



DeIDOT's Artificial Intelligence Enhanced Integrated Transportation Management System (AI-ITMS)

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Delaware Department of Transportation





Excellence in Transportation

Every Trip.

We strive to make every trip taken in Delaware safe, reliable and convenient for people and commerce.

Every Mode.

We provide safe choices for travelers in Delaware to access roads, rails, buses, airways, waterways, bike trails and walking paths.

Every Dollar.

We seek the best value for every dollar spent for the benefit of all.

Everyone.

We engage our customers and employees with respect and courtesy as we deliver our services.

Fatality Data

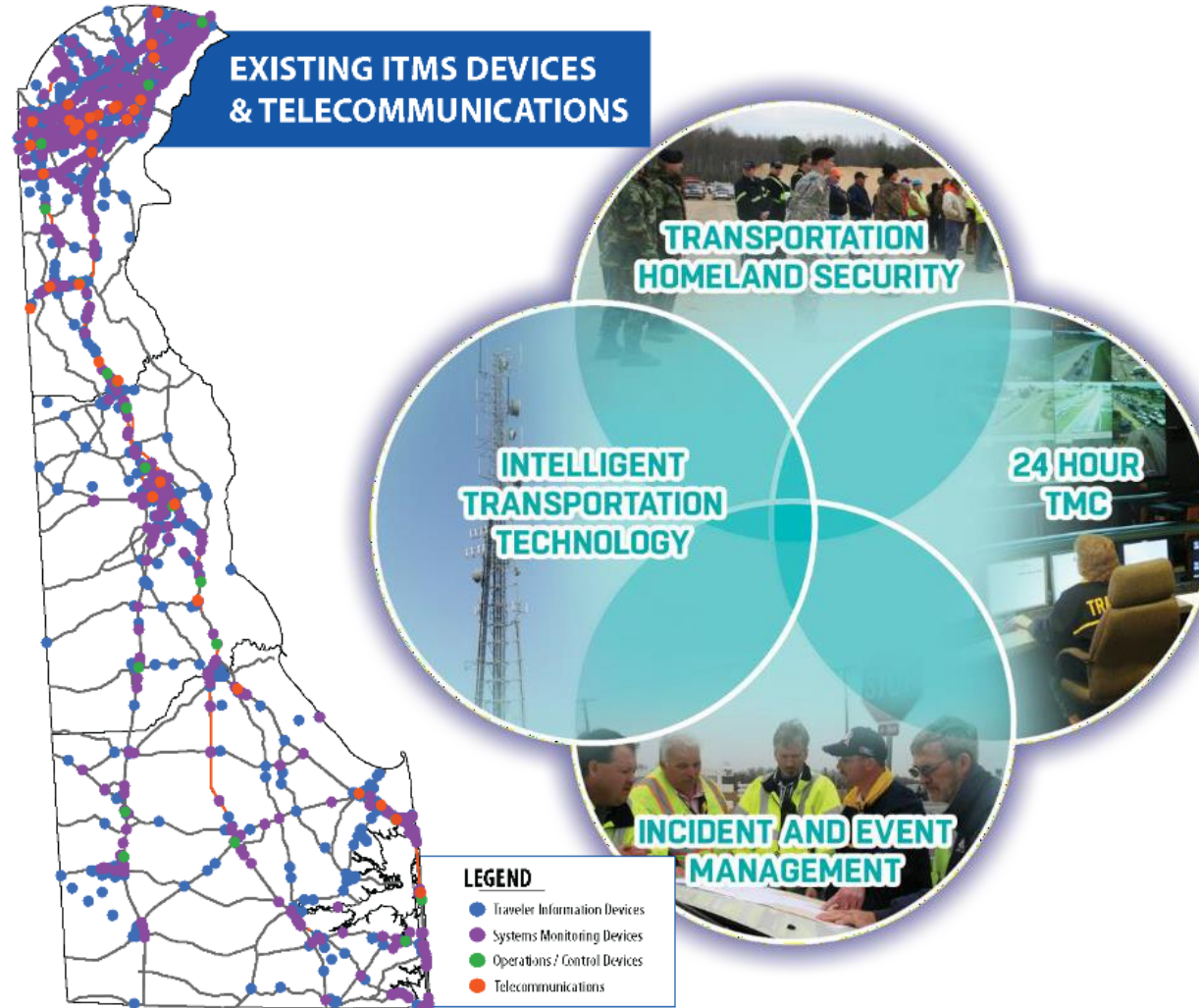
2024 Delaware Traffic Fatalities as of 4/15/2024							
	2024	2023			2022		
		Year-to-Date		Totals	Year-to-Date	Totals	
Fatalities	30	47	↓ -36%	137	42	↓ -29%	164
Delaware Residents	26	37	↓ -30%	110	32	↓ -19%	122
Person Types							
Vehicle Occupant	20	33	↓ -39%	89	29	↓ -31%	103
Pedestrian	6	9	↓ -33%	28	9	↓ -33%	32
Bicyclist	1	2	↓ -50%	5	1	0%	7
Motorcyclist	3	3	0%	15	3	0%	22
Crash Types							
Curve Related	3	8	↓ -63%	28	6	↓ -50%	19
Roadway Departure	11	23	↓ -52%	69	14	↓ -21%	55
Intersection Related	10	14	↓ -29%	37	14	↓ -29%	50
Median Crossover	0	3	↓ -100%	8	2	↓ -100%	8
Wrong Way	1	0	↑ N/A	1	2	↓ -50%	7
Work Zone	2	3	↓ -33%	9	0	↑ N/A	4



