

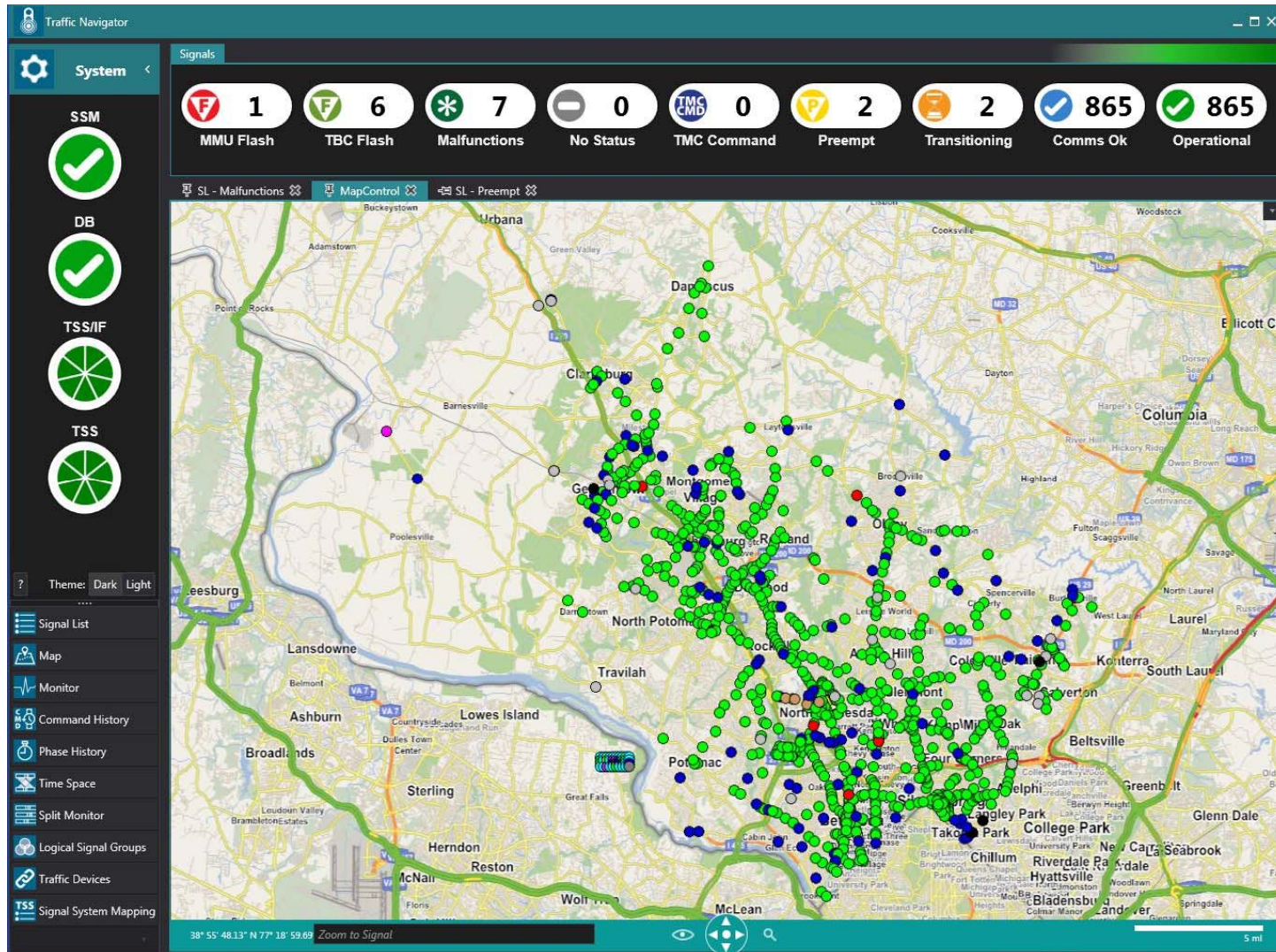


Montgomery County DOT ATMS Software Adaptive Signal Control

National Capital Region
Transportation Planning Board
SPOTS and Traffic Signals Subcommittee Joint Meeting
April 5, 2018

ITEM # 2

Advanced Transportation Management System



System by the Numbers

- 865 Traffic Signals operated/maintained by MCDOT
 - 572 owned by State of Maryland (SHA)
 - 280 owned by Montgomery County
 - 13 owned by a City (Rockville or Gaithersburg)
- Vehicle Detection Systems
 - Video (conventional, Gridsmart and FLIR)
 - Inductance Loops
 - Magnetometer
 - Microwave/Radar
- 419 Signals Equipped with Battery Backup Systems
- 117 Additional Battery Backup Systems planned by SHA
- 220 Traffic Surveillance Cameras
- 30 signals and 17 buses operating Transit Signal Priority

Day to Day Operations

- Monitor
 - Signal system health, dispatching technicians
 - Incident Management
 - Ride On Bus Central Communications (CAD/AVL)
 - CCTV used for verification
- Control
 - Signal Timing Adjustments on the fly as conditions change
 - Dynamic rerouting of Ride On buses as needed
- Information
 - Traffic show on Cable TV
 - Live traffic info on County website
 - Live messaging to general public via Everbridge
 - CCTV shared with broadcast media and with regional Government Agencies via Mview

Advanced Transportation Management System

Detailed Signal Status

Signal 858 - Shady Grove Metro Pedestrian Crosswalk [Hub-HG] Controller Time: 4/2/2018 8:41:36 AM

General

Status: ● Comms: ●

Operation Mode: Auto Flash:

Attempted Polls: 76 Successful Polls: 76

TMC Command: Free ●

Controller Override: Control ●

Stop Timing: Preempt

Last Initialized: 3/23/2018 4:46:57 PM

Coord Status

Transition: 0/0 Off. Transitioning: 0

Cycle Length: ● Cycle Length Rem.: 0

End of Cycle: ● Controller Cycle Zero

Cycle Fail: ● Cycle Fault

Coord Active: ● Coord Alarm

Coord Fail: ● Coord Fault

Free Request: ● Controller Free: ●

Correction Mode: Smooth Force Mode: Fixed

Max Mode: Maximum 2 Day Plan Status: 1

Pattern: Free Action Plan: 99

Fault Status

Detector Fault: Response Fault

Critical Alarm: Non Critical Alarm

MMU Flash: Controller Flash

Local Flash: Low Battery

External Start: ●

Phases

	1	2	3	4	5	6	7	8	9
	Phase 1	Metro C	Phase 3	Ped cro	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9
Color	●	●	●	●	●	●	●	●	●
Duration (seconds)		2097		60					
Ped Status	●	●	●	●	●	●	●	●	●
Veh. Call		●							
Ped Call									
Next									
On		●							

