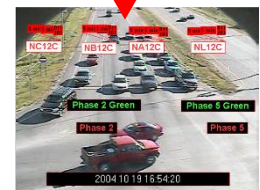
Video Feed



Fit PC



Event Log



Dynamic Overlay

Module Development

Build a Dynamic Object

Dynamic Object Name: DO8 dof Close

Controller: Voyage.com

phaseStatusGroupReds - Parameter Range Change Functions List to English

Index	Dynamic Object	
	Function	Group
1	phaseStatusGroupReds	1
2	phaseStatusGroupYellows	1
3	phaseStatusGroupGreens	1
4	phaseStatusGroupDon'tWalks	1
5	phaseStatusGroupWalks	1
6	phaseStatusGroupPedClears	1
7	vehicleDetectorStatusGroupActive	1
8	vehicleDetectorStatusGroupActive	2
9	vehicleDetectorStatusGroupActive	3
10	vehicleDetectorStatusGroupActive	4
11	vehicleDetectorStatusGroupActive	5
12	vehicleDetectorStatusGroupActive	6
13	vehicleDetectorStatusGroupActive	7
14	vehicleDetectorStatusGroupActive	8
15		
16		
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Insert Space

Remove a Function

Clear all Functions

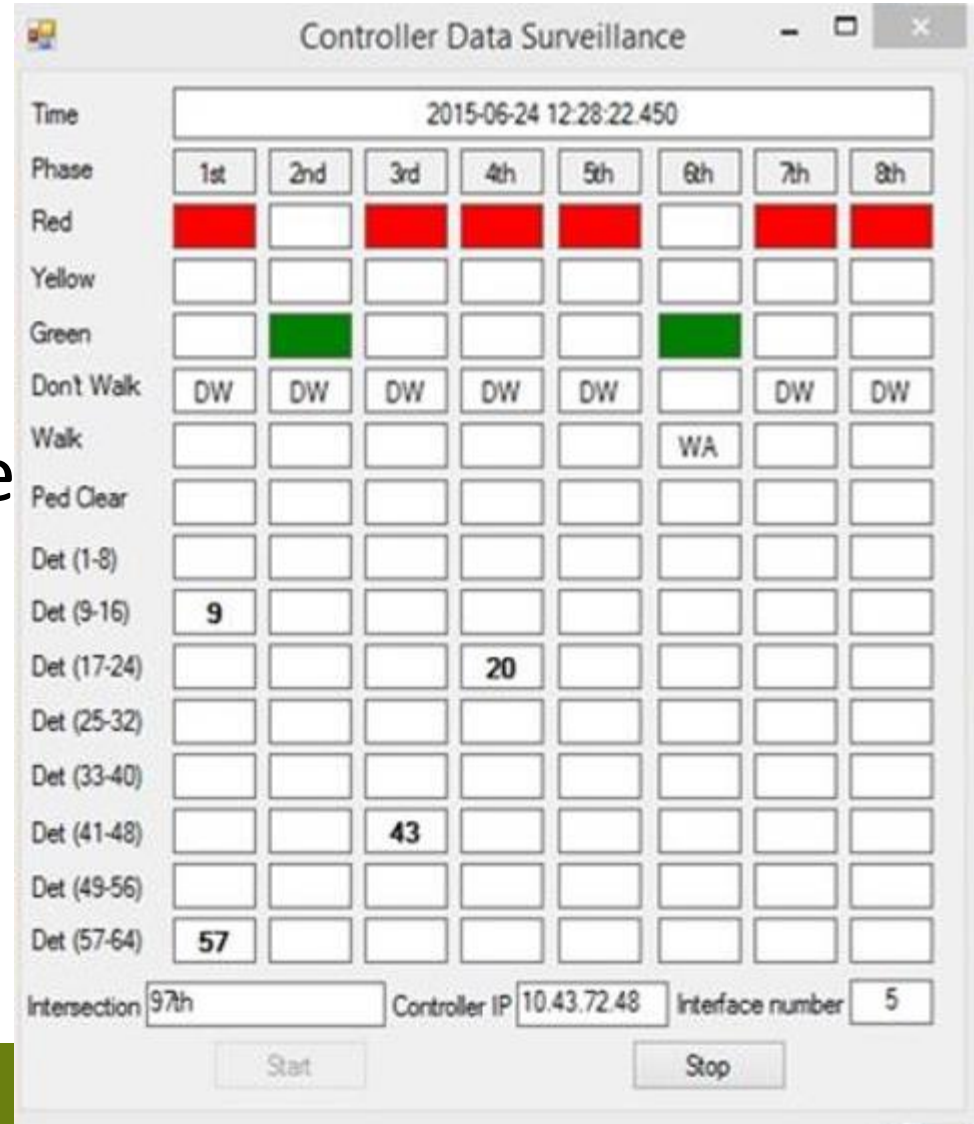
Move Up

Move Down

Dynamic Object Function List	
1	phaseStatusGroupReds
2	phaseStatusGroupYellows
3	phaseStatusGroupGreens
4	phaseStatusGroupDon'tWalks
5	phaseStatusGroupPedClears
6	phaseStatusGroupWalks
7	phaseStatusGroupVehCalls
8	phaseStatusGroupPedCalls
9	phaseStatusGroupPhaseOns
10	phaseStatusGroupPhaseNexis
11	-----
12	overlapStatusGroupReds
13	overlapStatusGroupYellows
14	overlapStatusGroupGreens
15	-----
16	channelStatusGroupReds
17	channelStatusGroupYellows
18	channelStatusGroupGreens
19	-----
20	vehicleDetectorStatusGroupActive
21	vehicleDetectorStatusGroupAlarms
22	vehicleDetectorAlarms
23	vehicleDetectorReportedAlarms
24	pedestrianDetectorAlarms
25	-----
26	volumeOccupancySequence
27	detectorVolume
28	detectorOccupancy
29	-----
30	unitControlStatus

Module Development