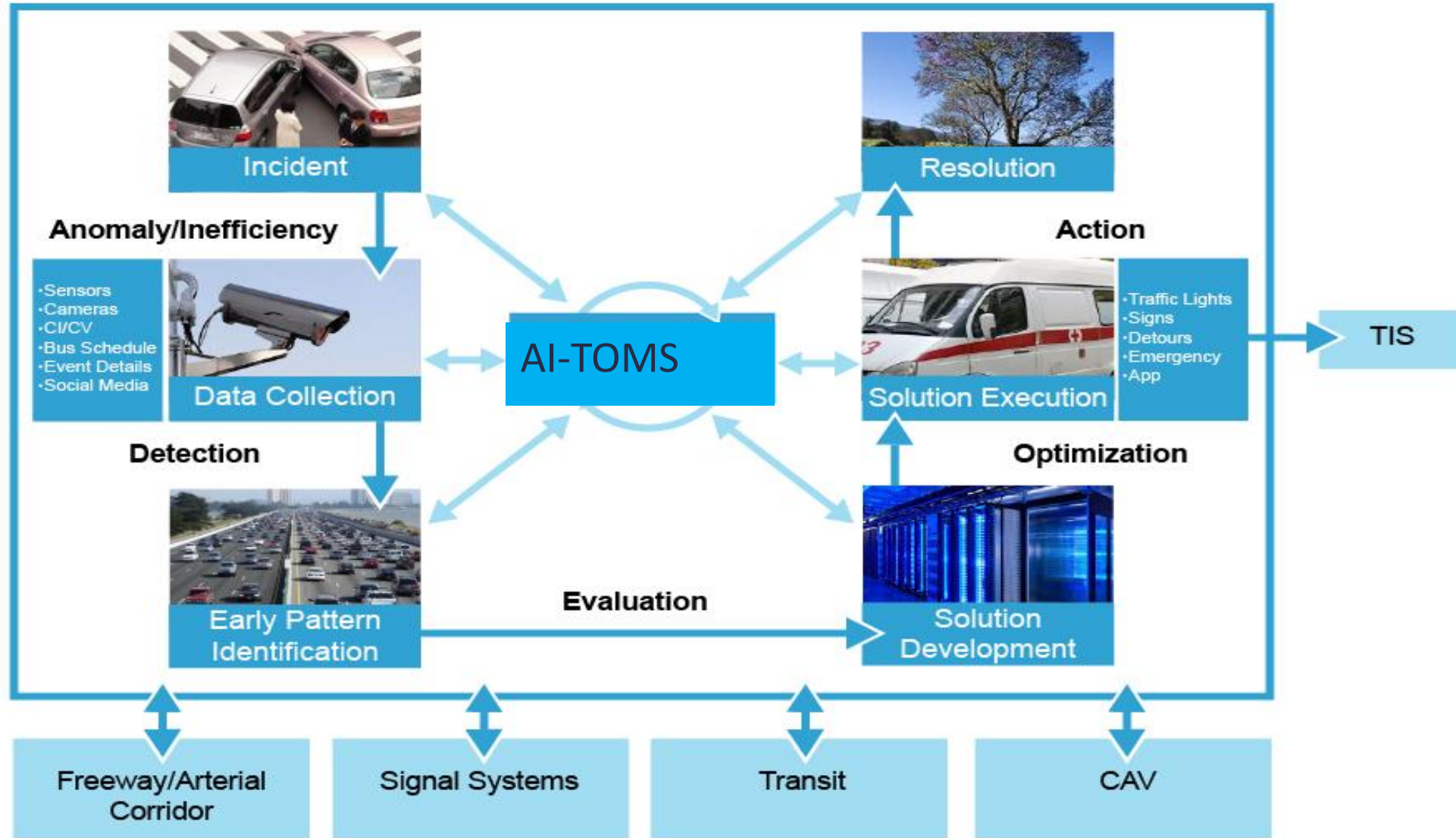
Outline

- DeIDOT's ITMS / AI-ITMS Program
- AI-TOMS Software Capabilities
 - Data Fusion
 - Short Term Traffic Flow Prediction
 - Proactive Incident Management and Decision Support
 - Machine Vision for Traffic Management
 - Traffic Signal Optimization and Operation
 - Connected Automated Vehicle (CAV) Integration
- Follow-up Efforts
 - Flood prediction and Vulnerable Road User safety for traffic management (ATTAIN grant)
 - Cloud based V2X and intersection safety (SMART grant)
 - Statewide Deployment of AI-ITMS

Integrated Transportation Management Systems (ITMS)



AI-ITMS



AI-ITMS Deployment Phases

Infrastructure and Data Fusion

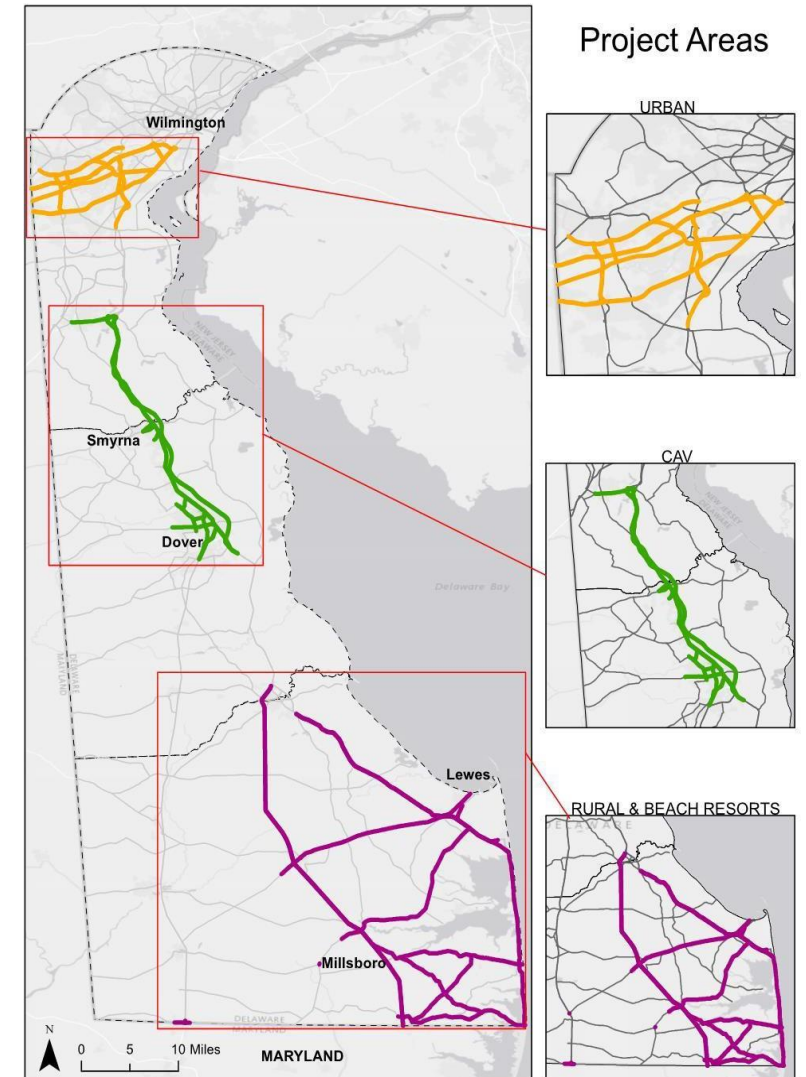
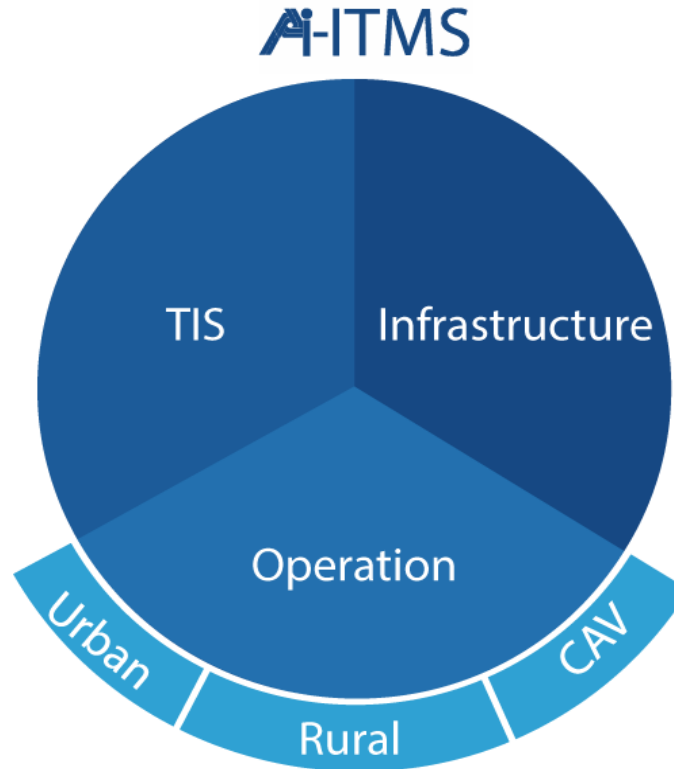
Upgrade and deploy ITS technologies to support data fusion and the deployment of AI-ITMS. Tons of sources of information are feeding the TMC and **the biggest advantage of AI/ML is the ability to integrate and make use of these data**

Operation

Development, integration, deployment, and testing of the AI-based software; includes three subprojects in distinct traffic networks: **Urban, Rural, and CAV.**

Traveler Information System

Update the DeIDOT website and mobile application to better inform the public of the information generated by the AI-ITMS program.



Data Fusion



Road Weather Data



Traffic Flow Data



Travel Time Data



ATSPM and SPaT Data



Traffic Camera Videos



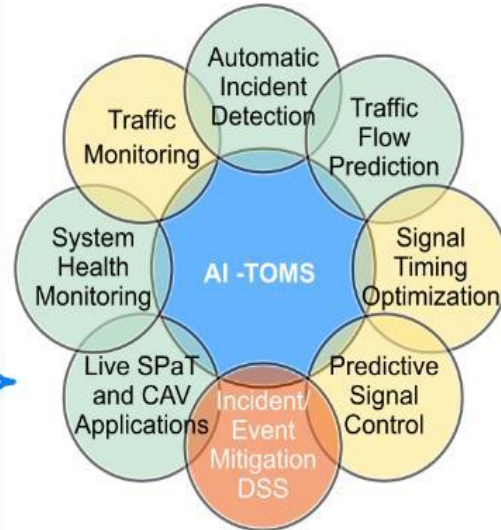
Travel Restrictions Data



CAV Data



Social Media Data



6494-001 (23.004)



AI-TOMS Dashboard

The dashboard displays a map of Dover, Delaware, with various traffic indicators. A sidebar on the left shows summary statistics:

- Traffic Incidents: 1
- Accidents: 1
- Construction: 6
- Incidents: 6
- Alerts: 0
- Events: 80

The main map shows a road network with a red square indicating a specific location. A detailed view of this location (22765NB) is shown on the right:

22765NB 20

22765NB 2023-12-11 21:05 1 / 20

Current Flow		Historic Flow	
speed	58 mph	avg Speed	71 mph
volume	14	avg Volume	25
occupancy	1%	avg Occupancy	1%

Flow Status		Anomaly	
Flow Status	No Delay	mdist	5.91
vol + occ	6%	severity	55
Flow Level	0	Status 3	Anomaly

SPEED

Speed (mph) vs Time of day

The speed graph shows Actual speed (orange line) and Baseline speed (green line) over time. The Actual speed shows a significant drop from approximately 70 mph to 40 mph around 18:00 on 11 Dec.