Overlaps

	1	2	3	4
	OL	AOL	BOL	COL D
Color	●	●	●	●

Alarms

	1	2	3	4
	Door Sw	Alarm 2	Alarm 3	Alarm 4
On				

Ped Detectors

#	1	2	3	4	5	6	7	8
Status								

Load Switch Channels

#	1	2	3	4	5	6	7	8
Color								

Special Functions

#	1	2
On		

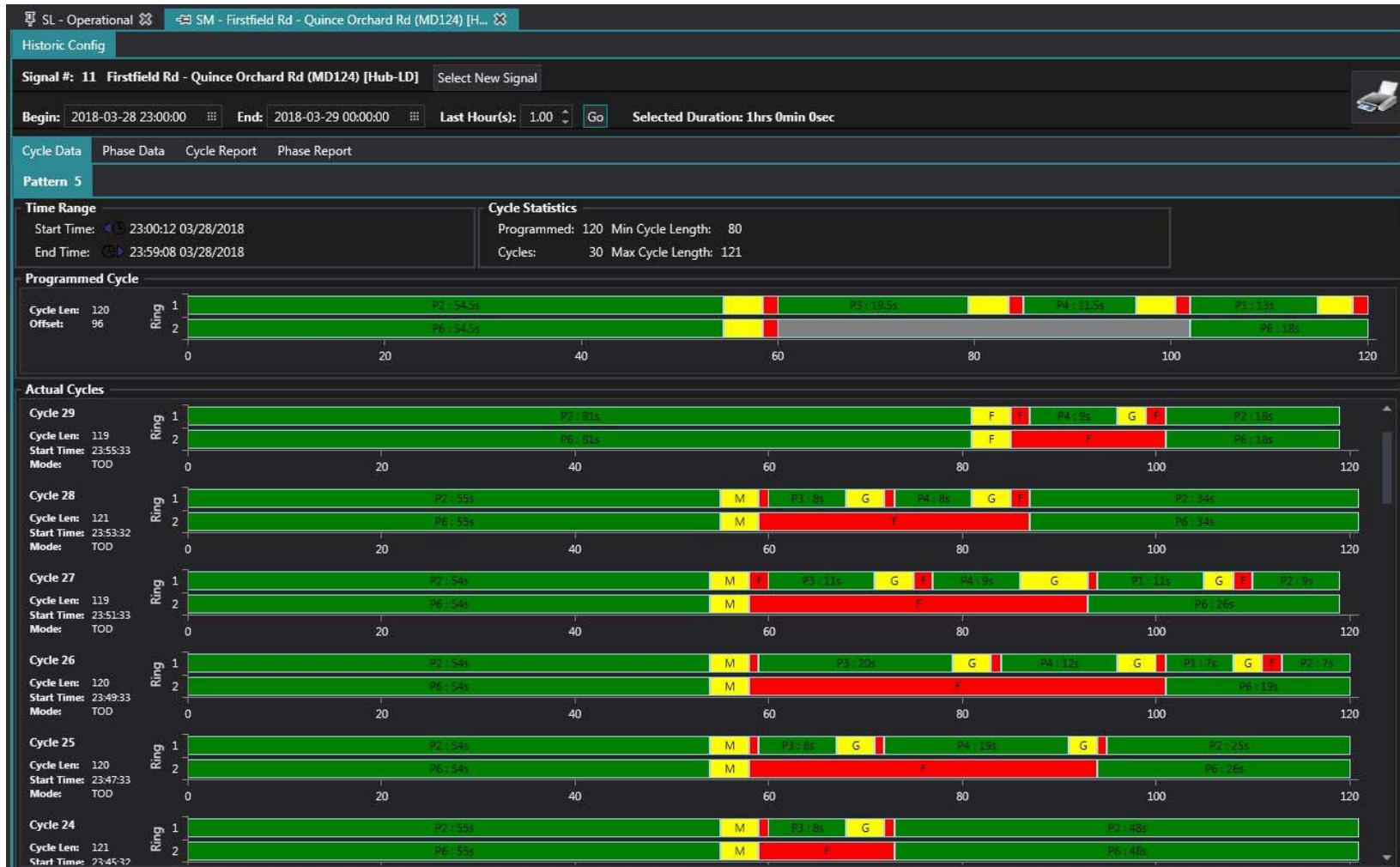
Rings

#	1	2
Status	●	●

Preempts

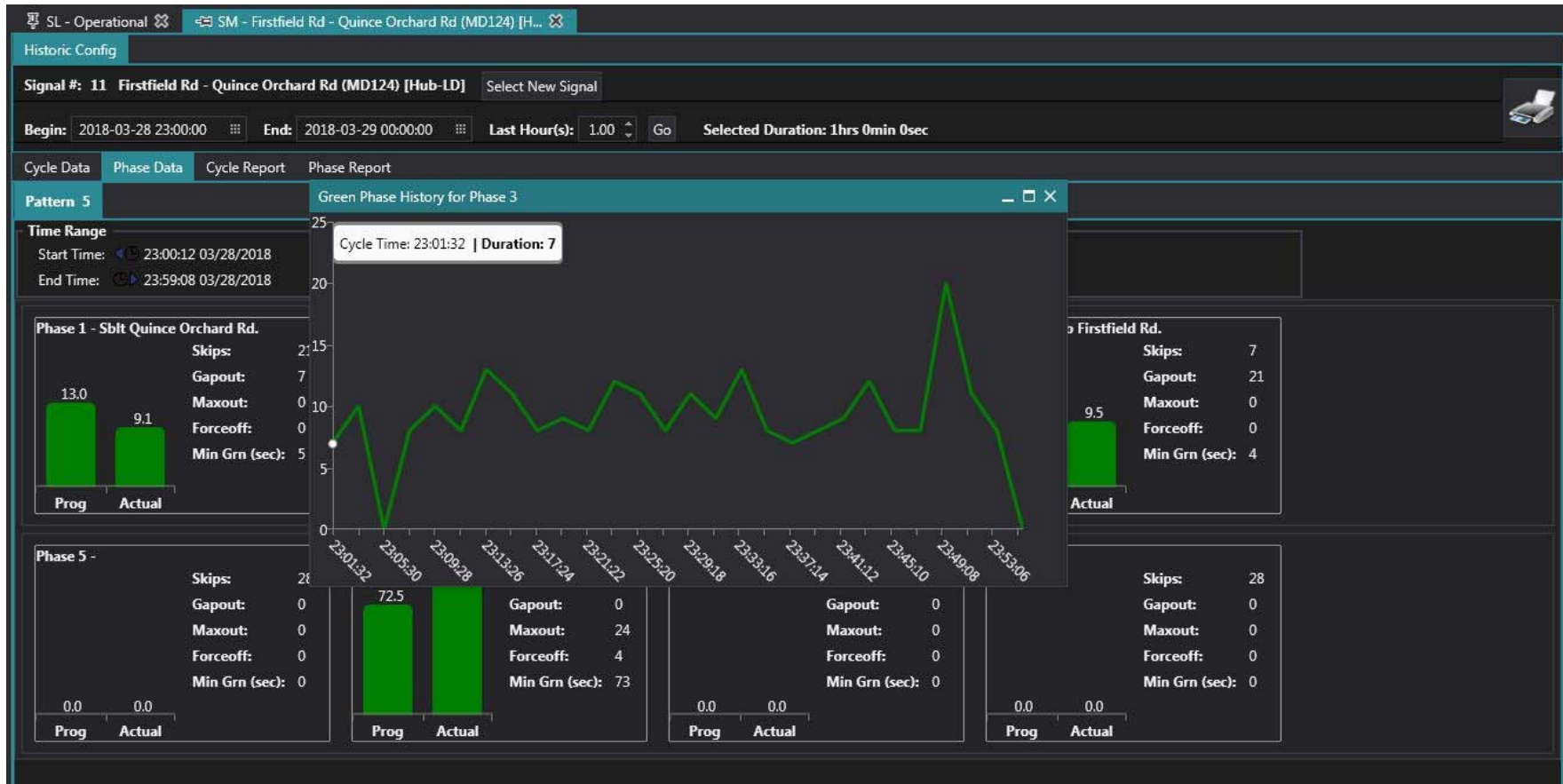
#	1	2
Status		

