NEW JERSEY STATE TRANSPORTATION INNOVATION COUNCIL

www.NJDOTtechtransfer.net/NJ-STIC

SPRING Meeting

May 7, 2019

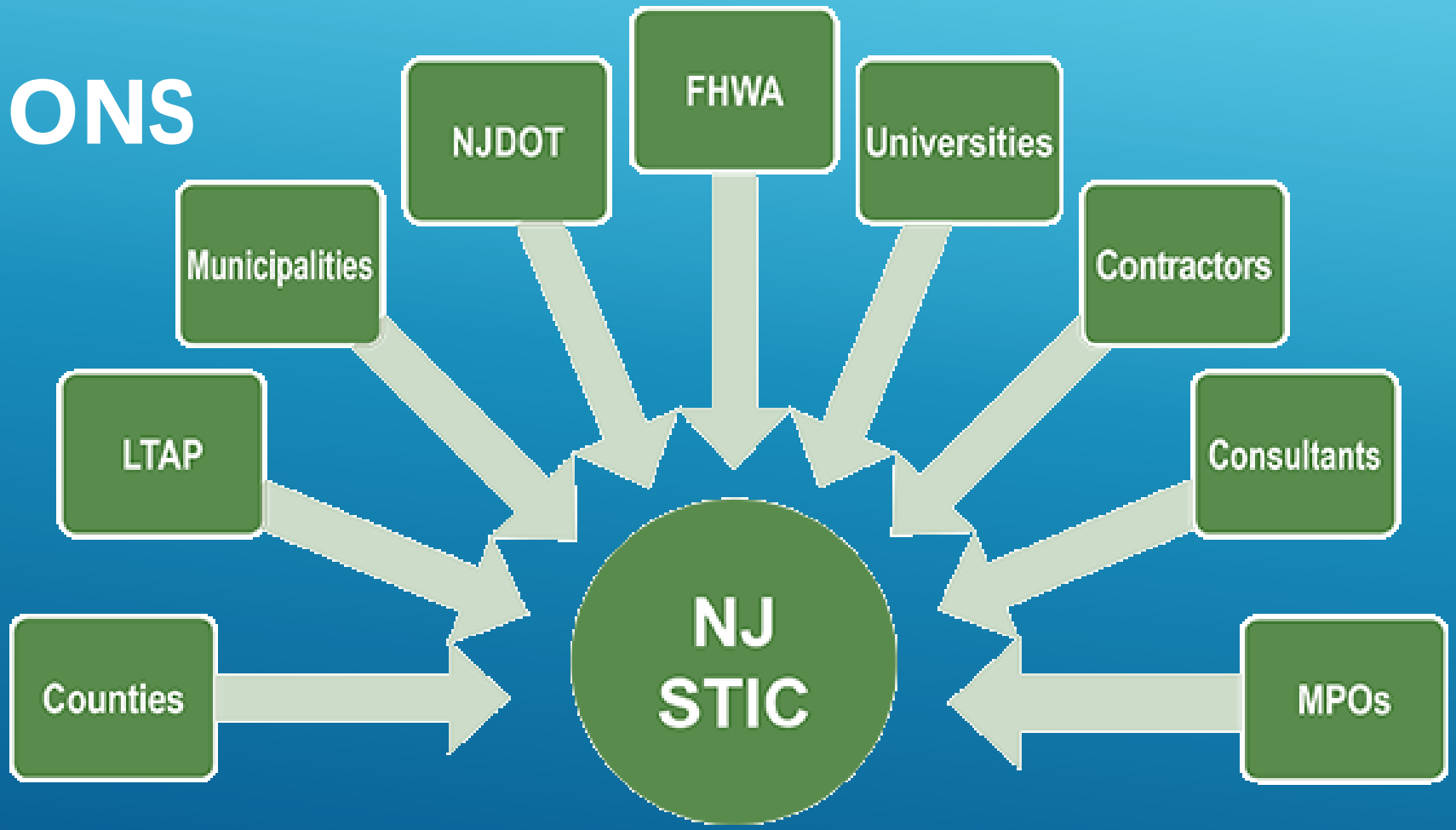
WELCOME & OPENING REMARKS

Mike Russo

Assistant Commissioner

NJDOT Planning, Multimodal & Grant Administration

INTRODUCTIONS



ROUNDTABLE RECAP

Amanda Gendek
Manager
NJDOT Bureau of Research

- Invite Municipalities & Counties to present
- Added American Public Works Association (APWA) to NJ STIC Council
- Multiple examples of innovations given, can be translated into presentations
- Adjust format of STIC Quarterly Meetings – Breakout/ Plenary Sessions
    - During the Roundtable at end of meeting, please offer feedback on specific changes to the format.

FHWA UPDATES

Helene Roberts, P.E.

Innovation Coordinator & Performance Manager

FHWA, NJ Division Office

CORE INNOVATION AREA REPORTS

CIA TEAM
SAFETY

NJDOT – Dan LiSanti

FHWA – Keith Skilton

CIA TEAM
MOBILITY & OPS

NJDOT – Sal Cowan & Wayne Patterson

FHWA – Ek Phomsavath

CIA TEAM
INFRASTRUCTURE PRESERVATION

NJDOT – Bob Signora

FHWA – John Miller

CIA TEAM

SAFETY

NJDOT – Dan LiSanti

FHWA – Keith Skilton

EDC – 5

Reducing Rural Roadway Departures

A Roadway Departure (RwD) is a crash in which a vehicle crosses an edge line, a center line, or otherwise leaves the traveled way.

Per FARS data, from 2014 to 2016 New Jersey had 10% of fatality crashes being Rural RwD, about 55-60 a year.

EDC – 5

Reducing Rural Roadway Departures

Benefits

Safer Roads. Practitioners can systemically apply safety treatments that mitigate roadway departure crashes at areas diagnosed as high risk.

Quick Deployment. Various pilot efforts have shown it is possible to implement a streamlined process to address the problem on more roads owned by more agencies, even with limited data, using existing crash modification factors and standards.

Flexibility. A wide range of analysis, diagnostic, and countermeasure selection tools and processes are possible to fit the data availability and technical expertise of the agency, while considering the SHSP goals of the State.