- Visual interface that can be overlaid on screen / video
- Event based data file recorded from state changes



Module Development

```
1.. 2015070909ChgData.txt
0 10 20 30 40
1 Intersection;Date;Time;Signal;Phase;Status
2 97th;2015-07-09;09:32:29.544;R;3;1
3 97th;2015-07-09;09:32:29.544;R;4;1
4 97th;2015-07-09;09:32:29.544;R;7;1
5 97th;2015-07-09;09:32:29.544;R;8;1
6 97th;2015-07-09;09:32:29.544;G;2;1
7 97th;2015-07-09;09:32:29.544;G;6;1
8 97th;2015-07-09;09:32:29.544;DW;1;1
9 97th;2015-07-09;09:32:29.544;DW;2;1
10 97th;2015-07-09;09:32:29.544;DW;3;1
11 97th;2015-07-09;09:32:29.544;DW;4;1
12 97th;2015-07-09;09:32:29.544;DW;5;1
13 97th;2015-07-09;09:32:29.544;DW;6;1
14 97th;2015-07-09;09:32:29.544;DW;7;1
15 97th;2015-07-09;09:32:29.544;DW;8;1
16 97th;2015-07-09;09:32:40.760;DET;9;1
17 97th;2015-07-09;09:32:41.748;DET;41;1
18 97th;2015-07-09;09:32:42.110;DET;9;0
19 97th;2015-07-09;09:32:42.161;DET;9;1
```

Module Development

Autoscope Video Player - 2015,06,24 12:17:15 -- 10.5.0 -- 100539FF2B530236 -- EB Phase 8 - 97th @ Lawnfield -- Lum mount -- 2 -- Terra Access Point NEMA --

File View Play Detector Overlay Bookmarks Window Help

MPEG4 Color (RTSP) 1/6 maximum

Controller Data Surveillance

Time: 2015-06-24 12:28:22.450

Phase	1st	2nd	3rd	4th	5th	6th	7th	8th
Red	■		■	■	■		■	■
Yellow								
Green		■				■		
Don't Walk	DW	DW	DW	DW	DW		DW	DW
Walk						WA		
Ped Clear								
Det (1-8)								
Det (9-16)	9							
Det (17-24)				20				
Det (25-32)								
Det (33-40)								
Det (41-48)			43					
Det (49-56)								
Det (57-64)	57							

Intersection: 97th Controller IP: 10.43.72.48 Interface number: 5


Start Stop

2015,06,24 12:17:15 -- 10.5.0 -- 10053AF...




1 MPEG4 - FPS = 5.00 (4.74) 2835 x0

2015,06,24 12:17:15 -- 10.5.0 -- 100539...