Advanced Transportation Management System Split Monitor



Advanced Transportation Management System

Green Phase History



Advanced Transportation Management System

Phase History

SL - Operational PhaseHistoryList

Signal #: 11 Run Query

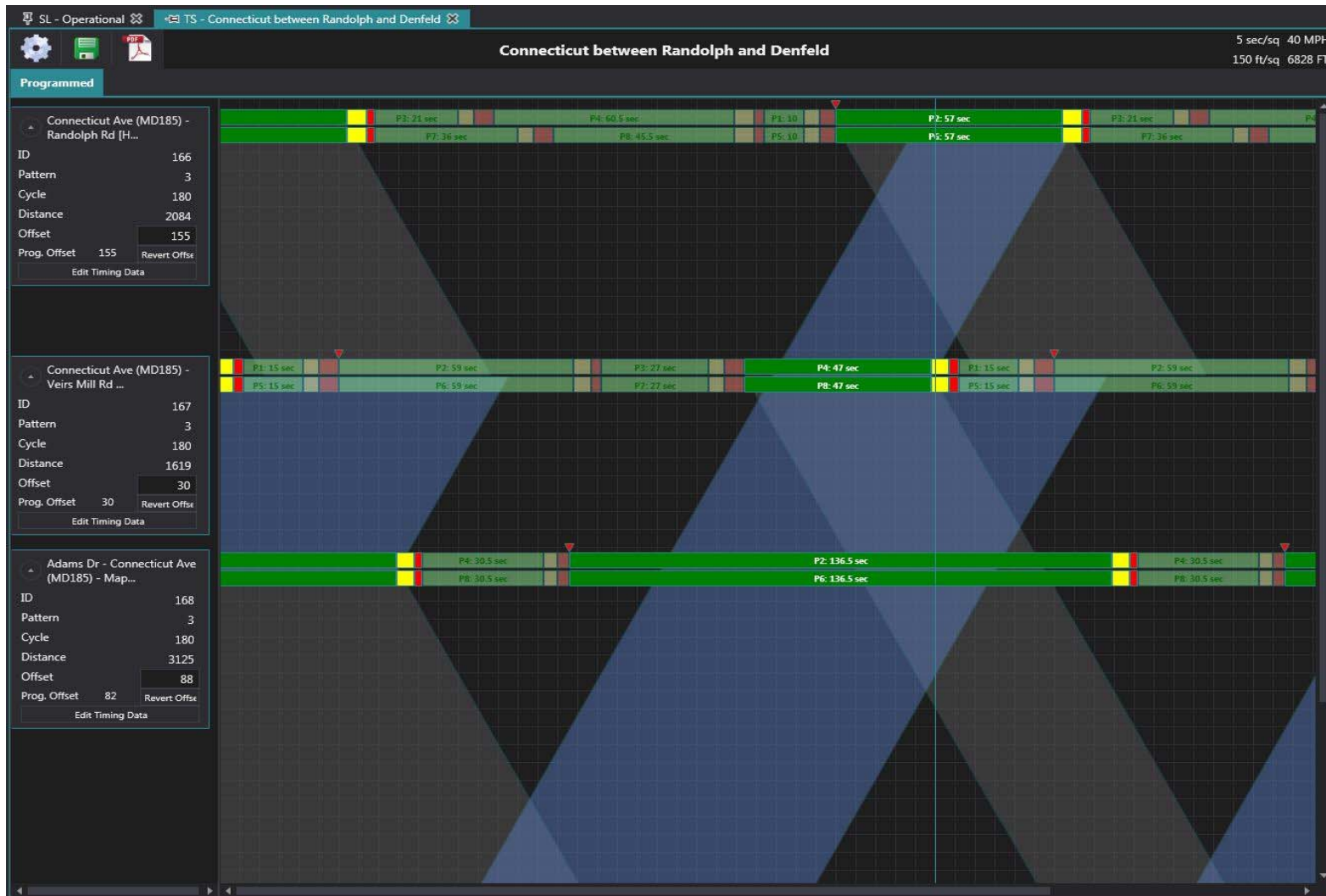
Begin: 2018-03-28 23:00:00 End: 2018-03-29 00:00:00 Last Minute(s): 1 Last Hour Today Last 24 Hours Yesterday