EDC – 5

Safe Transportation for Every Pedestrian (STEP)

Under EDC4, an action plan was completed for NJDOT which targeted specific countermeasures for improving pedestrian safety at uncontrolled intersections.

The EDC4 initiative is now considered Institutionalized.

The action plan recommends measures that when implemented may help reduce the number and rate of pedestrian crashes, fatalities, and injuries on New Jersey highways.

EDC – 5

Safe Transportation for Every Pedestrian (STEP)

Benefits

Improved Safety. Countermeasures are available that offer proven solutions for reducing pedestrian fatalities at uncontrolled and signalized crossing locations.

Targeted Investment. By focusing on pedestrian crossing locations, agencies can address a significant national safety problem.

Enhanced Quality of Life. Improving crossing opportunities boosts quality of life for pedestrians of all ages and abilities.

Building on the 4 ‘E’ approach (engineering, enforcement, education, and emergency medical services) within each State, communities can deploy proven, cost-effective countermeasures to improve pedestrian safety.

EDC – 5

Safe Transportation for Every Pedestrian (STEP)

The intent of this initiative is for the action plan to inform and be incorporated into the future strategies developed in NJ 2020 Strategic Highway Safety Plan. As the strategies are finalized, we will use the plan and **consider** the plan recommendations/next steps.

CIA TEAM

INFRASTRUCTURE PRESERVATION

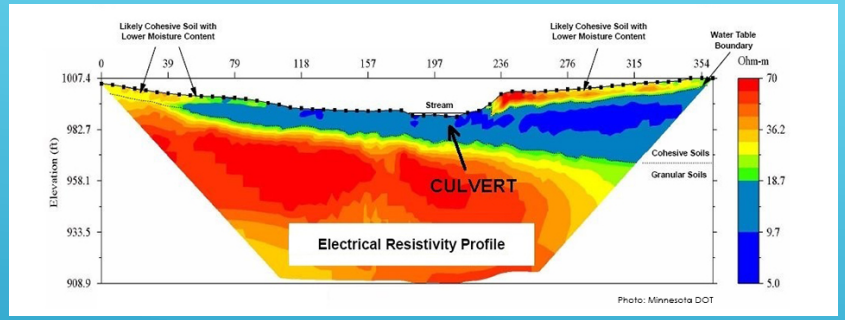
NJDOT – Bob Signora

FHWA – John Miller

EDC5 Initiatives Assigned:

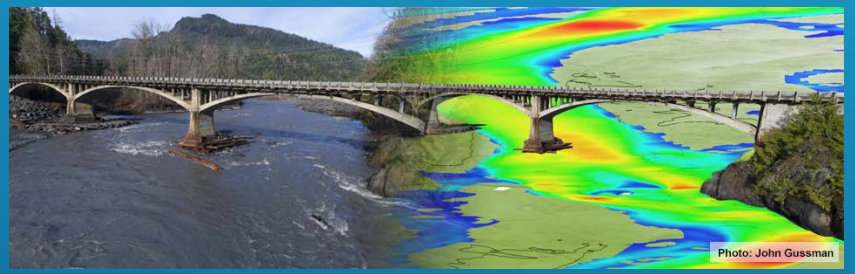
Advanced Geotechnical Exploration Methods

- Revising the Design Manual to include innovative technologies for enhancing the subsurface exploration program.
- Continuing to evaluate, on a project by project basis, the feasibility of implementing the new technologies.



Collaborative Hydraulics: Advancing to the Next Generation of Engineering

- We're putting together a document discussing pros and cons of using the program, as well as recommendations
- We will use one of the 2D models to show NJDEP. We will also continue to test the different abilities of the model.



EDC5 Initiatives Assigned:

Project Bundling

- NJDOT is exploring the use of project bundling solicitations for Intersection Improvement projects and Delaware & Raritan Canal bridge replacement projects.

CIA TEAM

MOBILITY & OPS

NJDOT – Sal Cowan & Wayne Patterson

FHWA – Ek Phomsavath

EDC5 Initiatives Assigned:

Weather-Responsive Management Strategies

<u>Goals:</u>

- Maximize the use of mobile road weather data to support NJDOT in implementing traffic and maintenance operations strategies during inclement weather.
- Improve safety, mobility, and minimize environmental impacts of weather on the transportation system.

<u>Initiatives:</u>

- FHWA Accelerated Innovation Deployment (AID) grant ($322,462): NJDOT was awarded the AID grant ($322,462) to install video camera dashboards and sensors onto NJDOT maintenance trucks and safety service patrol vehicles to collect streaming video and weather / pavement information to support road weather management throughout the state. We (Sue Catlett) are currently in the process of putting together the federal authorization package (i.e. project implementation schedule with cost breakdown) for submission to FHWA for funding.

- On Wednesday, April 24th, NJDOT participated in FHWA's Road Weather Management Capability Maturity Framework program. With help from the NJ Division Office and FHWA DC Headquarters Roemer Alfelor (Transportation Specialist for Road Weather Management), nearly 40 DOT employees and our weather vendor DTN discussed our current weather management strategies.

EDC5 Initiatives Assigned:

Unmanned Aerial Systems (UAS)

Goals:

- Utilize UAS to enhance data collection for structural/ construction inspections and emergency response while saving time and money for taxpayers.

