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

Mark Luszcz

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

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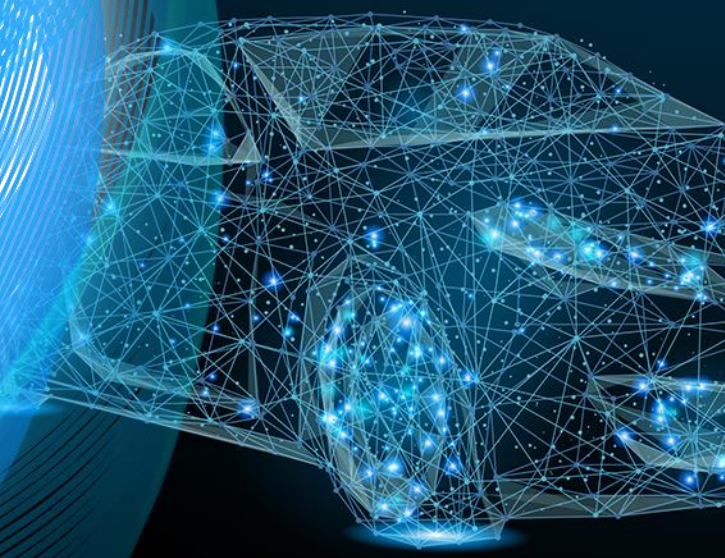
Outline

- DelDOT'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



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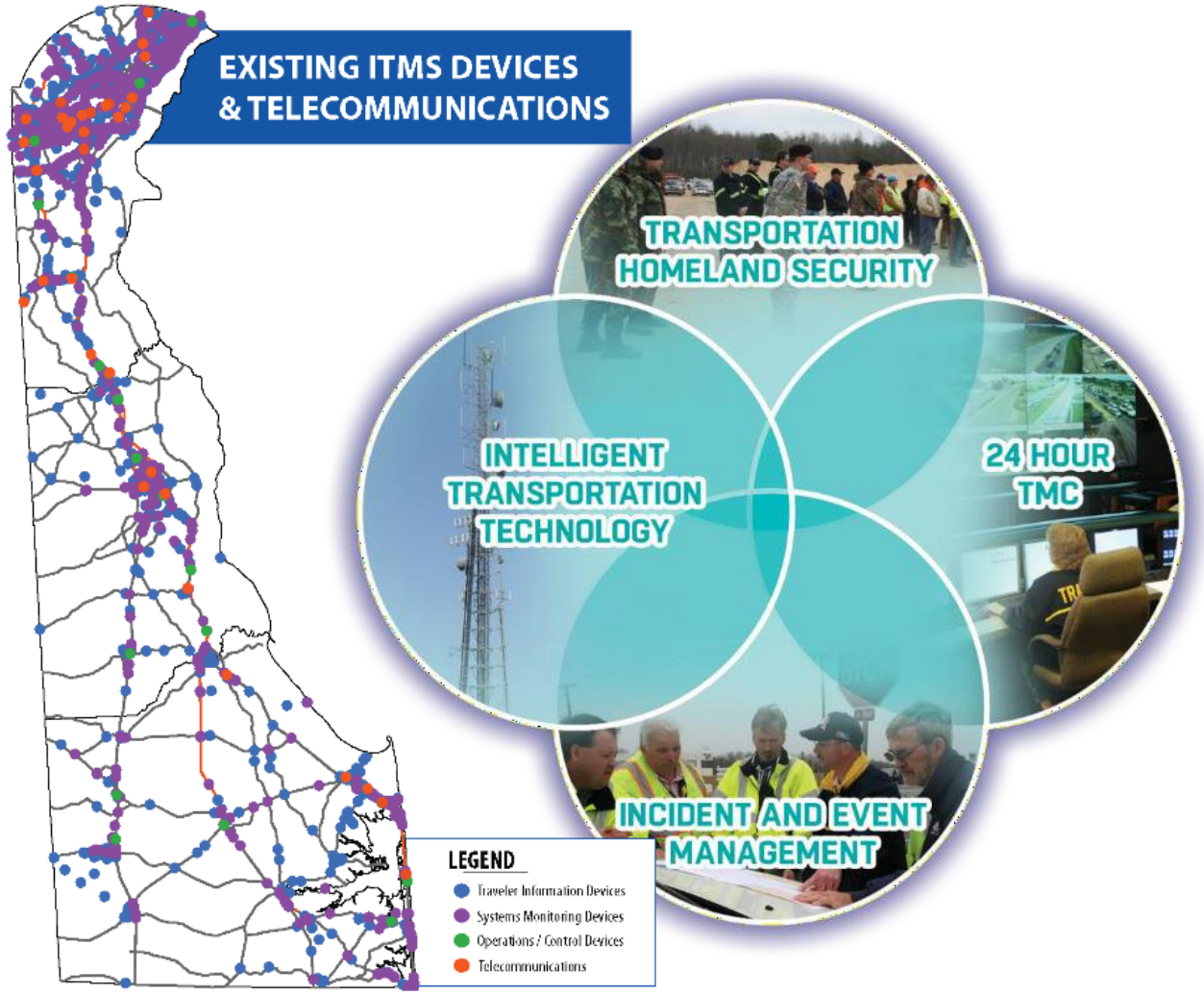
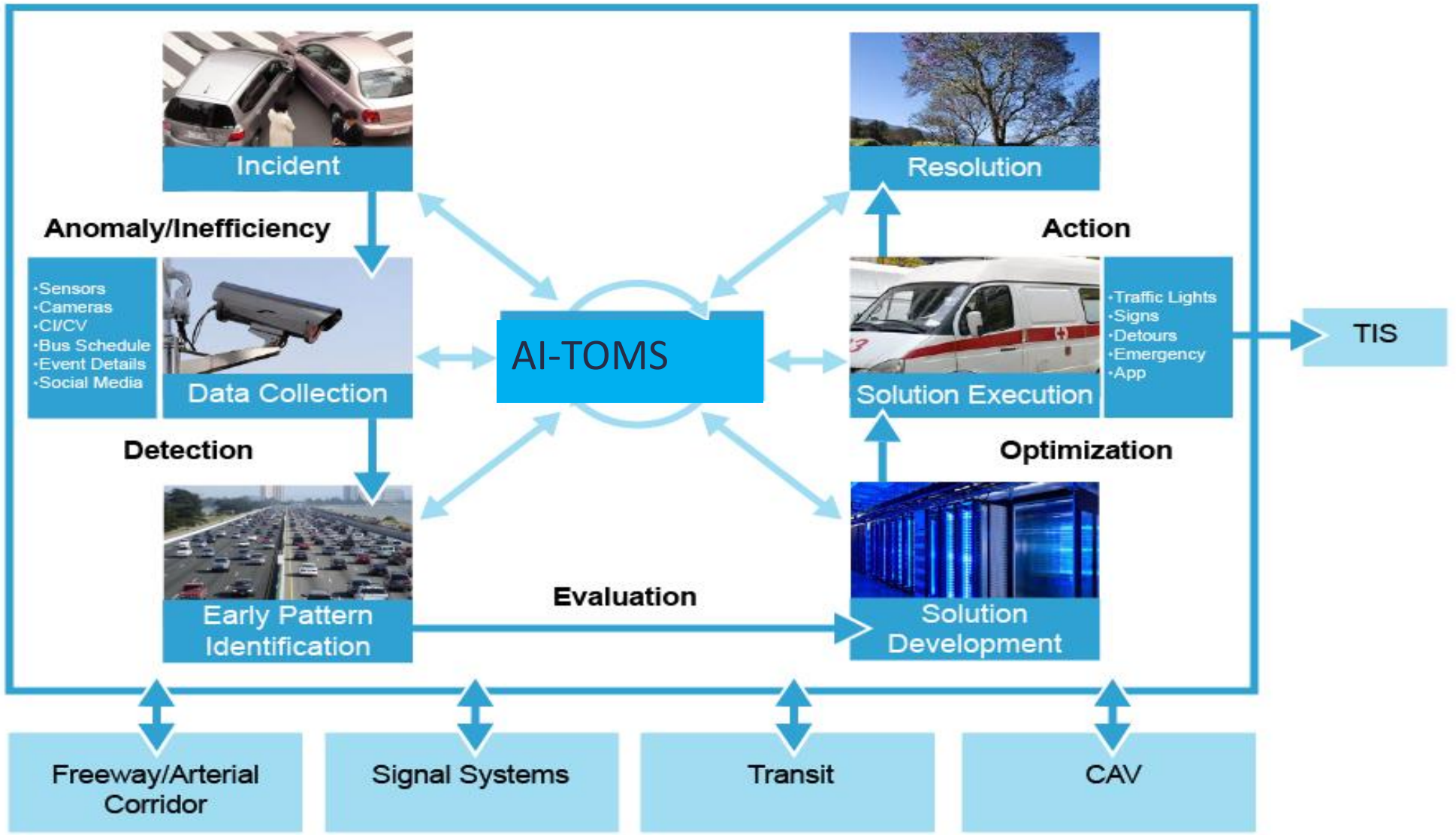
Integrated Transportation Management Systems (ITMS)