Filters Displayed: 289 Total: 289

Signal 11: Firstfield Rd - Quince Orchard Rd (MD124) [Hub-LD]

Time	Status	Pattern	Action Plan	P1	P2	P3	P4	P5	P6	P7	P8	P9	O1	O2	O3	O4
2018-03-28 23:00:27	Online	Pattern 5	Auto0		Y DW				Y DW							
2018-03-28 23:00:32	Online	Pattern 5	Auto0		R DW	G DW			R DW							
2018-03-28 23:00:42	Online	Pattern 5	Auto0			Y DW										
2018-03-28 23:00:46	Online	Pattern 5	Auto0			R DW										
2018-03-28 23:00:47	Online	Pattern 5	Auto0				G DW						G			
2018-03-28 23:01:09	Online	Pattern 5	Auto0				Y DW									
2018-03-28 23:01:12	Online	Pattern 5	Auto0				R DW									
2018-03-28 23:01:14	Online	Pattern 5	Auto0	G DW					G W							
2018-03-28 23:01:25	Online	Pattern 5	Auto0	Y DW									Y			
2018-03-28 23:01:28	Online	Pattern 5	Auto0	R DW									R			
2018-03-28 23:01:30	Online	Pattern 5	Auto0		G W											
2018-03-28 23:02:12	Online	Pattern 5	Auto0		G FDW				G FDW							
2018-03-28 23:02:27	Online	Pattern 5	Auto0		Y DW				Y DW							
2018-03-28 23:02:32	Online	Pattern 5	Auto0		R DW				R DW							
2018-03-28 23:02:33	Online	Pattern 5	Auto0			G DW										
2018-03-28 23:02:40	Online	Pattern 5	Auto0			Y DW										
2018-03-28 23:02:45	Online	Pattern 5	Auto0			R DW										
2018-03-28 23:02:46	Online	Pattern 5	Auto0				G DW						G			
2018-03-28 23:03:00	Online	Pattern 5	Auto0				Y DW						Y			
2018-03-28 23:03:07	Online	Pattern 5	Auto0		G W		R DW		G W				R			
2018-03-28 23:04:12	Online	Pattern 5	Auto0		G FDW				G FDW							
2018-03-28 23:04:28	Online	Pattern 5	Auto0		Y DW				Y DW							
2018-03-28 23:04:32	Online	Pattern 5	Auto0		R DW				R DW							
2018-03-28 23:04:33	Online	Pattern 5	Auto0			G DW										
2018-03-28 23:04:43	Online	Pattern 5	Auto0			Y DW										
2018-03-28 23:04:47	Online	Pattern 5	Auto0			R DW										