Initiatives:

NJDOT State Transportation Innovation Council (STIC) Incentive Funding Grant Application:

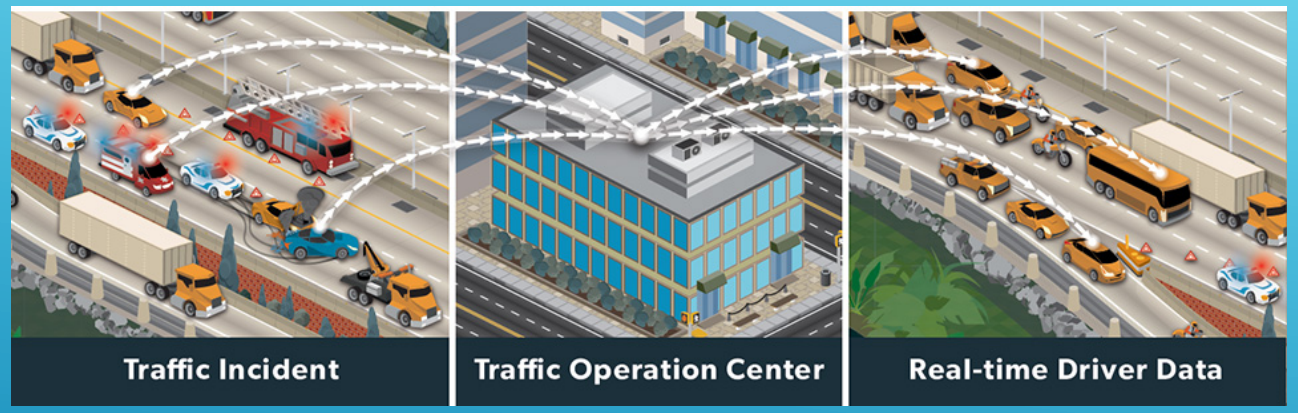
The Multi-Modal Bureau of Aeronautics have put together a proposal for STIC Incentive Funding ($43,104; note: total cost will change to increase the scope of the activity).

- Funding to procure thermal equipment for bridge deck inspections and counting bats under the bridge to comply with NJDEP regulations regarding potential wildlife under bridges.

- Funding is also provided for training courses related to Infrared Thermography, 3D Modeling, Drone Photography, and drone videography to help provide extended knowledge and experience for specialized situations to support other NJDOT divisions.

EDC5 Initiatives Assigned:

Use of Crowdsourcing to Advance Operations



Goals:

- Expands and improves real-time monitoring
- Enables more targeted and timely response
- Enables strategic / programmatic operational improvements

Initiatives:

Status of using crowdsource operations data in New Jersey:

- NJDOT is not participating in the use of crowdsourcing to advance traffic operations. We're institutionalized.
- Waze has been sharing traffic and incident report data with NJDOT by way of TRANSCOM. NJDOT TOC operators are using it for their incident detection and situational awareness when monitoring and verifying traffic conditions.
- On Tuesday, April 30th, Leadership from NJDOT met with the NJ Partnership Coordinators from Waze to discuss their "Waze Beacon" product (a GPS product that improves GPS accuracy within tunnels). This could possibly be a STIC incentive funding initiative for 2019. We are also exploring the option of having NJDOT sign up as a Connected Citizens Program, independent of our existing arrangement with Transcom.

FEATURE
CORE INNOVATION AREA
PRESENTATION

CIA TEAM

MOBILITY & OPS

NJDOT – Sal Cowan & Wayne Patterson

FHWA – Ek Phomsavath

NJDOT – Transportation Mobility

"Improving Lives by Improving Mobility"

Automated Traffic Signal Performance Measures

NJ State Transportation Innovation Council

May 7th, 2019

Kelly McVeigh, Principal Traffic Engineer

NJDOT – Transportation Mobility

Outline

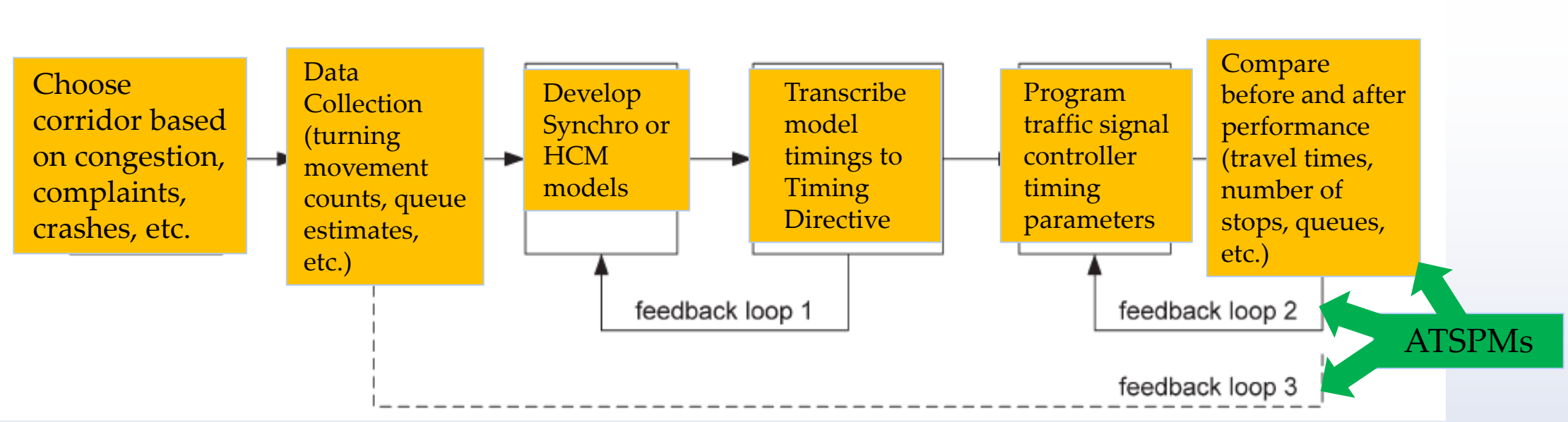
- Introduction to Automated Traffic Signal Performance Measures (ATSPMs)
- NJDOT Research Project
- Future work involving ATSPMs
- Questions

Introduction to ATSPMs

- What is the **NEED**?

Introduction to ATSPMs

- Traffic Engineers **NEED** to know how signal timings perform.
- Traditional process of knowing is a lengthy one.



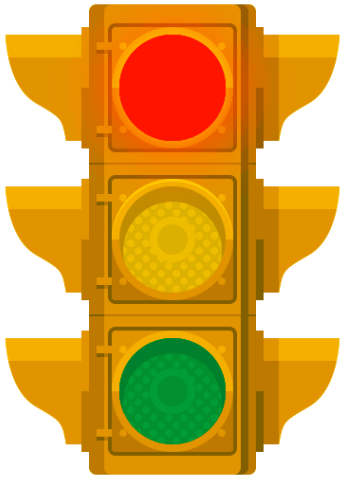
Introduction to ATSPMs

- Most practitioners would agree.