Ready 2 MPEG4 - FPS = 5.00 (4.96) 2885 x0

2015,06,24 12:17:15 -- 10.5.0 -- 100549F...



Ready 3 MPEG4 - FPS = 5.00 (3.76) 2305 x0

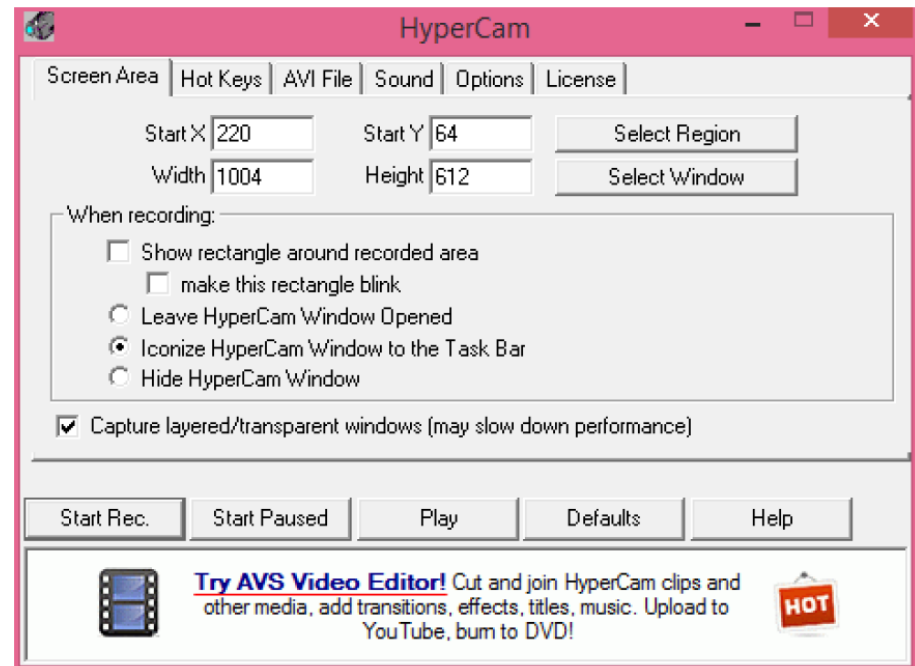
2015,06,24 12:17:15 -- 10.5.0 -- 100538FF5...



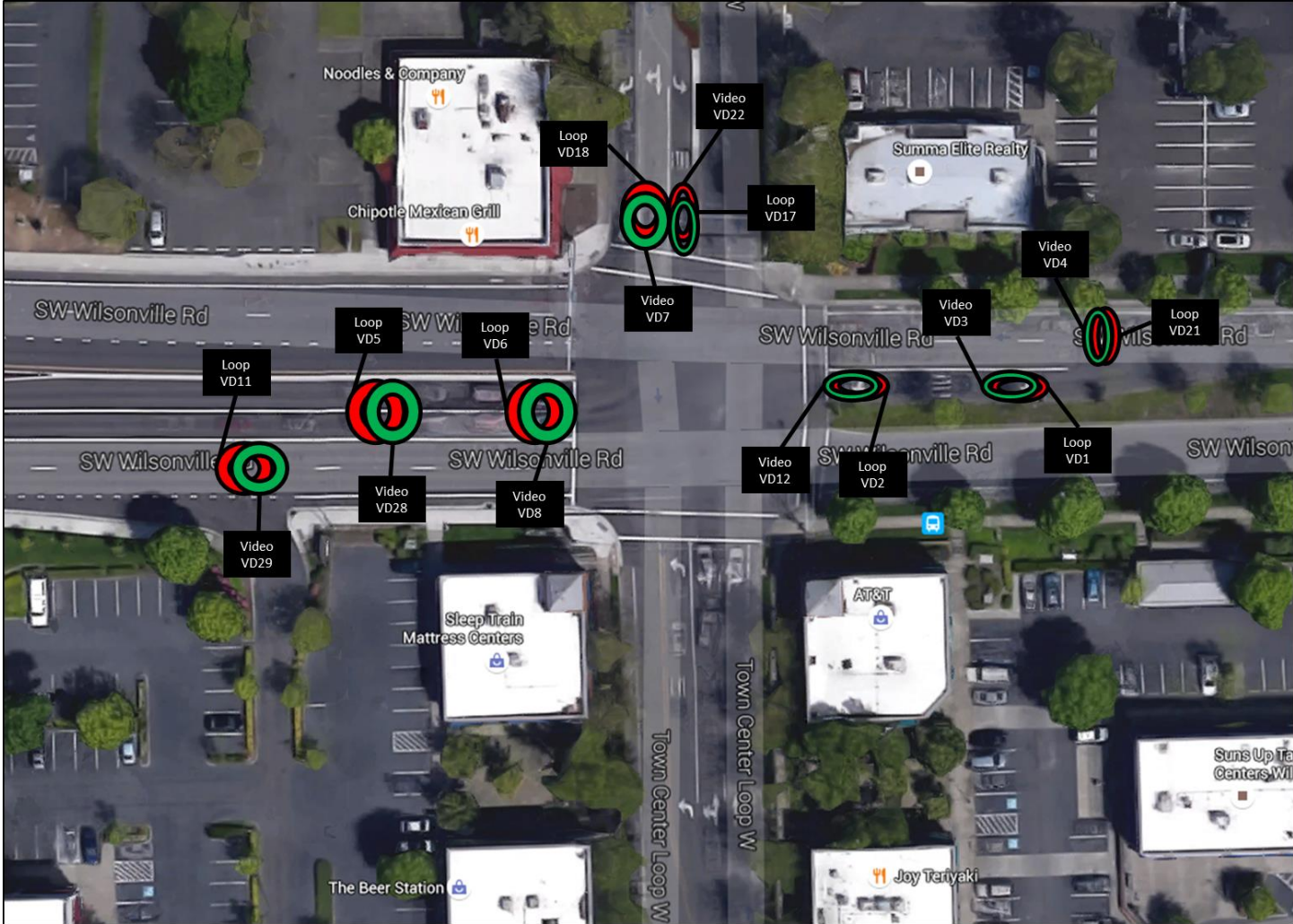
Ready 4 MPEG4 - FPS = 5.00 (4.30) 2385 x0