Advanced Transportation Management System Time-Space Diagram



Advanced Transportation Management System

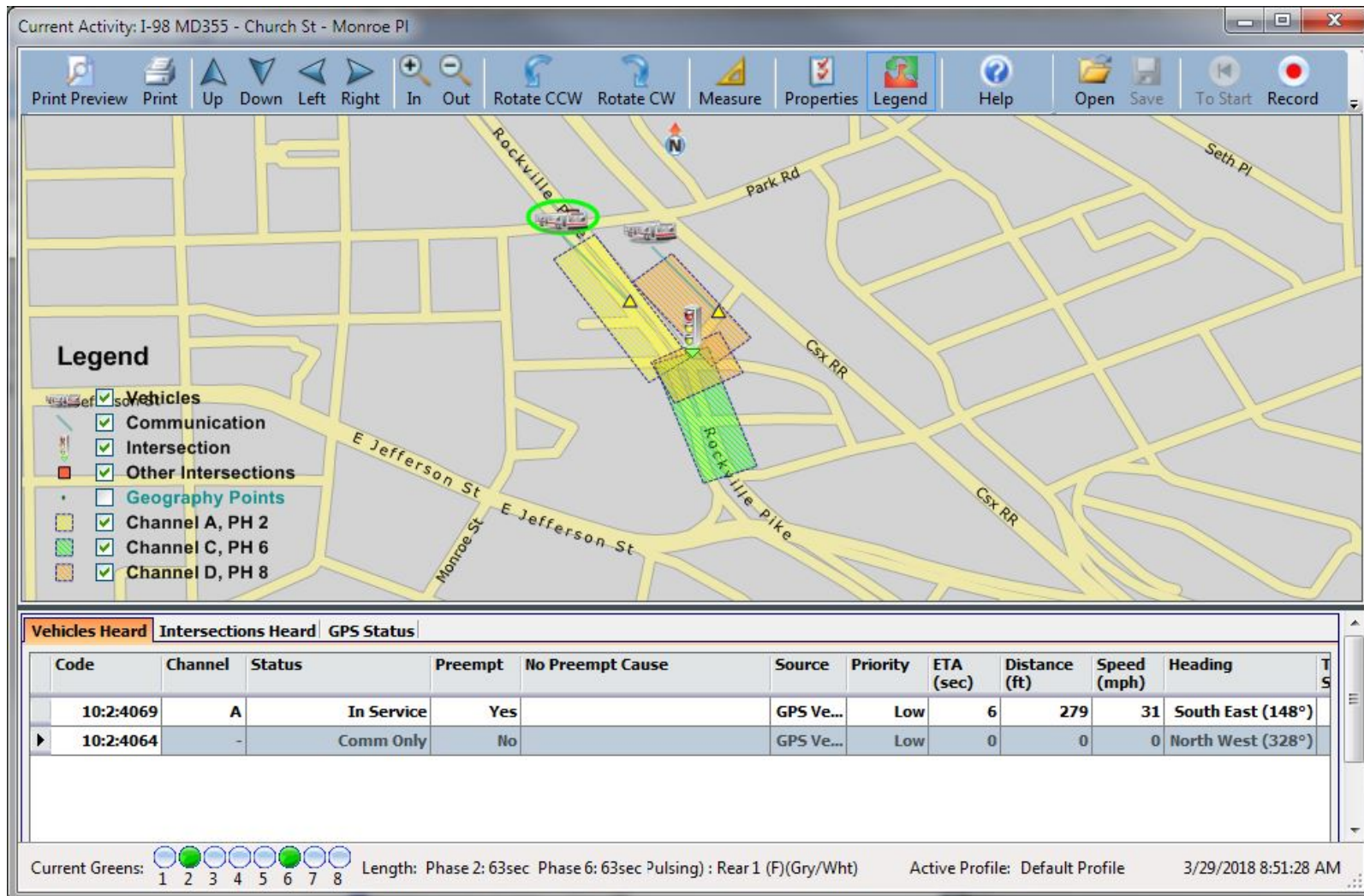
Logical Signal Groups

The screenshot displays a web application interface for managing signal groups. At the top, there are two browser tabs: 'SL - Operational' and 'LogicalGroup'. Below the tabs is a navigation bar with four icons: a list icon, a plus sign, a red X, and a refresh icon. The main content area is titled '36 Logical Signal Groups' and contains a list of 18 expandable folders, each with a folder icon and a label indicating the number of signals it contains. The folders are:

- > Airparck Incident2/08/2014 (5 signals)
- > CBD Bethesda (34 signals)
- > CBD Friendship Heights (6 signals)
- > CBD Silver Spring (36 signals)
- > CBD Wheaton (10 signals)
- > Congressional Fireworks (2 signals)
- > Emergency Operations timing adjustment (840 signals)
- > Falls Rd. Time Space (8 signals)
- > Gaithersburg Fireworks #1 (8 signals)
- > Gaithersburg Fireworks #2 (10 signals)
- > Gaithersburg Fireworks #3 (12 signals)
- > Germantown Fireworks #1 (5 signals)
- > Germantown Fireworks #2 (4 signals)
- > Kenwood Fireworks (2 signals)
- > Mall, Lakeforest (19 signals)
- > Mall, Milestone Shopping Center (10 signals)
- > Mall, Montgomery (10 signals)
- > Mall, Rio Shopping Center (4 signals)

Advanced Transportation Management System

Transit Signal Priority Current Activity



Advanced Transportation Management System Transit Signal Priority CMS Logs

Opticom Logs - Opticom™ Central Management Software

File Edit View Tools Help

Opticom Logs

View
 Grid View
 Pivot Table View

Date Range
 Within the Last Day
 Within the Last Week
 Within the Last Month
 Within the Last Year
 Custom Date Range

From: 3/29/2018
 To: 3/29/2018
 Display Logs

Select Jurisdictions/Intersections/Routes
 Montgomery County
 Montgomery County DOT
 Routes

Location Management
 Vehicle Management
 Monitoring
 Scheduling
 Evacuation Plans
 Reports
 Opticom Logs
 Role Management

Location Management | Opticom Logs | Monitoring |

Logs (Grid View): 3/29/2018 to 3/29/2018

Date	Location	Vehicle Name	Code	Start Time	End Time	Duration	In-Range Duration	Jurisdiction	Channel Name	
Vehicle Name: Ride On extRa bus 4056										
Vehicle Name: Ride On extRa bus 4058										
Vehicle Name: Ride On extRa bus 4060										
Location: 01 I-4 Lakeforest Blvd - N Frederick Ave (MD355) - Perry Pkwy										
Location: 02 I-5 N Frederick Ave (MD355) - Odendhal Ave [Hub-HA]										
Location: 03 I-6 Chestnut St - N Frederick Ave (MD355) [Hub-HA]										
Location: 05 I-526 Education Blvd - S Frederick Ave (MD355) [Hub-HC]										
3/29/2018	05 I-526 Edu...	Ride On extRa bus 4060		10:2:4060	6:57:28 ...	6:59:3...	22	23	Montgomery Count...	NB PH 6
3/29/2018	05 I-526 Edu...	Ride On extRa bus 4060		10:2:4060	7:36:13 ...	7:36:3...	2	3	Montgomery Count...	SB Ph 2
3/29/2018	05 I-526 Edu...	Ride On extRa bus 4060		10:2:4060	7:36:38 ...	7:36:4...	3	4	Montgomery Count...	SB Ph 2
3/29/2018	05 I-526 Edu...	Ride On extRa bus 4060		10:2:4060	7:36:41 ...	7:37:0...	17	18	Montgomery Count...	SB Ph 2
							44			
Location: 06 I-14 E Deer Park Dr - S Frederick Ave (MD355) - W Deer Park Rd [Hub-HC]										
Location: 07 I-15 S Frederick Ave (MD355) - S Westland Dr [Hub-HC]										
Location: 08 I-16 Frederick Rd (MD355) - Shady Grove Rd [Hub-HG]										
Location: 09 I-739 Frederick Rd (MD355) - King Farm Blvd - Metro Station Drwy [Hub-HG]										
Location: 10 I-579 Frederick Rd (MD355) - Indianola Dr - Watkins Pond Blvd [Hub-HG]										
Location: 11 I-130 Frederick Rd (MD355) - Lexus Drwy - Rockville Corp Ctr Drwy [Hub-HG]										
Location: 12 I-90 College Pkwy - Frederick Rd (MD355) [Hub-HE]										
Location: 13 I-91 Hungerford Dr (MD355) - N Campus Dr [Hub-HE]										
Location: 14 I-92 Hungerford Dr (MD355) - Mannakee St [Hub-HE]										
Location: 15 I-97 E Middle Ln - Park Rd - Rockville Pike (MD355) [Hub-HE]										
Location: 16 I-98 Church St - Monroe Pl - Rockville Pike (MD355) [Hub-HE]										
Location: 17 I-115 Dodge St (MD660) - Richard Montgomery Dr - Rockville Pike (MD355) [Hub-DE]										
Location: 18 I-101 Halpine Rd - Rockville Pike (MD355) [Hub-DD]										
Location: 19 I-102 Rockville Pike (MD355) - Rollins Ave - Twinbrook Pkwy [Hub-DD]										
Location: 20 I-104 Bou Ave - California Cir - Rockville Pike (MD355) [Hub-DD]										
Location: 21 I-107 Mid Pike Plaza Drwy - Rockville Pike (MD355) [Hub-DA]										