Traffic Data



Traffic Flow Prediction





Traffic Flow Prediction

Table 6. Mean Absolute Percent Error of Traffic Volume Predictions at Detector N19997

Prediction Model	5-Minute	10-Minute	15-Minute	20-Minute	60-Minute
Naïve	11.70	12.54	13.88	16.90	23.59
Historical Average	16.40	16.40	16.40	16.40	16.40
LSTM + Good Data	4.55	8.08	9.96	10.99	11.94
LSTM + 10% Random Data	32.07	28.43	19.83	18.42	19.26
Robust LSTM + Good Data	4.72	8.24	10.16	11.01	12.35
Robust LSTM + 10% Random Data	5.69	9.14	10.94	11.61	12.83

Traffic Incident Detection and Management

The screenshot displays the TOMS v1.1.4 interface for Traffic Incidents on May 16, 2023. The dashboard is divided into three main sections: a list of incidents on the left, a map of the selected incident in the center, and a detailed incident profile on the right.

Incident List

Incident ID	Location	Duration	Severity	Proof
Incident 11695	Urban US13 NB	43min	70	19
Incident 11697	Urban DE1 NB	51min	83	42, 31, 26
Incident 11698	Urban I-95 NB	130min	52	27
Incident 11700	Urban US13 NB	58min	68	27
Incident 11703	Urban US13 SB	32min	68	16
Incident 11706	Urban US13 SB	50min	70	43

Incident 11697 Details

TIME
Start Time: MAY 16, 8:49 AM
End Time: MAY 16, 9:40 AM
Duration: 51 MIN

LOCATION
Region: URBAN AREA
Route: DE1 NB
Detectors: 19968, 19958

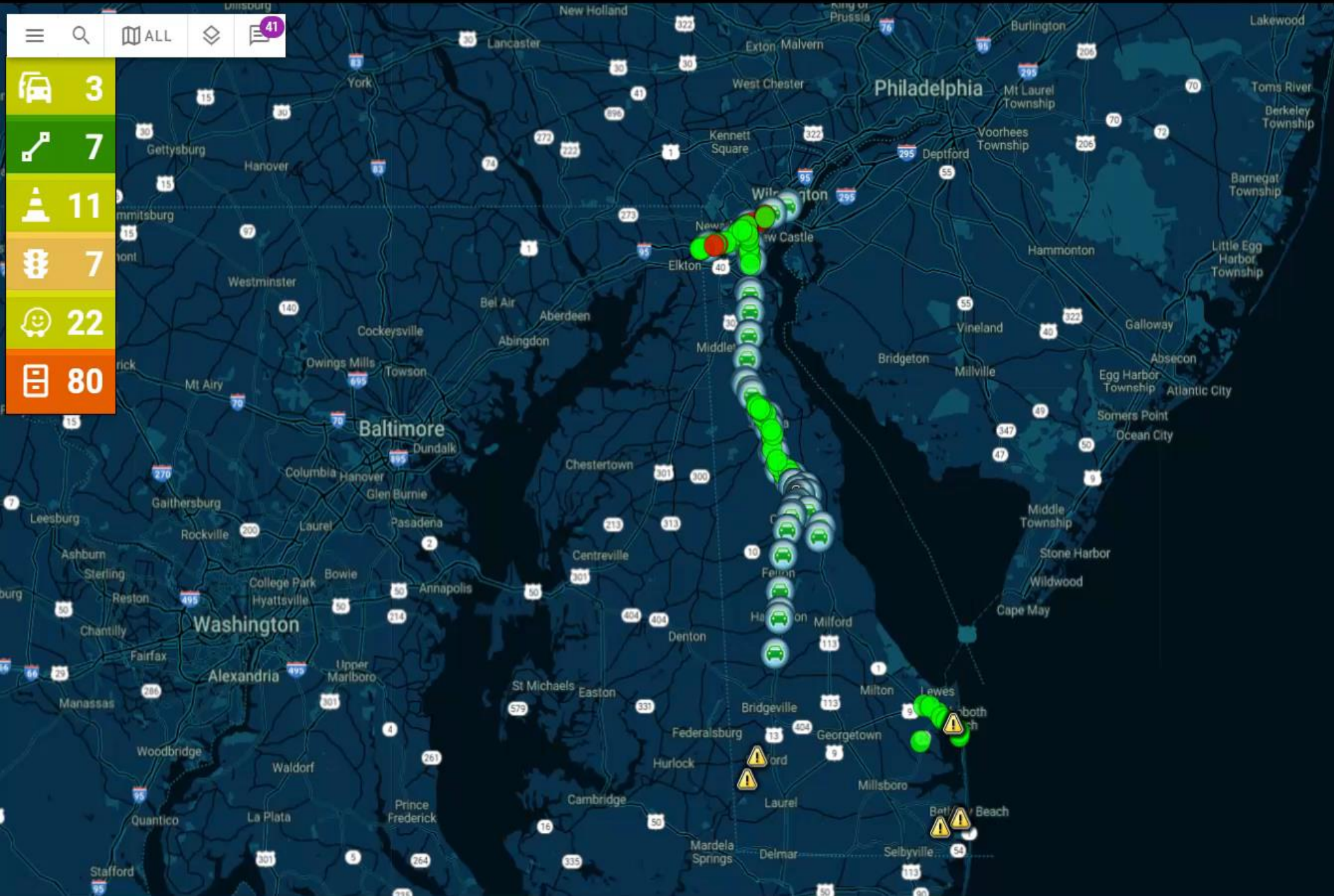
TYPE
Type: Incident
Proof: 42, 31, 26
Severity: 83

Incident Timeline

- 07:50 AM: First waze alert received
- 08:44 AM: Incident start
- 08:49 AM: Travel time anomaly detected
- 08:50 AM: M-dist anomaly detected
- 09:15 AM: Last waze alert received
- 09:39 AM: Travel time anomaly cleared

Navigation icons: Menu, Search, ALL, 41

- 3
- 7
- 11
- 7
- 22
- 80



Navigation icons: Home, Full Screen, Zoom In, Zoom Out

Incident Detection Accuracy – 2021 Urban Data

Route	Minor	Intermediate/ Medium	Major	Total
I-95	16	38	4	57
DE-1	2	25	6	33
Total	18	62	10	90

Major	Intermediate	Minor
100%	90.47%	88.88%

Response Plan Recommendation and Implementation

TOMS Traffic Flow Data INCIDENT MITIGATION September 21, 2021

INCIDENT LOCATION AND SIGNALS

MITIGATION SOLUTION INCIDENT 3730

RECOMMENDED TIMING PLAN

08:00 TIME OFFSET: 0 MIN

Current Plan & MOE

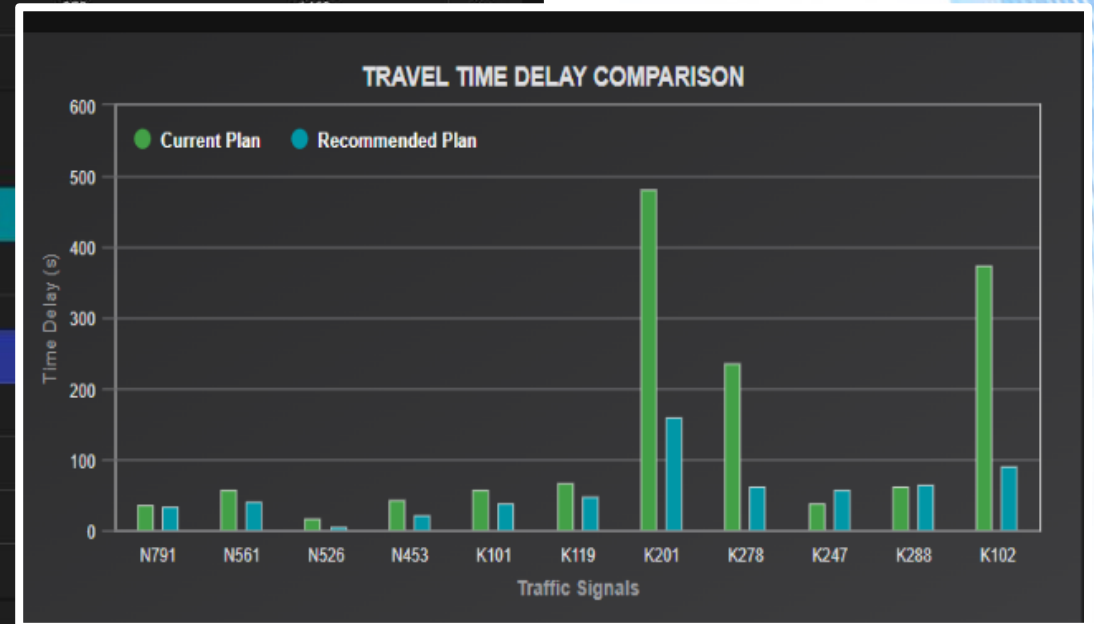
Group	Time Plan #	Cycle Length	LOS	Delay	Bottleneck Volume	Travel Time
K999	231	120	D	38		
K001	231	120	F	188		