Introduction to ATSPMs

- **HOW** do you generate ATSPMs?

Indiana Traffic Signal Hi Resolution Data Logger Enumerations



6 Events occur at the signal head:
1. Begin of Green
2. End of Green
3. Begin of Yellow
4. End of Yellow
5. Begin of Red
6. End of Red

When a controller timestamps those events, they become **Hi-resolution Data**

Introduction to ATSPMs

- **WHY** would you generate ATSPMs?
- **Increased Safety.** A shift to proactive operations and maintenance practices can improve safety by reducing the traffic congestion that results from poor and outdated signal timing.
- **Targeted Maintenance.** ATSPMs provide the actionable information needed to deliver high-quality service to customers, with significant cost savings to agencies.
- **Improved Operations.** Active monitoring of signalized intersection performance lets agencies address problems before they become complaints.
- **Improved Traffic Signal Timing and Optimization Policies.** Agencies are able to adjust traffic signal timing parameters based on quantitative data without requiring a robust data collection and modeling process.

NJDOT Research Project

NJDOT Project 2016-14
Real-Time Traffic Signal Performance Measurement

NJDOT – Transportation Mobility
“Improving Lives by Improving Mobility”

NJDOT Research Project

Project Team

NJDOT Research
Kim Davis, Section Chief, Statewide Planning
NJDOT Transportation Mobility
Kelly McVeigh, Principal Engineer Traffic
Shazia Khizir, Assistant Engineer Traffic
Rutgers Center for Advanced Infrastructure and Transportation (CAIT)
Peter Jin, Ph.D., Assistant Professor
The College of New Jersey (TCNJ)
Thomas Brennan, Ph.D., PE., Associate Professor
Rowan University
Mohammad Jalayer, Ph.D., Assistant Professor

NJDOT Research Project

- **Objectives:**
  - Development of metrics, guidelines, and implementation strategies for Automated Traffic Signal Performance Measures.
  - Based on the **existing infrastructure** operated and maintained by NJDOT.
  - Develop a prototype ATSPM system.
- **NJDOT Infrastructure:**
  - Centralized control (servers)
  - Fiber-optic communication
  - **Adaptive Signal Control Technology (ASCT)**

NJDOT Research Project

- NJDOT is actively deploying ASCT.

Full Operation:
NJ-18 (SCATS) = 13 Signals
US-1 (InSync) = 22 Signals
US-130 (SCATS) = 18 Signals
US-130 (InSync) = 12 Signals
NJ-168 (InSync) = 11 Signals
MASSTR (SCATS) = 123 Signals

Under Construction/Final Design:
US-1 = 12 Signals
NJ-73 = 29 Signals
US-322 & US-40 = 27 Signals

Concept Development:
11 Corridors = 122 Signals

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NJDOT Research Project

- **What do Adaptive Systems have to offer?**

Time	Duration	Movement	Phase 2 (NT)		Phase 3 (WL)		Phase 4 (ET)		Phase 6 (ST)		Period
			Q	W	Q	W	Q	W	Q	W	
06:03:32 AM	148		13	47	1	15	0	0	6	31	200
06:05:09 AM		Ped Called									
06:06:09 AM	17		0	0	2	172	1	77	0	0	200
06:06:24 AM		Ped Sent									
06:06:33 AM	34		0	0	0	0	2	100	3	21	200
06:07:14 AM	101		0	0	1	29	0	0	11	62	200
06:09:04 AM	17		0	0	2	139	1	19	1	3	200

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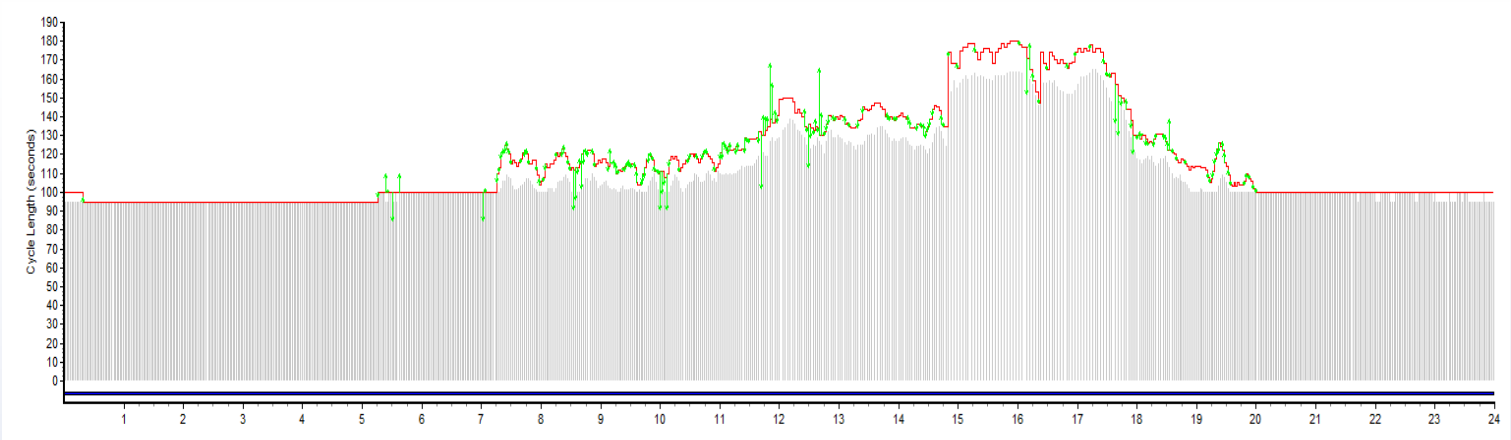
NJDOT Research Project