Record 382 of 1814

ATMS\mkinney | SQLDB.atms.dpwt.com | Opticom Logs - Opticom™ Central Management Software

Advanced Transportation Management System Transit Signal Priority System Usage Report

System Usage Report

From 2/28/2018 to 3/29/2018

Jurisdictions included: Montgomery County DOT

Report Generated :
3/29/2018 8:55 AM

Summary of Intersections/Vehicles		Attempted Preempts	Granted Preempts	Average Granted Preempts
Low Priority				
31	Intersections	60280	44058	1421.2
18	Registered Vehicles	60280	44058	2447.7
0	Unregistered Vehicles	0	0	0.0
17	Authorized Vehicles	60280	44058	2591.6
0	Unauthorized Vehicles	0	0	0.0

Traffic Adaptive Initiative

- Phase A – Preliminary Engineering (Funded FY17)
 - Selected Montrose Rd/Pkwy corridor for the Pilot
 - Selected SCOOT and Kadence systems for pilot testing
- Phase B – Deployment (Proof of Concept, Funded FY18)
 - July 2017 - Funding appropriated
 - July – September 2017 – Field installation of required detection
 - September 2017 - Collected before traffic data (after school started)
 - October 2017 through February 2018 - Alternatively running SCOOT and Kadence and collecting traffic data

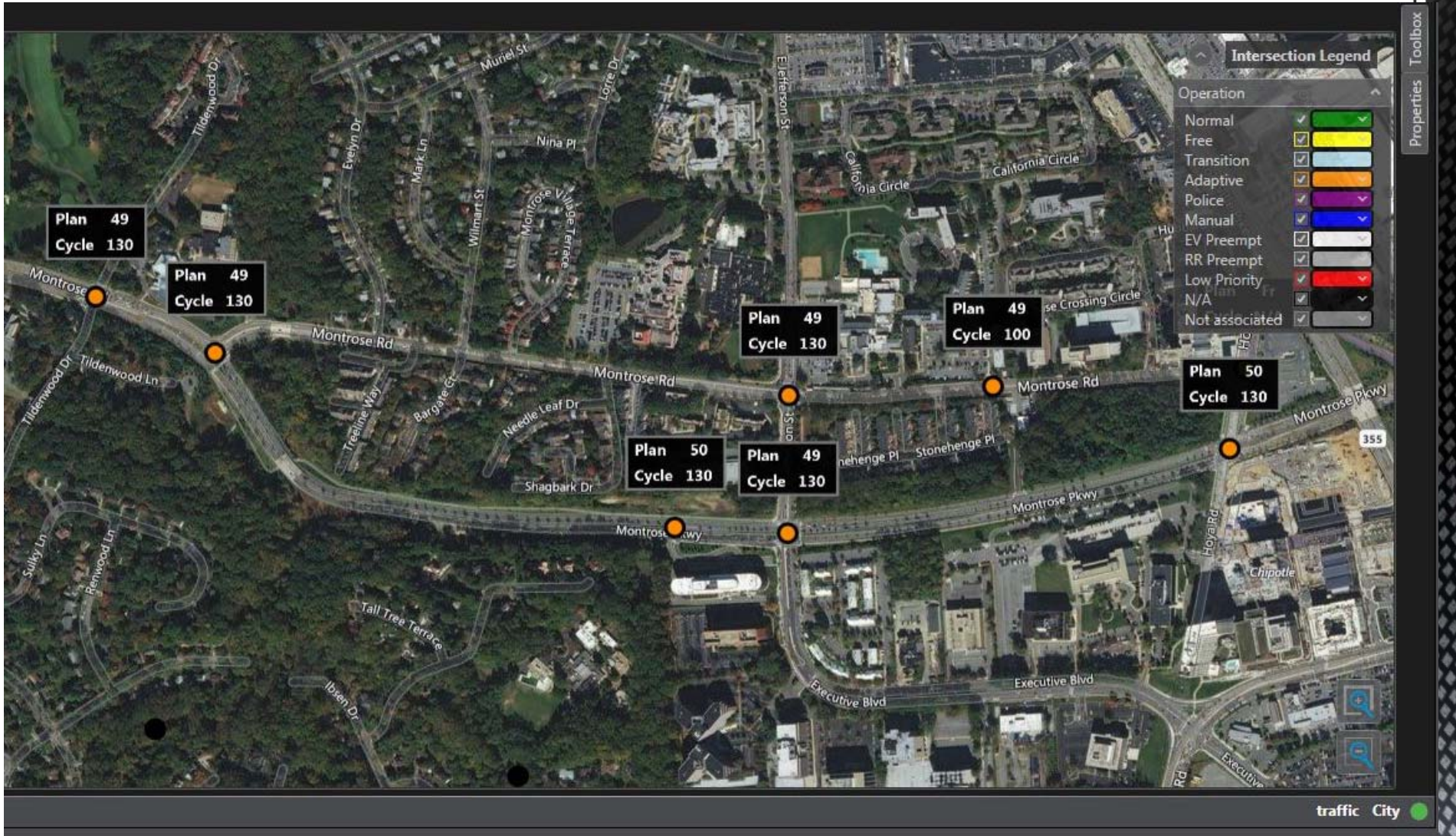
Traffic Adaptive Systems Evaluated

Comparison	Kadence	SCOOT
Cost	\$\$	\$\$\$
Optimization	Split, Cycle, Offset in steps	Split, Cycle, Offset continuous
Detection	Existing stop bar and arterial advance detectors	Upstream per-lane detectors all approaches
Responsiveness	Slow – every few cycles	Very Fast – Each cycle or phase
Application	Mainly arterials	Grids, arterials, all combinations
Architecture	NTCIP – uses inherent controller capability	Gemini Outstation cabinet hardware
Feature Set	TOD Tuner, Saturation Enhancements	Bus priority, gating, incident detection