Module Development

- Use HyperCam to capture screen
- Slice video and data files into 1 hr increments with batch operation
- Will run “indefinitely”



Site Locations



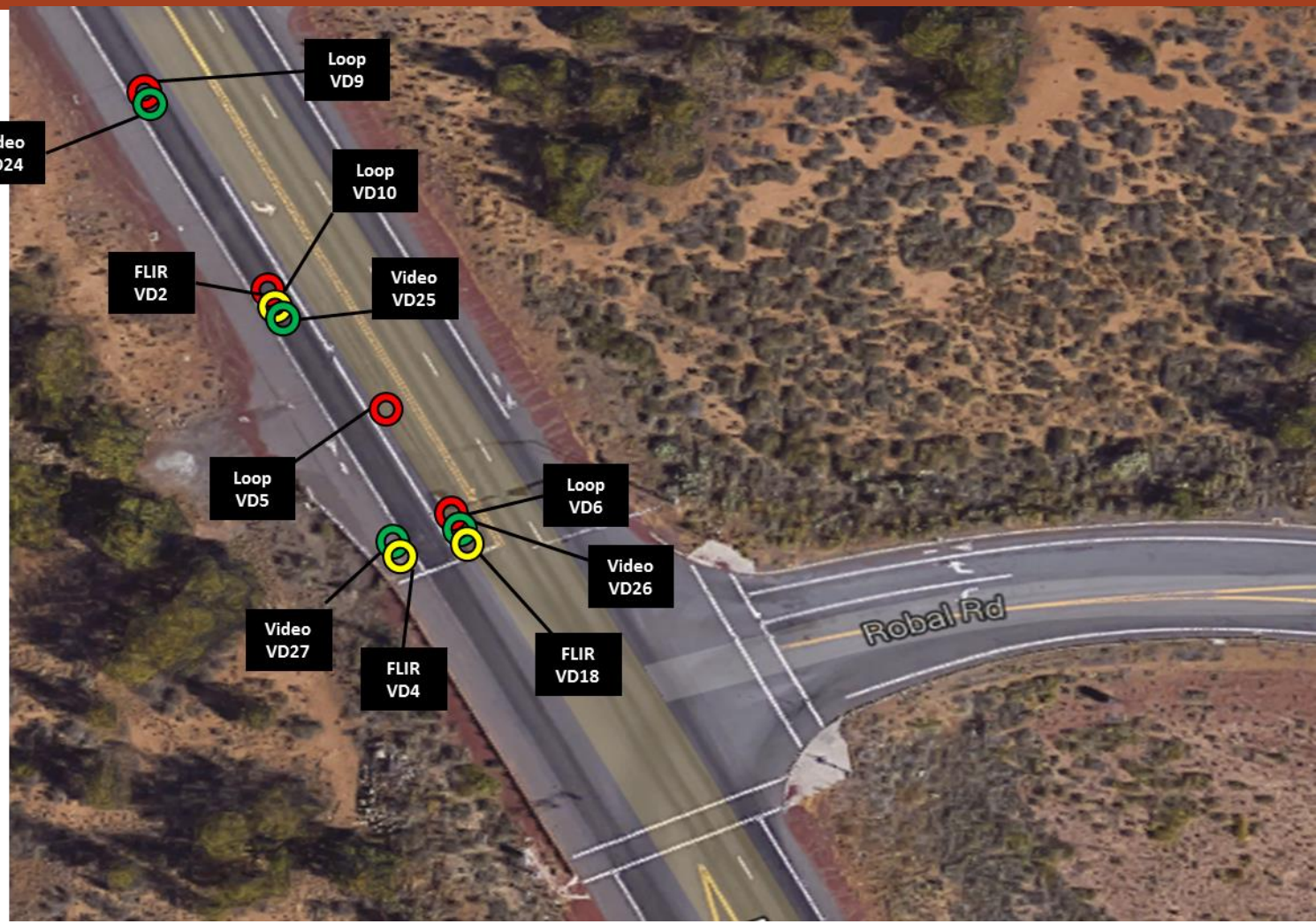
Town Center
Loop West &
Wilsonville Road