- **What do Adaptive Systems have to offer?**



Time	Secs	Phases
7:58:47 AM	151	<101> 17 33
8:01:18 AM	143	<90> 16 37
8:03:41 AM	135	<87> 23 25
8:05:56 AM	146	<91> 42
8:08:22 AM	143	<85> 22 36
8:10:45 AM	135	<83> 22 30
8:13:00 AM	142	<87> 16 39
8:15:22 AM	125	<85> 16 24
8:17:27 AM	151	<101> 19 31
8:19:58 AM	144	<90> 22 32
8:22:22 AM	129	<85> 30
8:24:31 AM	152	<97> 24 31
8:27:03 AM	138	<84> 21 33
8:29:21 AM	145	<87> 47
8:31:46 AM	134	<81> 24 29
8:34:00 AM	148	<87> 15 46
8:36:28 AM	122	<80> 16 26
8:38:30 AM	135	<97> 15 23
8:40:45 AM	157	<102> 44
8:43:22 AM	123	<85> 25
8:45:25 AM	144	<102> 29

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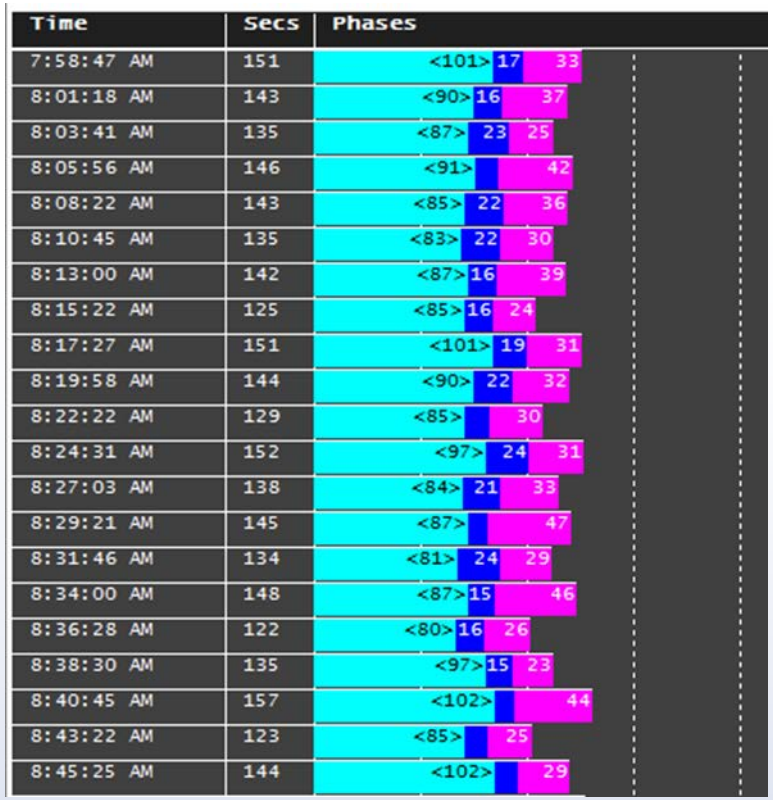
NJDOT Research Project

- **Project Team Challenge:**
- Translate Adaptive Signal Data to ATSPM Source Code Data



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8:31:46 AM	134	<81> 24 29
8:34:00 AM	148	<87> 15 46
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8:38:30 AM	135	<97> 15 23
8:40:45 AM	157	<102> 44
8:43:22 AM	123	<85> 25
8:45:25 AM	144	<102> 29

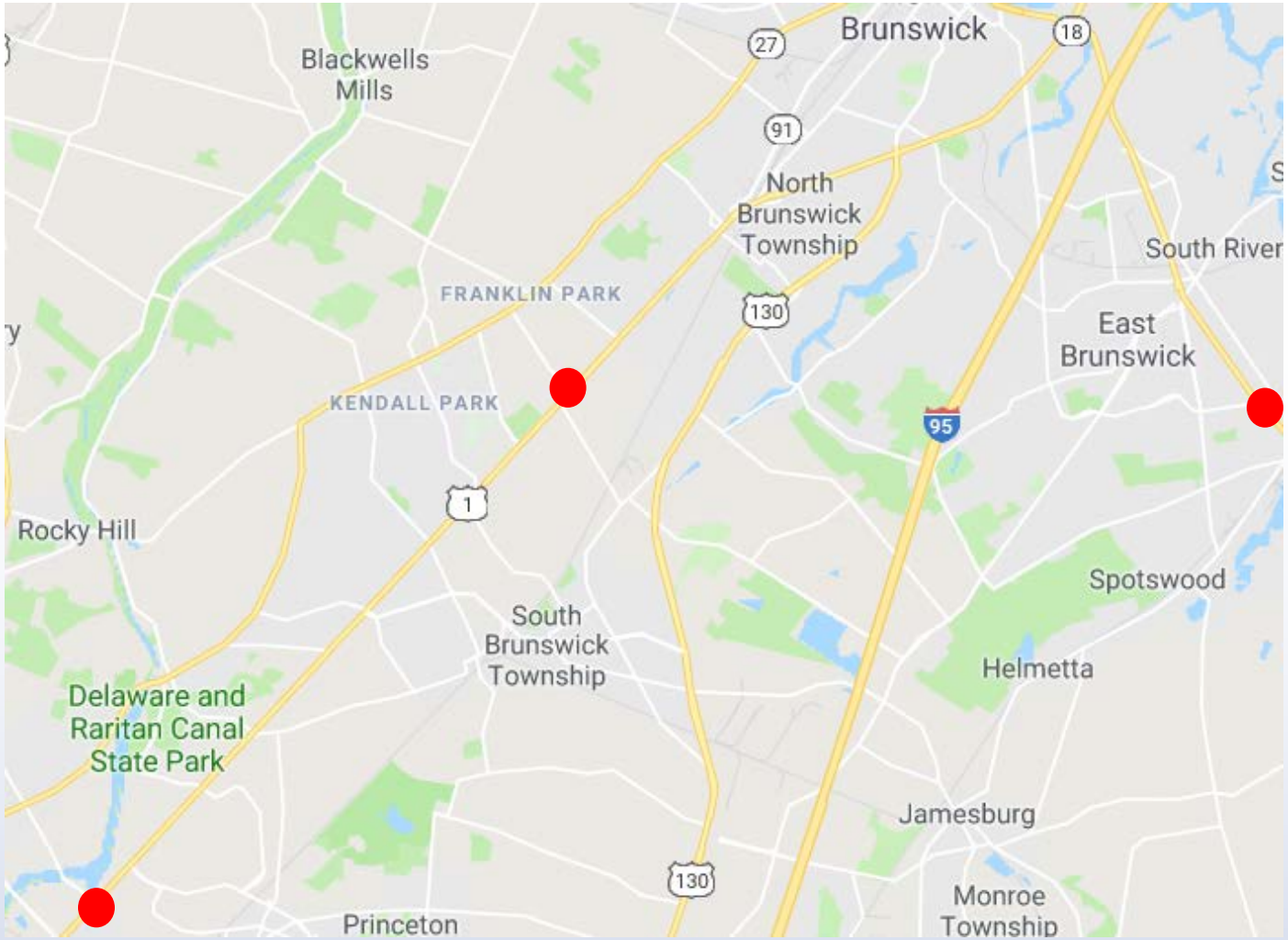
Indiana Traffic Signal Hi Resolution Data Logger Enumerations