Recommended Plan & MOE

Group	Time Plan #	Cycle Length	LOS	Delay
K999	231	120	C	20

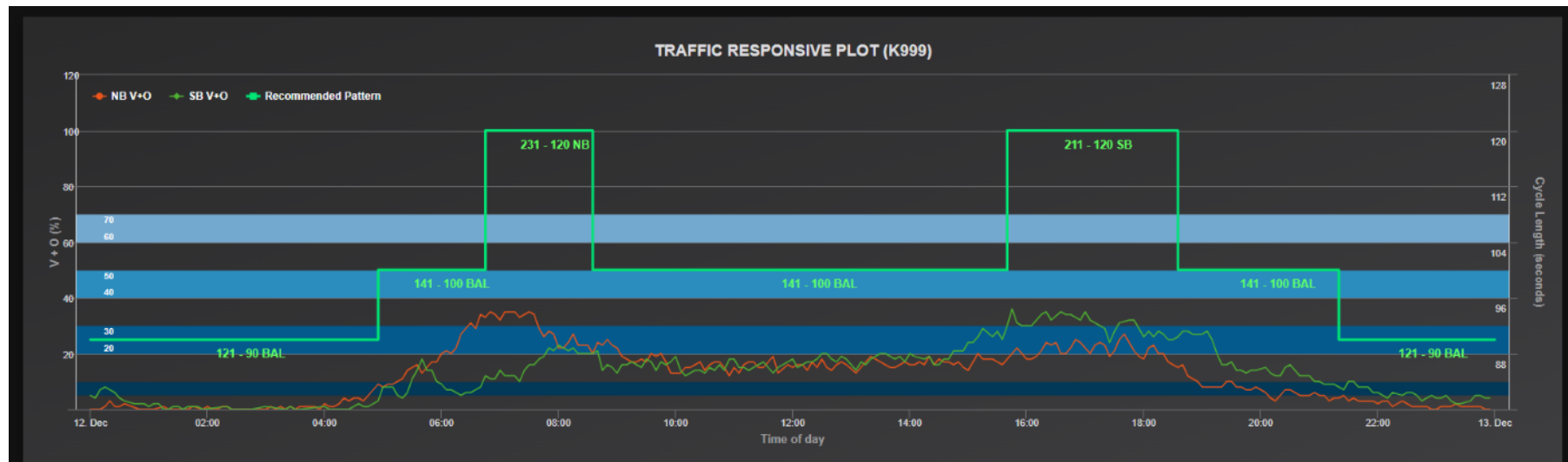
Permit	Offset	LOS	Delay	P1	P2
N/91	95	C	23	/	106
N561	0	C	31	22	53
N526	115	A	6	9	96
N453	12	B	19	10	76

K001 231 120 C 69 358 1218

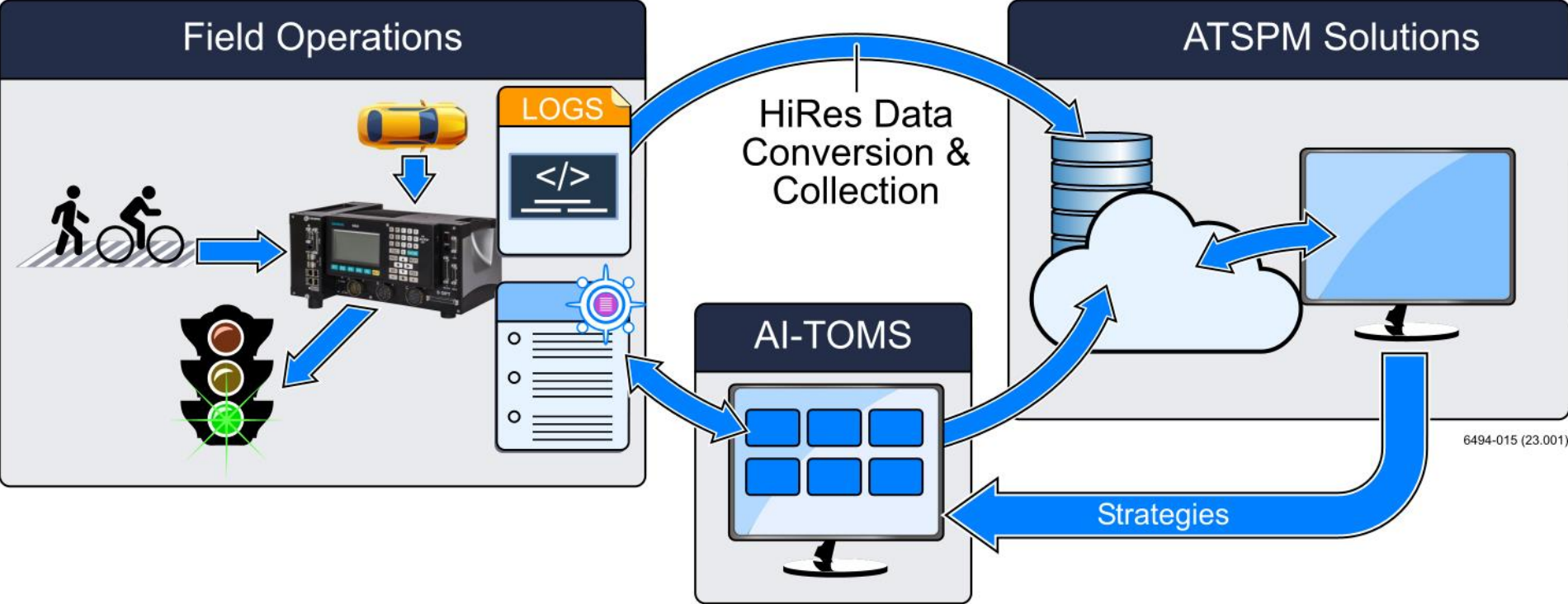


Adaptive/Predictive Signal Timing

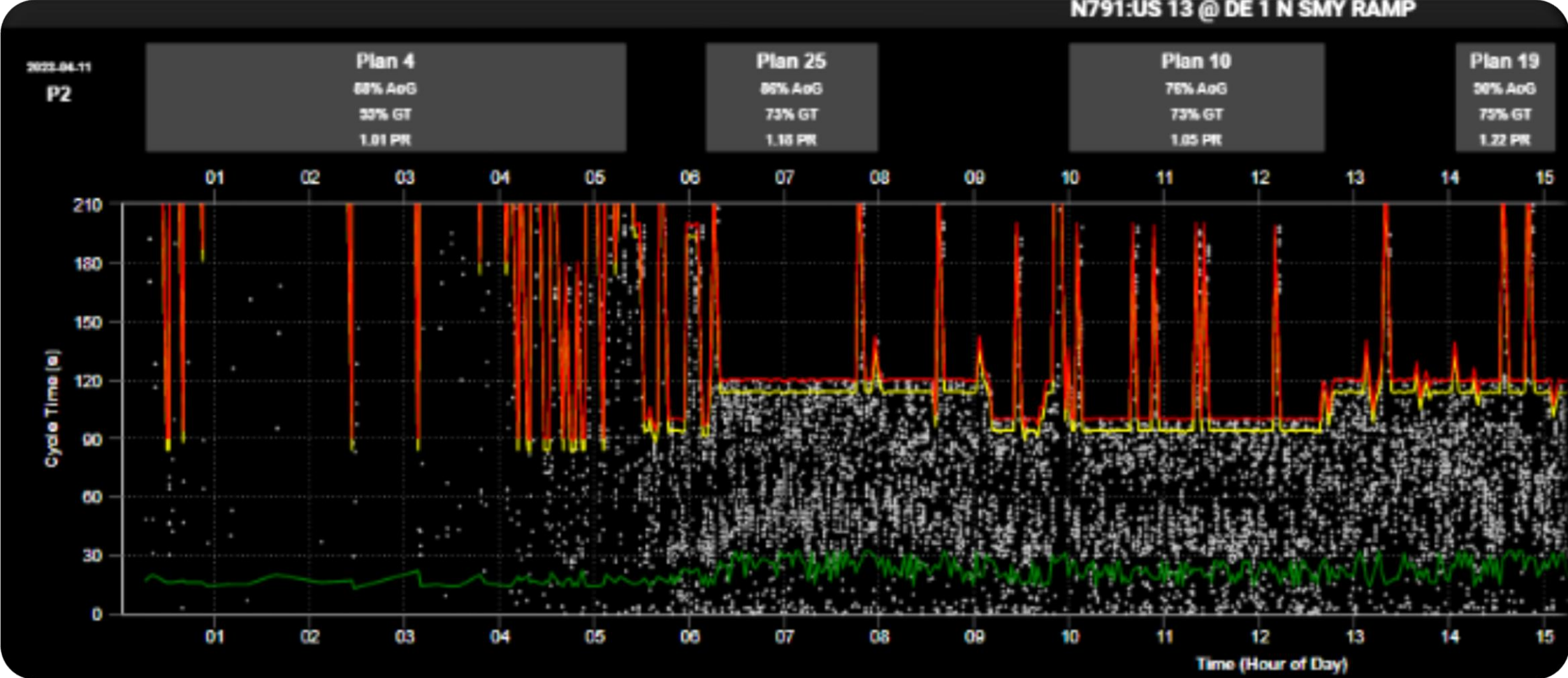
- Three control modes:
 - AI-TOMS: Recommends signal patterns based on real-time demand
 - Time-of-Day: Issues signal patterns based on a pre-determined schedule
 - Manual: Allows technicians to issue manual signal pattern changes
 - Third Party: AI-TOMS does not issue changes
- Allow group-based or individual intersection level control
- Leverage NTCIP 1202 to communicate with signal controllers