Site Locations



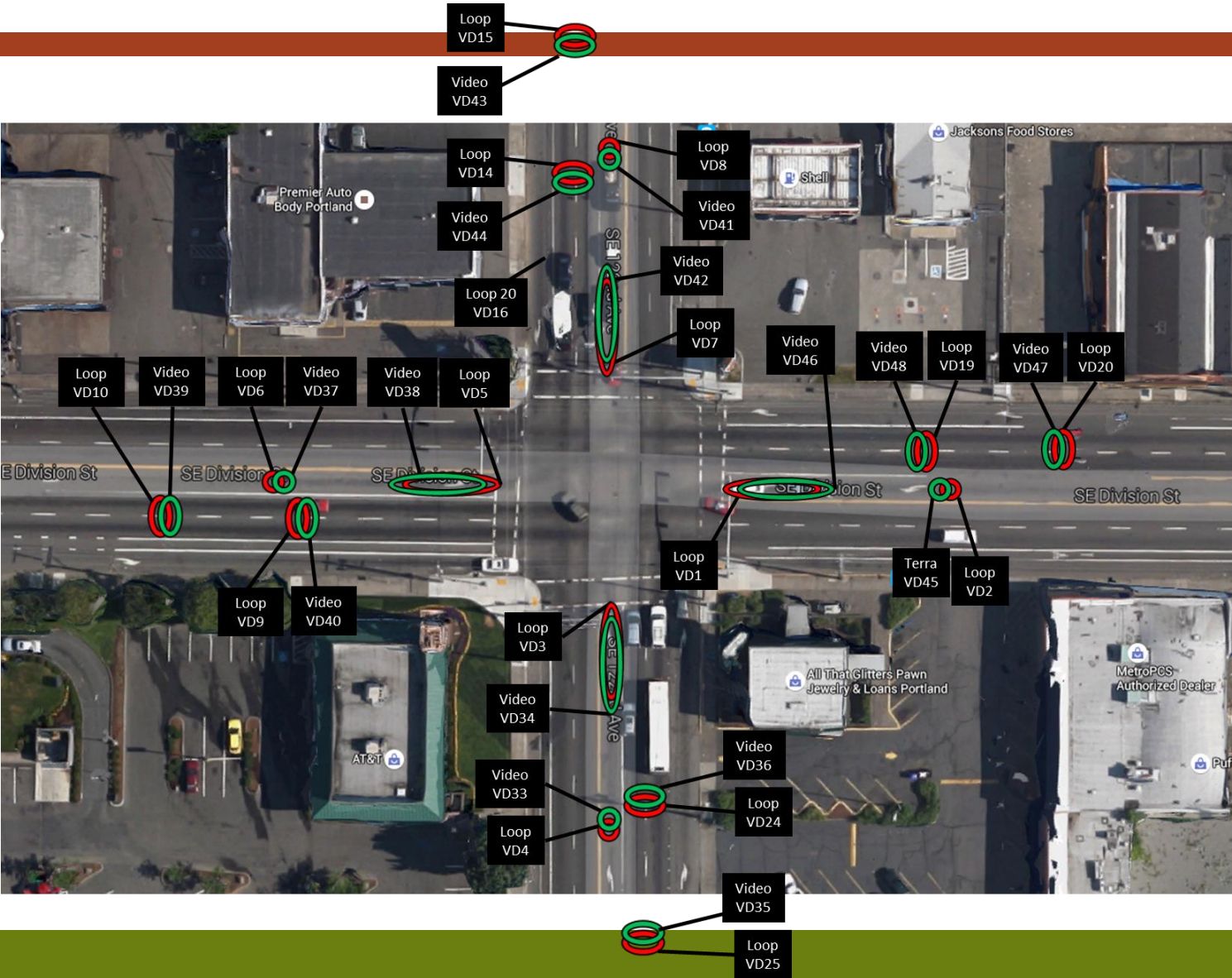
97th & Lawnfield Road, Clackamas County

Site Locations



US 20 & Robal Road, Bend

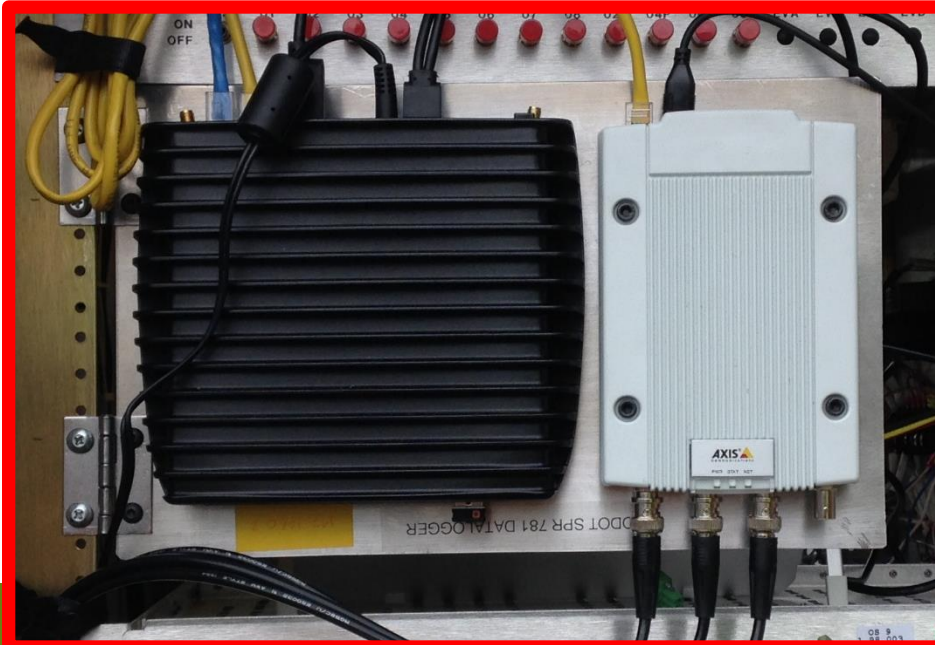
Site Locations



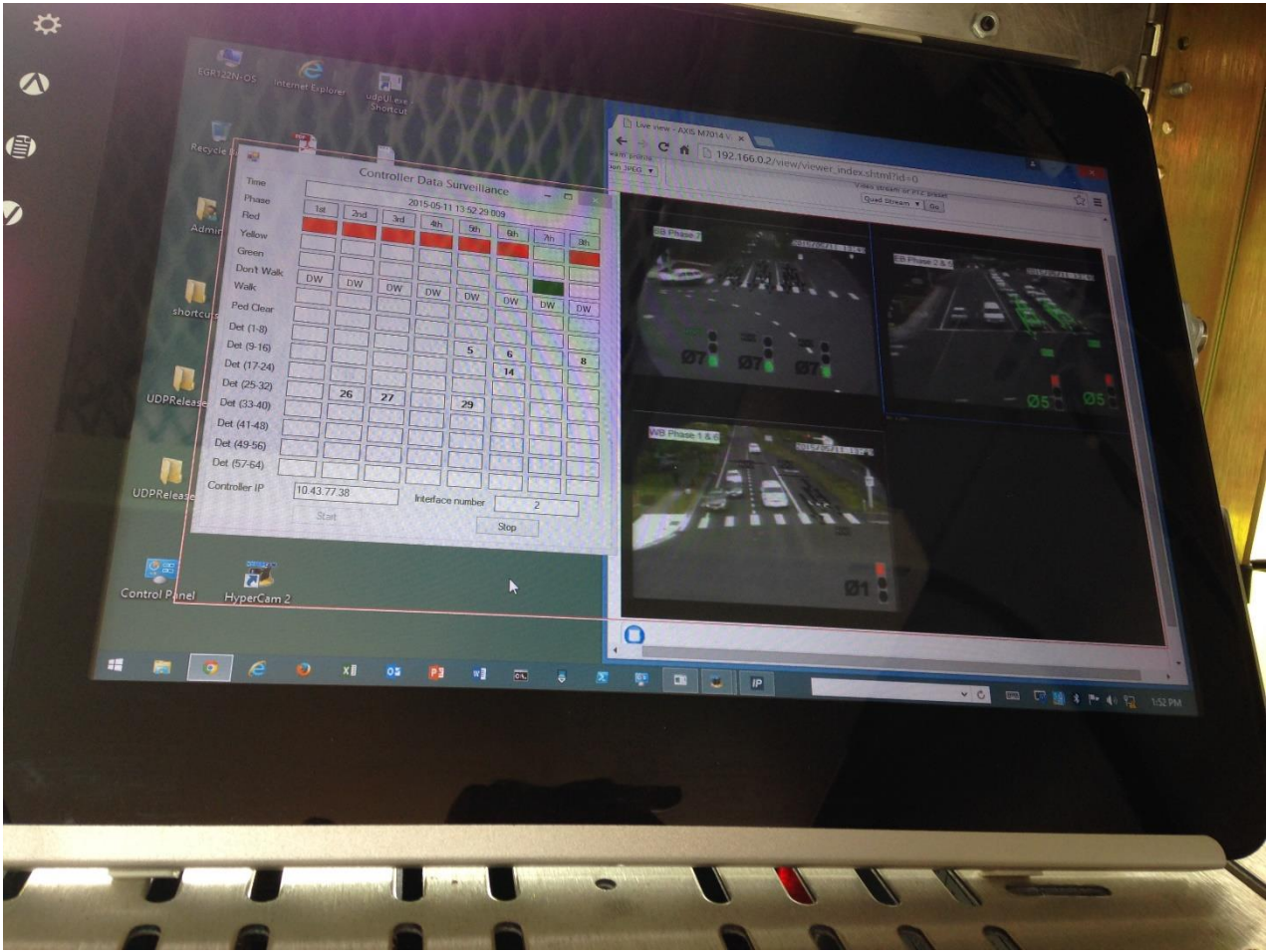
122nd Ave &
Division St.
Portland

Data Collection

- Used Fit PC and Axis encoder as hardware
- Ethernet connections
- Does not have to be onsite



Data Collection



Preliminary Results

- Over 5 million unique records
- Tableau used as visualization tool



Lessons Learned

- Use Linux
- IT policies make it challenging for an external partner to monitor data collection
 - Data lost due to site visit gaps
- Support from project partners is critical
- Support from vendors is also critical
- While data collection module does not need to be on site, much bandwidth needed
- Processing power can be an issue

- Data logger:
 - Very promising for data collection under Voyage
 - Ability to monitor virtually anything in controller (Dynamic Object set)
 - Future of Voyage in question, however
 - Scalable to other platforms, however detector status by channel must be reported (NTCIP communications)

- Overall project
 - Complete recommendations for ODOT
 - Detection comparison
 - Recommendations for selection of technology and zone design for adaptive implementation
 - Cost analysis comparison
 - Life Cycle Cost Analysis
 - Adaptive system
 - Detection technology
 - Includes maintenance and troubleshooting of devices

Acknowledgements

- Oregon Department of Transportation
 - Jon Lazarus, Roger Boettcher, Dave Hirsch and SPR 781 TAC
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Questions?

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Thank you!