Event Code	Event Descriptor	Parameter	Description
Active Phase Events:			
0	Phase On	Phase # (1-16)	Set when NEMA Phase On becomes active, either upon start of green or walk interval, whichever occurs first.
1	Phase Begin Green	Phase # (1-16)	Set when either solid or flashing green indication has begun. Do not set repeatedly during flashing operation.
2	Phase Check	Phase # (1-16)	Set when a conflicting call is registered against the active phase. (Marks beginning of MAX timing)
3	Phase Min Complete	Phase # (1-16)	Set when phase min timer expires.
4	Phase Gap Out	Phase # (1-16)	Set when phase gaps out, but may not necessarily occur upon phase termination. Event may be set multiple times within a single green under simultaneous gap out.
5	Phase Max Out	Phase # (1-16)	Set when phase MAX timer expires, but may not necessarily occur upon phase termination due to last car passage or other features.
6	Phase Force Off	Phase # (1-16)	Set when phase force off is applied to the active green phase.

NJDOT Research Project

- **Project Test Intersections**

- US-1 at Harrison (InSync)
- US-1 at Henderson (InSync)
- NJ-18 at Hillsdale (SCATS)



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NJDOT Research Project

Insync Signal Event Conversion

Convertible Signal Event

Code	Event	Insync Translator Logic
0	PhaseOn	Get from movement start time
1	PhaseBeginGreen	Get from movement start time
2	PhaseCheck	Get from conflicting movement
3	PhaseMinComplete	Duration > Minimum Green time
4	PhaseGapOut	Movement is Truncated Based on Insync Log
5	PhaseMaxOut	if not Gapout, then it will be Maxout
7	PhaseGreenTermination	Movement End Time
8	PhaseBeginYellowClr	Begin Yellow is the same as green termination
9	PhaseEndYellowClr	Phase end time + yellow change interval
10	PhaseBeginRedClr	Begin Red Clearance is the same as end of Yellow Interval
11	PhaseEndRedClr	Begin of Red + Red Clearance Interval
12	PhaseInactive	If a movement not exist in a certain cycle, then create phaseInactive
21	PedBeginWalk	"pedestrian Sent" is in Insync log
43	PhaseCallRegistered	conflicting movements have waiting time
45	PedestrianCallRegistered	"Pedestrian Called" is in Insync log

SCATS Signal Event Conversion

Convertible Signal Event

Code	Event	Insync Translator Logic
0	PhaseOn	"Current Running" in SCATS message
1	PhaseBeginGreen	"Current Running" in SCATS message
2	PhaseCheck	"Phase demand" in SCATS message
3	PhaseMinComplete	"Signal Group: SG6=off" in SCATS message
4	PhaseGapOut	Green Duration < Maxium Green
5	PhaseMaxOut	Green Duration > Maxium Green
7	PhaseGreenTermination	"Phase interval: Yellow" in SCATS message
8	PhaseBeginYellowClr	"Phase interval: Yellow" in SCATS message
9	PhaseEndYellowClr	"Phase interval: All Red" in SCATS message
10	PhaseBeginRedClr	"Phase interval: All Red" in SCATS message
11	PhaseEndRedClr	keyword: "Phase termination"
12	PhaseInactive	If a movement not exist in a certain cycle, then create phaseInactive
21	PedBeginWalk	keywords: "Walk"+"Active=On"
22	PedBeginClearance	Keywords: "Walk" + "Active=Off"
45	PedestrianCallRegistered	keywords: "Walk"+"Demand=On"

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Key ATSPM Performance Metrics translated from Adaptive Systems	ATSPM Event Code Used
Purdue Coordinate Diagram (PCD)	Controller timing of red, yellow, and green intervals (event 1, event 7, event 8, event 9, event 10, event 11)
Purdue Phase Termination Charts	Termination reasons (event 4, event 5)
Split Monitor	Phase Termination Events (event 0, event 7, event 8, event 9, event 11)
Pedestrian Delay	Pedestrian Actuation (event 21, event 43, event 45)

NJDOT Research Project

- Translator:

```python
def NEMAphaseNumber():
    # get NEMA Phase and Number hashtable from metadata
    global InsyncMetaData
    nemaPhase2Number = {}
    nemaNumber2Phase = {}
    phaseFieldNum = []
    movesAndNums = set(zip(InsyncMetaData["phaseMove"],InsyncMetaData["phaseNum"]))
    for item in movesAndNums:
        moves, nemaNumbers = item
        for item in zip(moves.split("/"),nemaNumbers.split("/")) :
            nemaPhase2Number[item[0]] = int(item[1])
            nemaNumber2Phase[item[1]] = item[0]
            phaseFieldNum.append(int(item[1]))
    phaseFieldNum = list(set(phaseFieldNum))
    phaseFieldNum.sort()
    return  nemaPhase2Number, nemaNumber2Phase, phaseFieldNum
```

Python Code

NJDOT Research Project

- Example Event Translation: Pedestrian Delay (SCATS to ATSPM)