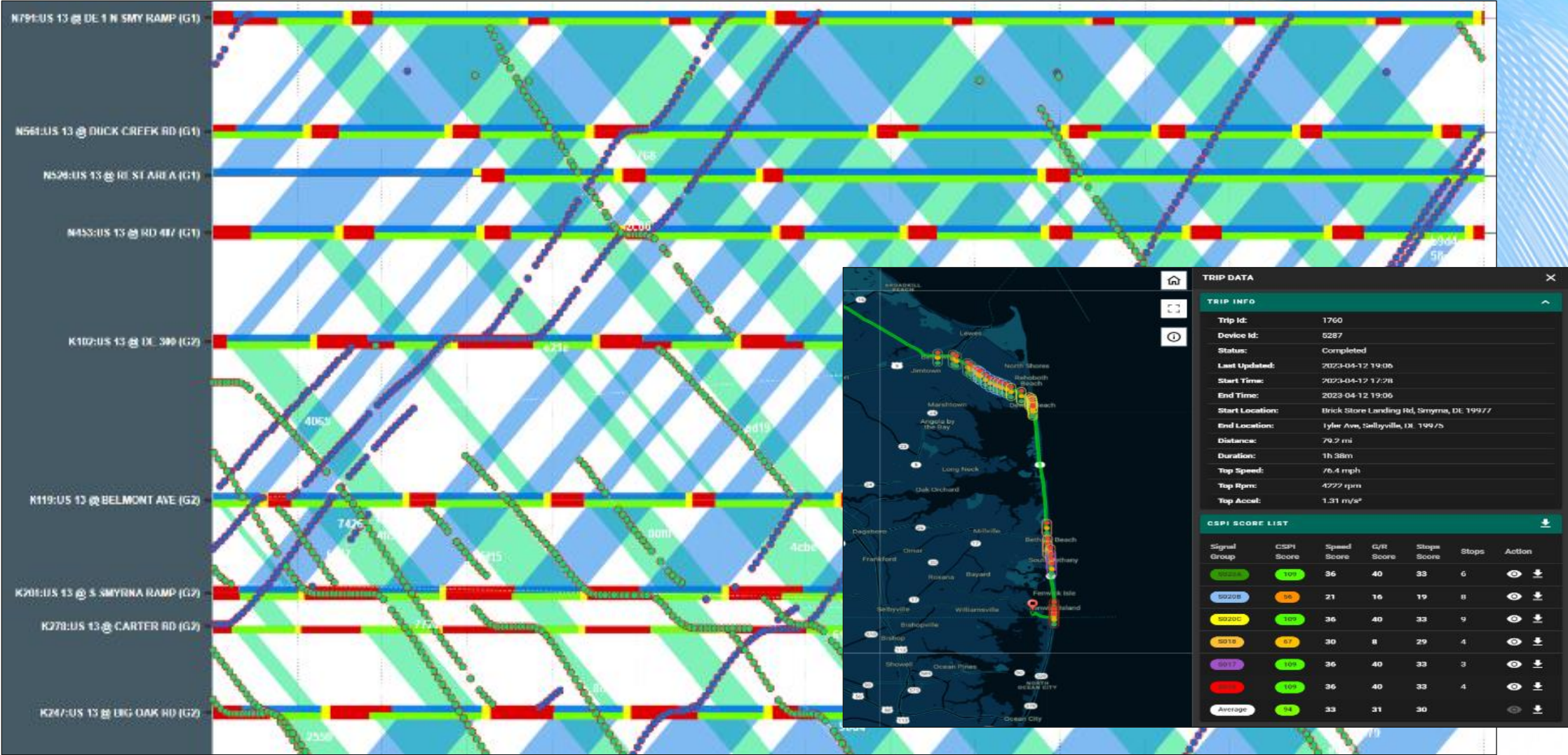
Automated Traffic Signal Performance Measures (ATSPM)



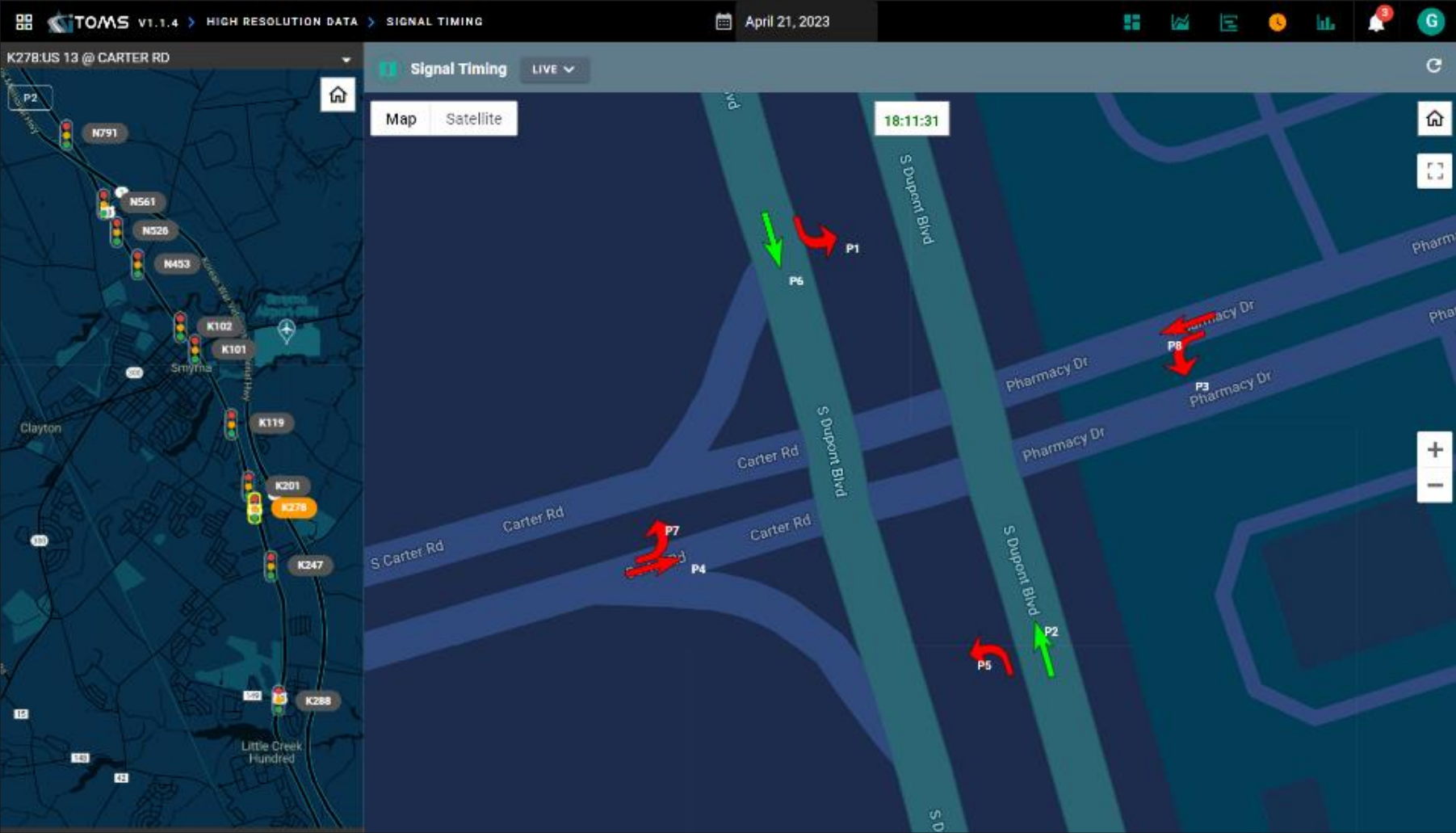
Advanced Traffic Signal Performance Measures