Traffic Adaptive Observations

- Kadence
 - Signal controllers operate in a way similar to how the County currently runs time based coordination (familiar to users)
 - Slower to respond to changes in traffic (typically waits 3 cycles to adjust to changes in demand)
 - Discovered limitations in deployment of transit signal priority (needs further investigation, TSP is not a feature of the test corridor)
 - User interface is useful and rather intuitive
 - Requires some intervention in unusual traffic conditions
 - Have observed some negative citizen correspondence during Kadence operation

Kadence Map



Kadence Phase Utilization

Montgomery County Advanced

Admin Home Intersections System Detection Adaptive Incident Management Map

Sections Intersection Parameters Section Parameters Links Detectors Schedule Trace Log Action Log Phase Util Arrival On Green Coordination Diagram Queue Estimation TOD Tuner TOD Cycle/Split Graph TOD Offset

Configure Schedule Real-Time Graphs/Reports TOD Tuner

Intersections (10/10) Stop Time (0) Alerts (0/0) Servers

KITS Map Action Log - 23: E Jefferson St-Montrose Rd Phase Util - 23: E Jefferson St-Montrose Rd TOD Offset Graph: 23: E Jefferson St-Montrose Rd

Phase Util Chart Phase Util Graph

Drag a column header and drop it here to group by that column

	Time	Y	Offset	Y	Split1	Y	PU1	Y	Split2	Y	PU2	Y	Split3	Y	PU3	Y	Split4	Y	PU4	Y	Split5	Y	PU5	Y	Split6	Y	PU6	Y
	2/13/2018 2:07:18 PM		31		22		76		57		54		20		64		36		80		14		43		74		40	
	2/13/2018 2:05:28 PM		31		20		100		42		57		19		92		29		76		20		75		52		0	
	2/13/2018 2:03:38 PM		30		32		88		42		47		18		91		18		33		17		60		67		27	
	2/13/2018 2:01:48 PM		30		20		100		42		8		18		100		30		66		20		81		52		0	
	2/13/2018 1:59:59 PM		30		27		81		48		42		18		75		16		20		19		66		66		14	
	2/13/2018 1:58:08 PM		30		23		100		42		38		18		100		28		41		0		0		75		20	
	2/13/2018 1:56:18 PM		30		20		94		42		33		18		66		30		58		14		40		58		16	
	2/13/2018 1:54:28 PM		30		20		100		42		31		18		100		30		79		0		0		72		25	
	2/13/2018 1:52:38 PM		30		20		93		42		38		18		100		30		70		10		0		62		13	
	2/13/2018 1:50:41 PM		30		20		100		52		34		19		92		26		62		0		0		80		15	
	2/13/2018 1:48:26 PM		31		25		85		52		28		22		93		36		93		0		0		86		0	
	2/13/2018 1:46:12 PM		31		44		76		50		15		22		81		18		36		0		0		104		21	
	2/13/2018 1:43:57 PM		31		25		100		52		41		22		87		36		90		21		76		65		14	
	2/13/2018 1:41:43 PM		31		39		100		51		35		22		93		22		48		16		43		84		27	
	2/13/2018 1:39:48 PM		31		23		100		43		28		25		92		24		44		16		43		60		18	
	2/13/2018 1:37:58 PM		30		20		100		42		47		18		83		30		50		0		0		72		8	
	2/13/2018 1:36:08 PM		30		29		84		42		50		18		100		21		41		15		46		66		38	
	2/13/2018 1:34:18 PM		30		20		100		42		47		18		100		30		91		19		73		53		21	
	2/13/2018 1:32:28 PM		30		20		100		42		27		18		91		30		62		20		81		52		5	

Kadence Intersection Detail

Status	Operation	Plan		Cycle Offset	
Online	Normal	2	Database	120	32
Master	Local	Time	Previous	121	32
53	99	09:44:53	Current	22	

Ring 1	1-EBL	2-WBT	3-SBT	4-NBT
Database	28	42	19	31
Previous	3	0	0	0
Current	0	22	0	0
Veh. Phases				
Ped. Phases				
Veh. Calls				
Ped. Calls				

Ring 2	5-WBL	6-EBT	7	8
Database	28	42	0	0
Previous	0	3	0	0
Current	0	22	0	0
Veh. Phases				
Ped. Phases				
Veh. Calls				
Ped. Calls				

Traffic Adaptive Observations

- SCOOT
 - SCOOT takes over operation of the signal from the local signal controller
 - Responds quickly to changes in traffic (each phase change is based on current demand at detectors)
 - Responds appropriately to transit signal priority (TSP) requests (SCOOT has a mature TSP module that is in use in other places)
 - User interface is more complicated but usable
 - Update to user interface anticipated in 2018
 - Handles most unusual traffic situations without intervention
 - Requires a hardware interface in the cabinet unless you have Siemens controllers

SCOOT Map

Change Max Cycle

Change Min Cycle

RMR 00/06 on SCOOT

Cycle Time: 128 [128]

CHAN MAX STAGE

CHAN MIN STAGE

The map displays several intersections along Montrose Rd and Montrose Pkwy. Each intersection is marked with a colored circle (green, red, or yellow) and a numerical label. For example, intersection #22 has a green circle with '3' and '88', and intersection #784 has a green circle with '2' and '88'. Other intersections shown include #23, #655, #24, #809, #785, #831, #10131, #10141, #10151, #10161, #10171, #10211, #10221, and #10231. The map also shows local landmarks like St Elizabeth Church, Faith United Methodist Church, and various retail stores like Target and Chick-fil-A.