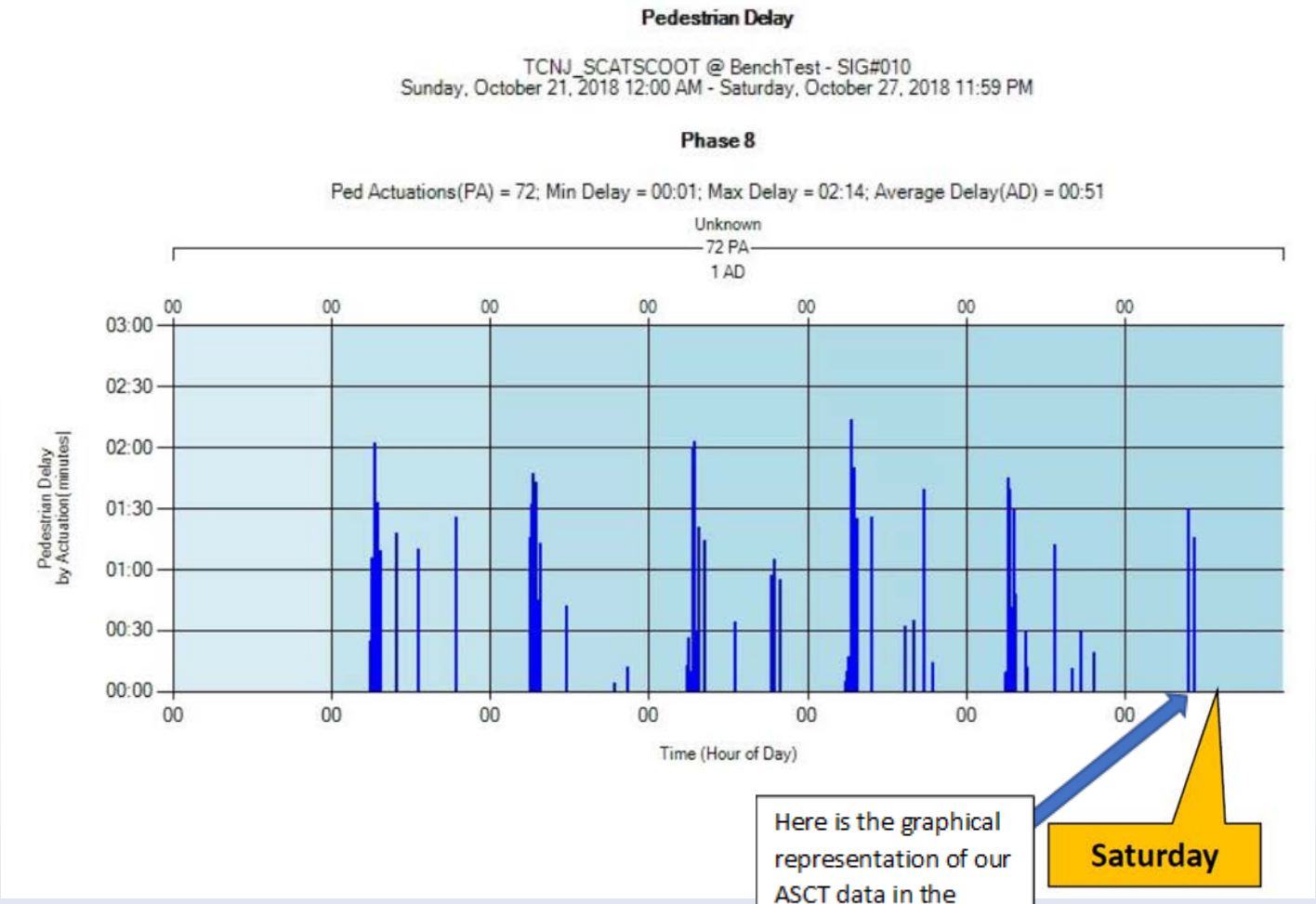
9:38:22 AM	Walk: statuses=[Walk 8: Demand=On]
9:38:37 AM	Phase interval: Rest or extension green
9:38:40 AM	Controller request to terminate phase: request termination for A
9:38:42 AM	Controller request to terminate phase: no request termination for A
9:38:46 AM	Cycle length: changes=[Active=112]
9:38:51 AM	Controller request to terminate phase: request termination for A
9:38:56 AM	Controller request to terminate phase: no request termination for A
9:39:43 AM	Phase termination request confirmation from controller: current phase=A
9:39:44 AM	Signal group: SG2=Off SG6=Off
9:39:45 AM	Phase interval: Yellow
9:39:50 AM	Cycle generator: restart
9:39:50 AM	Phase interval: All red
9:39:52 AM	Phase demand: B=Off
9:39:52 AM	Signal group: SG8=On SG24=On SG4=On
9:39:52 AM	Walk: statuses=[Walk 8: Demand=Off Active=On]
9:39:53 AM	Phase termination: phase=A MX=0 GT=94 CG=3
9:39:53 AM	Alarm timer: value=0
9:39:53 AM	Current running phase=B. Flags=[]
9:39:53 AM	Phase interval: Minimum green
9:39:57 AM	Phase demand: A=On
9:39:59 AM	Signal group: SG24=Off
9:39:59 AM	Walk: statuses=[Walk 8: Active=Off]

This SCATS logged event indicates that the Phase 8 pedestrian push button was triggered. This translates to **ATSPM Event Code 45: "Pedestrian Call Registered".**

This SCATS logged event indicates that the Phase 8 pedestrian walk signal is on. This translates to **ATSPM Event Code 21: "Pedestrian Begin Walk".**

NJDOT Research Project

- Example Event Translation: Pedestrian Delay (SCATS to ATSPM)