Connected Vehicle Data



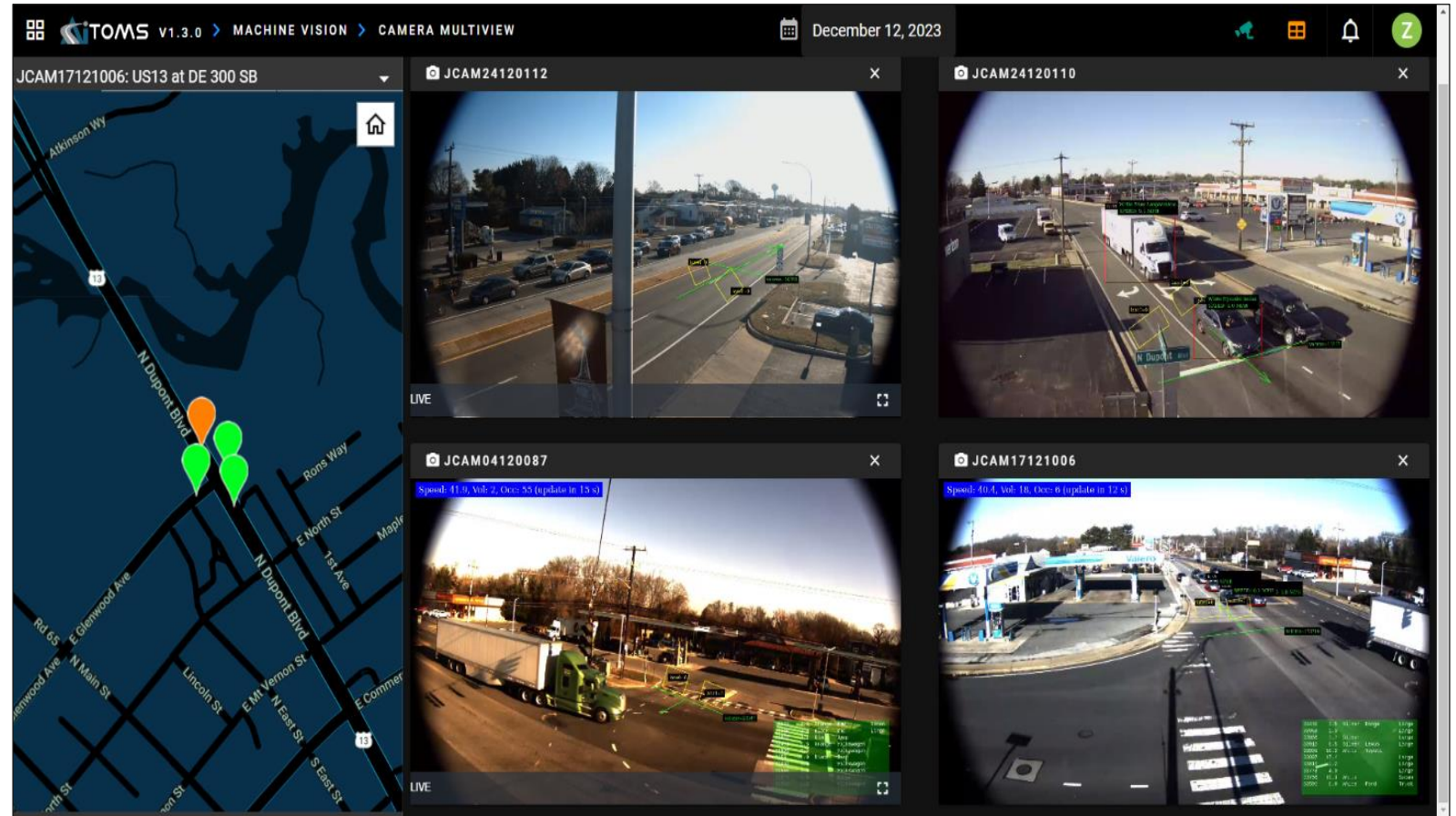
Live Signal Phase and Timing (SPaT) Broadcasting



Machine Vision for Traffic Monitoring



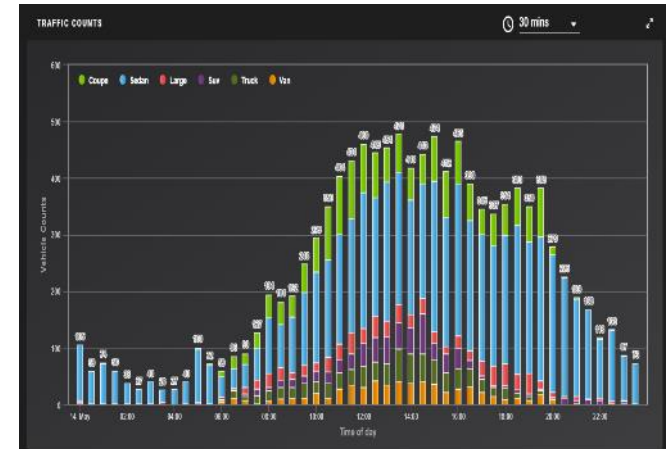
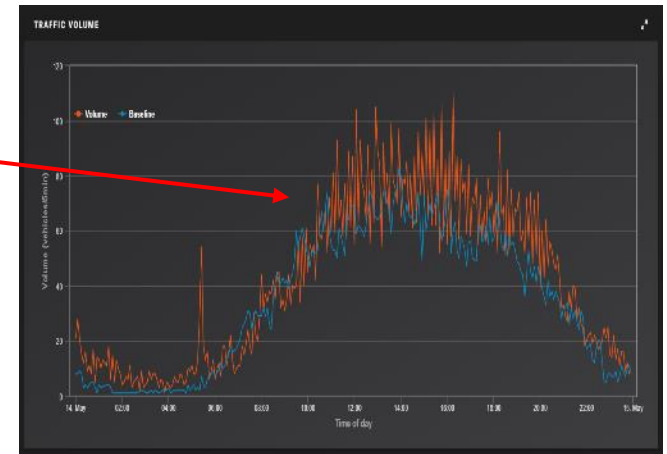
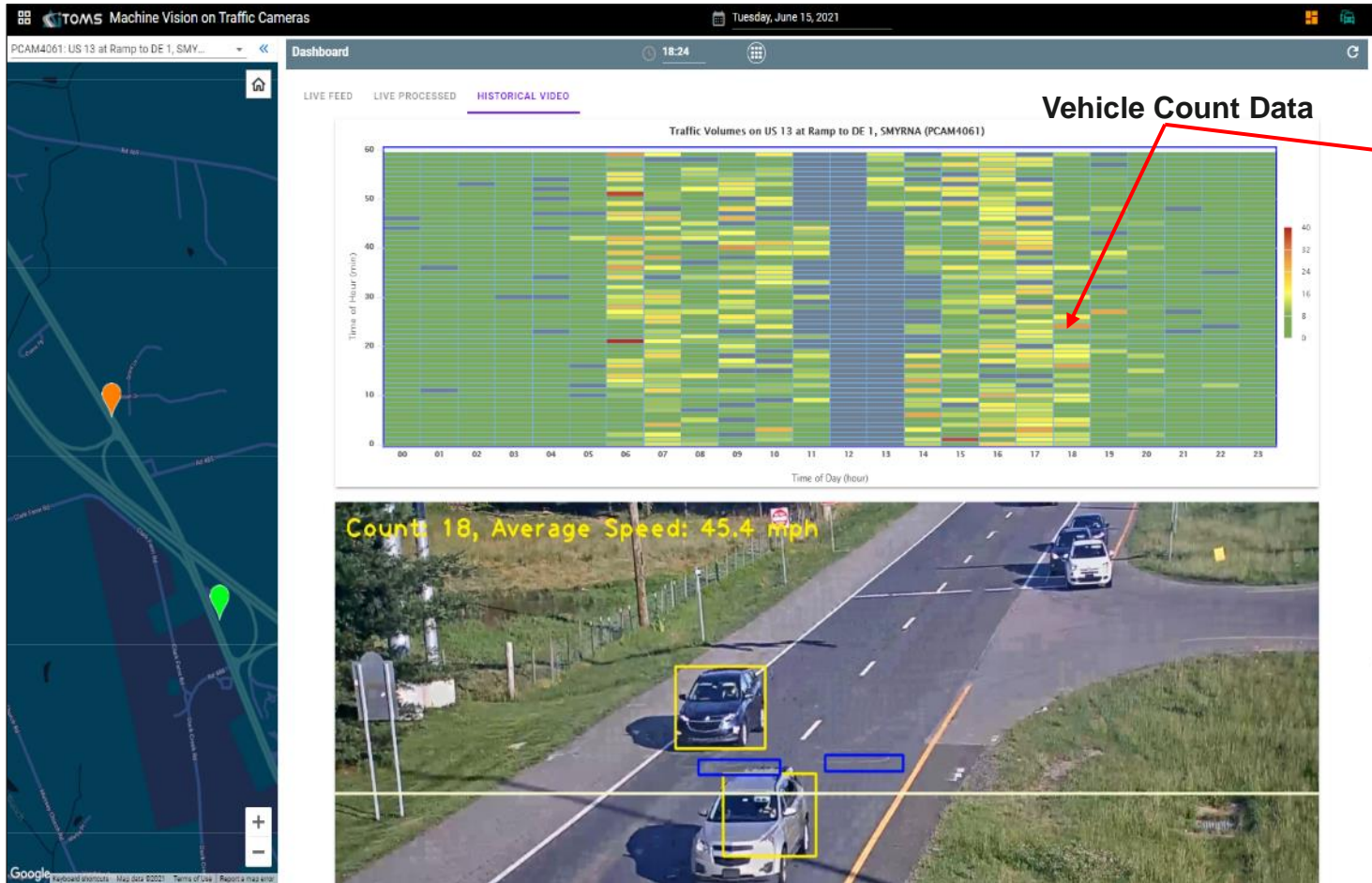
US-13 @ DE-300