MCDOT
Montgomery County
Department of Transportation

System Status

Detector Status

System Faults

Clear System Faults

List CAST
EDIT CAST

System Log Output

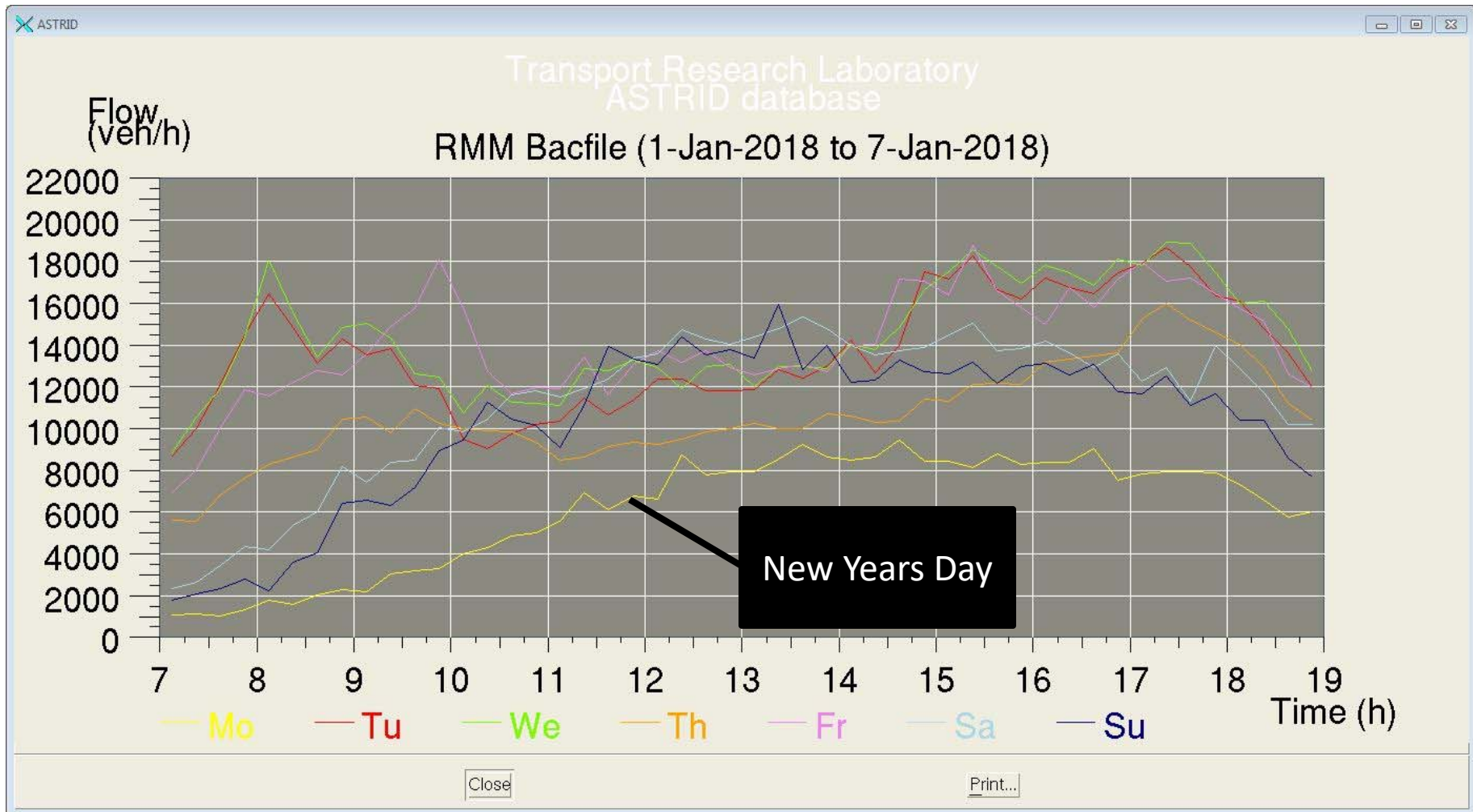
List Intersections

List SCOOT Intersections

Link Map

GRAPH DATA

SCOOT Traffic Flow



SCOOT Intersection Detail

J10151_EJefferson

File View Zoom (99%) Options Help

#23 Montrose Rd & E Jefferson

SCOO XSCO

OUTT X10150 — OK
 OUTT J10151 — OK
 OUTT N10151 — OK

Montrose Rd & Montrose Pkwy

Montrose Rd

Montrose Rd / Hebrew Home

Montrose Pkwy & E Jefferson

Execute CAST Event CLEAR ERRORS

DETECTOR STATUS AREA MAP LINK MAP DETECTORS

GRAPH DATA SYS INFO List CAST EDIT CAST OUTSTATIONS

DIPM NFTD MONI RFTD Timetable Edit Timetable JUNCTION

Link a OUTT N10151a1 OUTT N10151a2

Link b OUTT N10151b1 OUTT N10151b2

Link c OUTT N10151c1 OUTT N10151c2

Link d OUTT N10151d1

Link e OUTT N10151e1 OUTT N10151e2

Link f OUTT N10151f1 OUTT N10151f2

Link g OUTT N10151g1

Link h OUTT N10151h1 OUTT N10151h2

Link i OUTT N10151i1 OUTT N10151i2

Link j OUTT N10151j1 OUTT N10151j2

RMM 00/04 on SCOOT
 Cycle Time: 88 [88]

N10151
 Cycle Time: 128 [112+]
 Stage: N10151/3
 Translation Plan: 1

J10151 Plan No 000 (Timetable)
 LOCAL

SCOOT STAGES OUTT

1 OUTT 2 OUTT 3 OUTT 4 OUTT

A 2 6 B 3 3 C 4 4 D 1 5 E 1 6 F 2 5

VALU CHAN MaxS CHAN MaxS CHAN MaxS CHAN MaxS

VALU CHAN MinS CHAN MinS CHAN MinS CHAN MinS

Maryland's Smart Traffic Signal Initiative

- SHA is investing \$50.3 million to deploy Adaptive Signal Control on 14 corridors in Maryland by the end of 2018
- MD 108 corridor identified as the adaptive corridor in Montgomery County
- DOT is working with SHA and expects to operate the MD 108 adaptive corridor for SHA

Traffic Adaptive Findings

- DOT has observed operational improvements on Montrose Rd/Pkwy with both adaptive systems
- Adaptive systems will require additional staff to manage system and maintain field hardware/detection
- Cost Estimate (not including staffing)
 - **\$90K** Average per intersection
 - Vehicle detection infrastructure – over 60% of system cost
- Detailed traffic analysis is expected in mid April 2018

Questions?

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Sabra, Wang & Associates

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mkinney@sabra-wang.com