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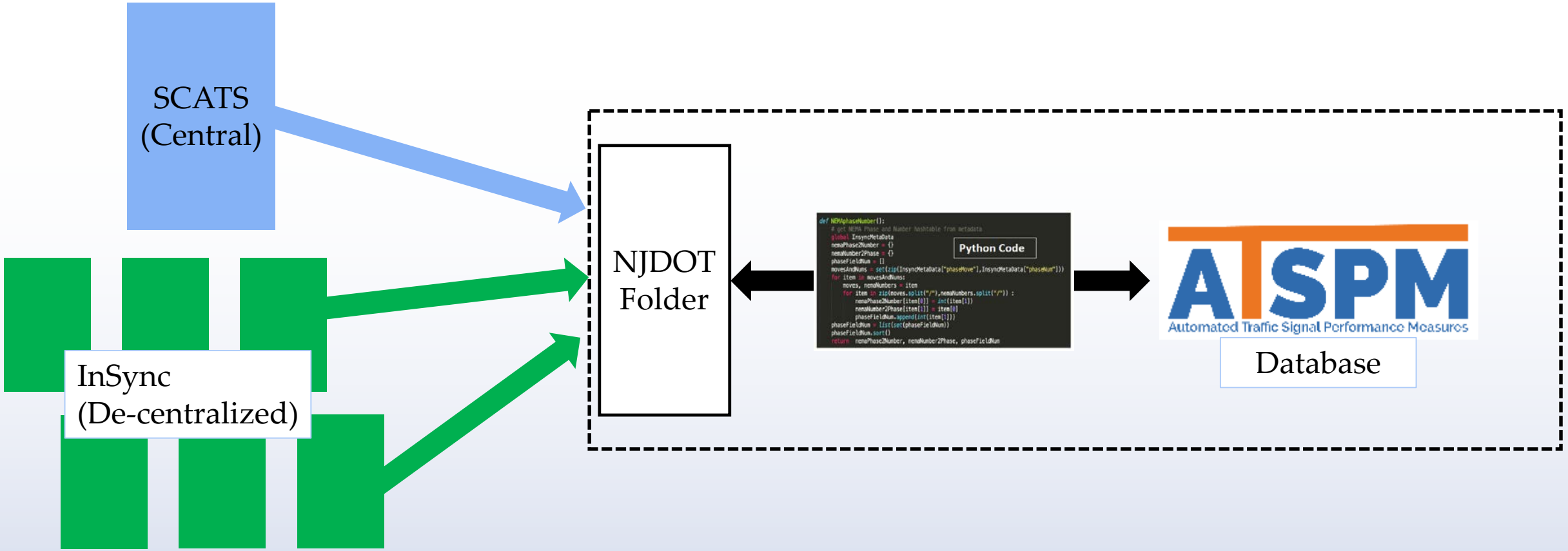
NJDOT Research Project

- Overall Process:



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NJDOT Research Project

- **Challenges:**
- Python Code sits outside of ATSPM software. This process is mostly independent of the ATSPM software.
- Estimating maximum green time for individual phases (Adaptive). Issue for Phase Termination.
- Obtaining the hi-resolution detector inputs is not currently possible. Limits available measures.

- **Successes:**
- Able to provide Purdue Phase Termination graph, Pedestrian Delay, Split Monitor, Purdue Coordination Diagram (without detector actuations).
- Able to automatically generate an ATSPM file that can be read by the FHWA ATSPM source code.

Future ATSPM Work

- Develop NJDOT ATSPM architecture.
  - Work with OIT to assign server for ATSPM suite of applications (includes Web Server) and SQL DB.
  - Map ATSPM server to InSync and SCATS Data Folders.
  - Download Python Software Package and web-scraper tool.
  - Update field hardware (TS Controllers) for traditional ATSPM deployment.
- ATSPM source code edits.
  - 3rd party software developer proficient in C# and Adaptive Vendors.
  - SCATS Degree of Saturation, Original Volume, and Corrected Volume.
  - InSync Queue and Wait Times.
- Determine how to best utilize ATSPM outputs.
  - Develop policy for changing signal timings (e.g. using Link Pivot algorithm).
  - Potential for utilizing specific ATSPMs in an Adaptive or Responsive mode of operation.


Question?

FEATURE LOCAL PRESENTATION:
Signal Timing In Burlington County

Martin is joined by:

Paul Carafides, DVRPC
Lindsey Klein, Imperial Traffic

Not attending:
Preston Hitchens, TWT

CALL FOR FUTURE PRESENTERS

WHO?

- Any member of the STIC Council or a designated representative

WHAT?

- Depending on the topic, 15-30 minutes
- Any of the EDC initiatives

When?

- Quarterly, at each STIC Meeting

WHY?

- NJ STIC is not solely a NJDOT initiative.

AUGUST 8, 2019
NJ STIC SUMMER MEETING:
LOCAL PERSPECTIVE ON EDC INNOVATIONS

A Presentation By County And Municipal STIC Members On What Works And Doesn't Work On the Local Level

Deanna Stockton, Municipal Engineer, Princeton

OUTREACH & COORDINATION EFFORTS

RECENT:

- National STIC Network meeting (April 11th, 2019)
  Recording Available:
  https://connectdot.connectsolutions.com/pkwieo1olkkk/
- NJ TransAction Conference (April 17)

FUTURE:

- County Engineers Meeting (May 17)
- ACEC NJ - Design Summit (May 22)
- PA STIC Meeting (July 17 or Nov 13)
- ACEC Fall Conference (Sept 22-24)
- Tech Talk! -- Safe Transportation for Every Pedestrian (Oct 30)

ONLINE NJ STIC SURVEY

- Emailed 4/25/19 – NJDOT Bureau of Research – New Jersey STIC Innovation Initiatives SURVEY
- **PURPOSE**: to identify innovative practices being undertaken by organizations outside the purview of NJDOT (i.e. County, Municipality)
- **GOALS**:
  - Greater recognition (news articles, awards)
  - Sharing of lessons learned
  - Encourage greater deployment of innovations
  - Identification of presentation topics for STIC Quarterly Meetings
- **Responses DUE May 22!**

REMINDERS!

NJ STIC Quarterly Meetings

Summer – August 8th, 2019

Fall – November 9th, 2019

National STIC Meeting

October ? at NJDOT/FHWA or can participate remotely

Build A Better Mousetrap Competition

Entries due July 1st (local agency, August 15th (state agency)

https://cait.rutgers.edu/mousetrap/

BUILD A BETTER MOUSETRAP COMPETITION

2018 Winner: NJDOT Crew 333

The Roncovitz Post Pusher & Post Puller

ROUNDTABLE DISCUSSION

1 TO 2 MINUTES EACH

STIC
State Transportation Innovation Councils

EDC

THANK YOU!

www.NJDOTtechtransfer.net/NJ-STIC
(609)963-2242 – Bureau of Research