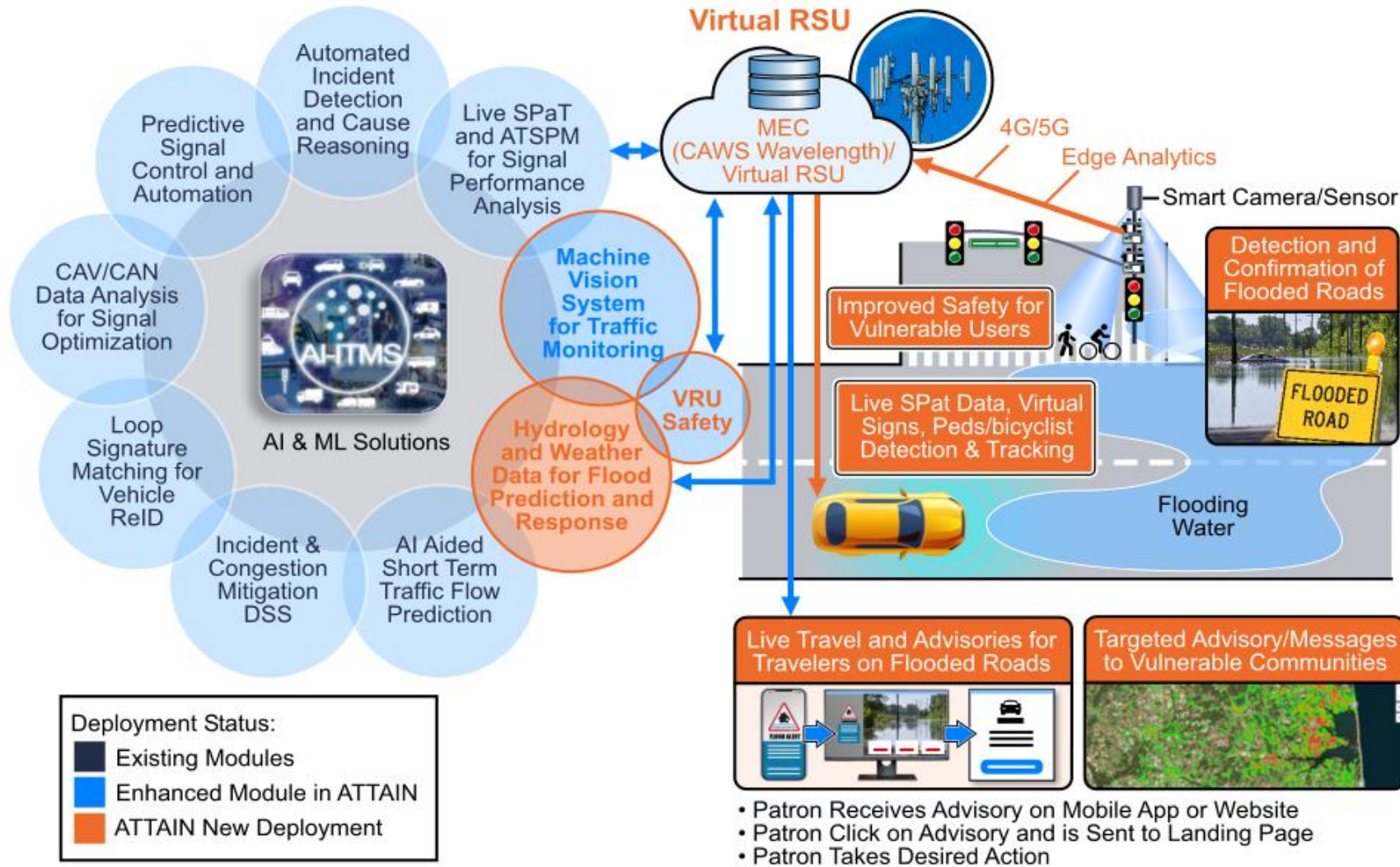
AI-TOMS Interface for Machine Vision Cameras and Data Analysis

Machine Vision for Traffic Monitoring

Count, Speed and Occupancy



Follow on Efforts – ATTAIN Grant

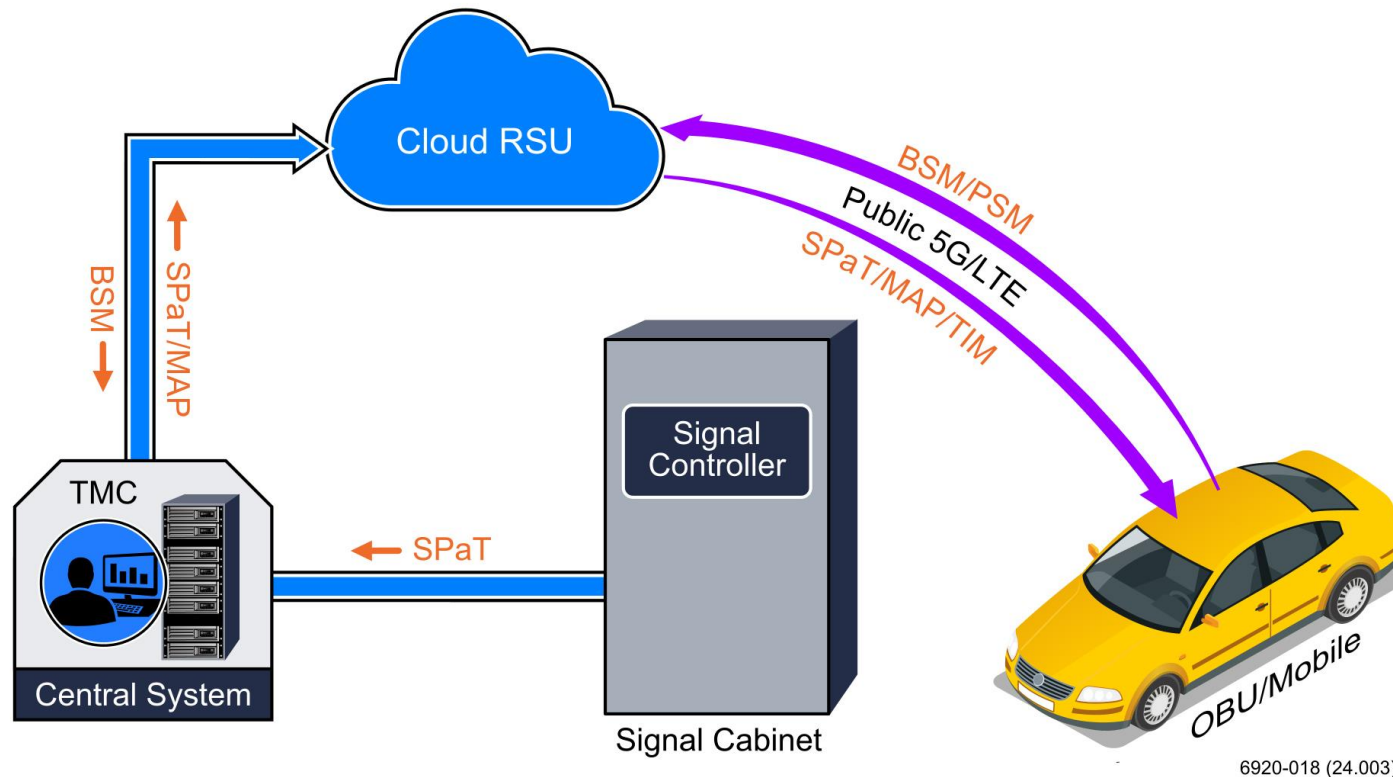


- Flood Prediction
- Targeted warning and assistance
- Virtual RSU and road signs
- Machine vision for VRU detection and conflict warning

Traffic Management and Safety for Flooding Roadways and Vulnerable Road Users (VRUs)

Follow on Efforts – SMART Grant

- Cloud-based vehicle-to-everything technology (CbV2X)
- Dilemma Zone (DZ) application



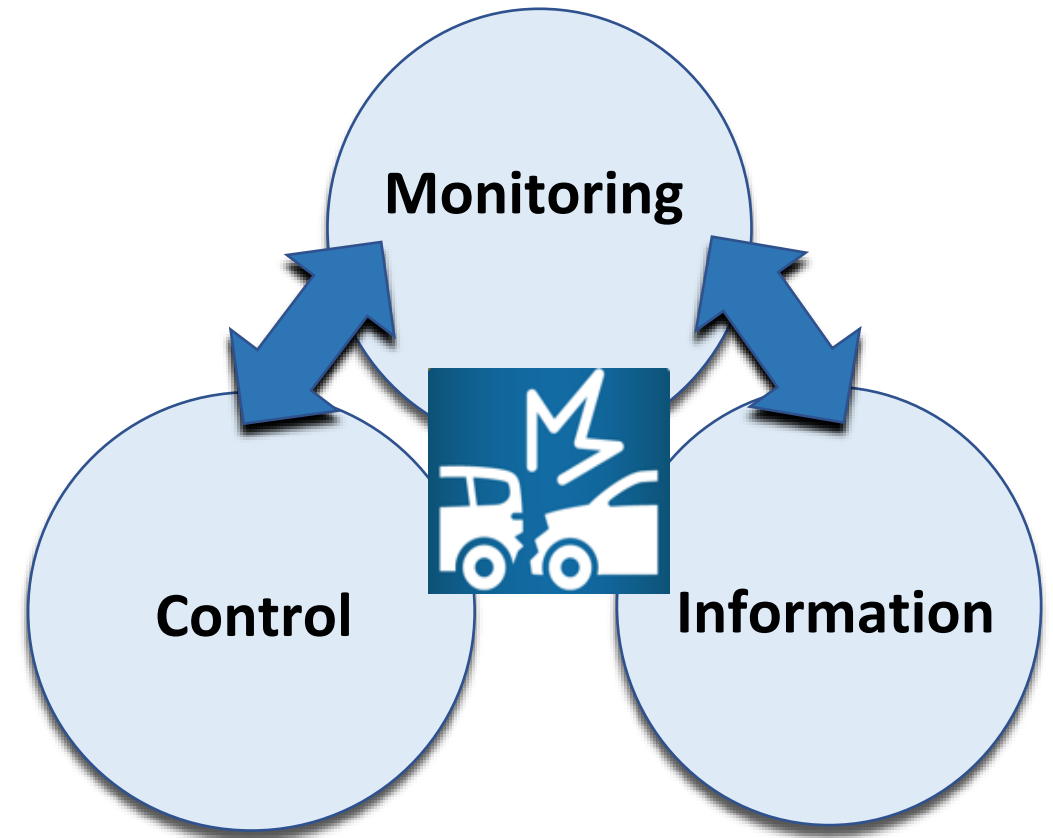
Architecture of CbV2X Technology

- Cloud and MQ Telemetry Transport (MQTT) technology
- 50 millisecond roundtrip delay times for SPaT data
- SPaT-enabled signal status information
- DZ warning advisories with both visual and audible prompts

6920-018 (24.003)

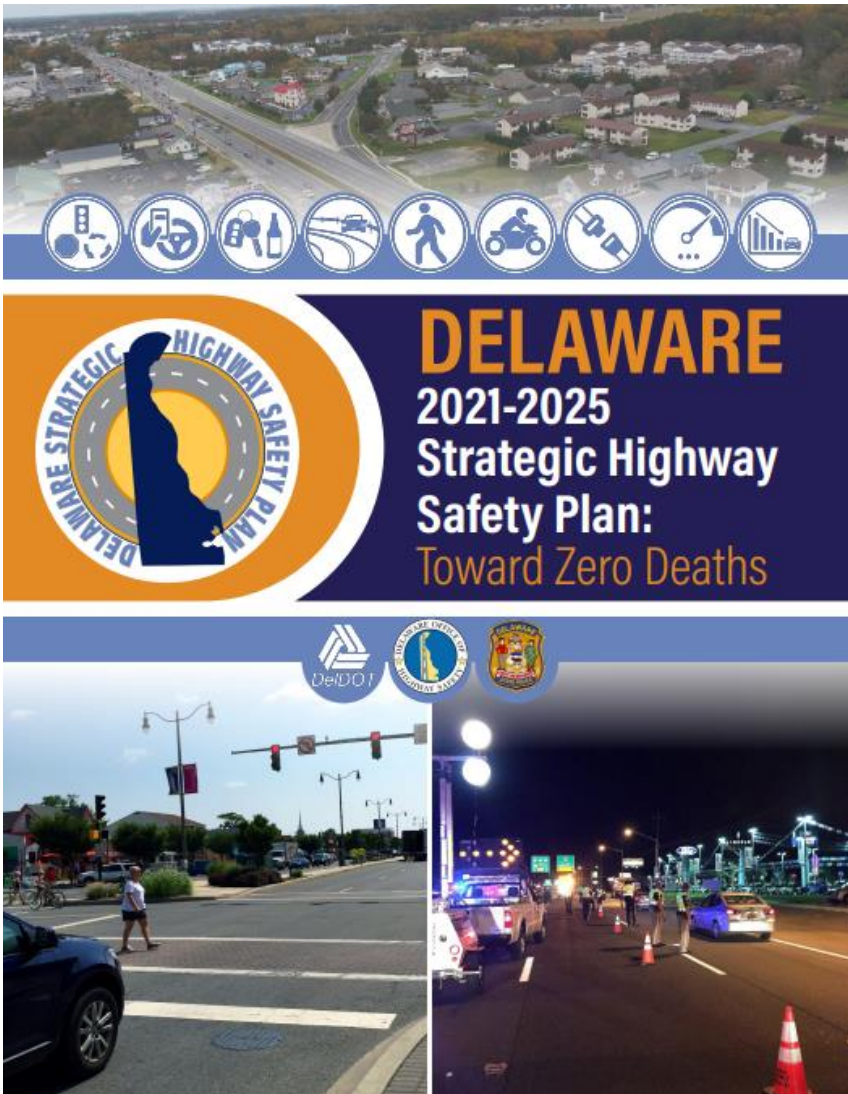
Statewide Deployment of AI-ITMS

- Expand AI-TOMS to all freeways and key corridors
- Continuous enhancement – system will continuously learn, as a traffic engineer would, and automate operations
- Understanding what it takes to support this advanced system – need support of staff/team with the required knowledge, skills and abilities
- Detection system of today – enhancements with ML and AI
- Enhance mobility not only in Delaware, but for transportation systems everywhere
- **A truly predictive and adaptive self-monitoring statewide transportation management system that gets smarter over time**



<https://deldot.gov/Programs/itms/>

Linkage to Strategic Highway Safety Plan



Emphasis Areas



Thank You!

<https://deldot.gov/Programs/itms/>

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