AI-ITMS



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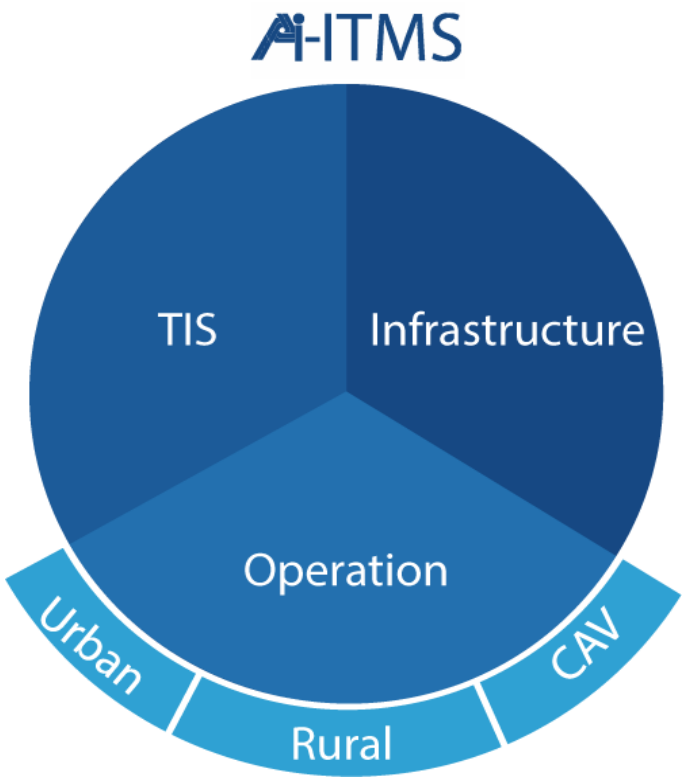
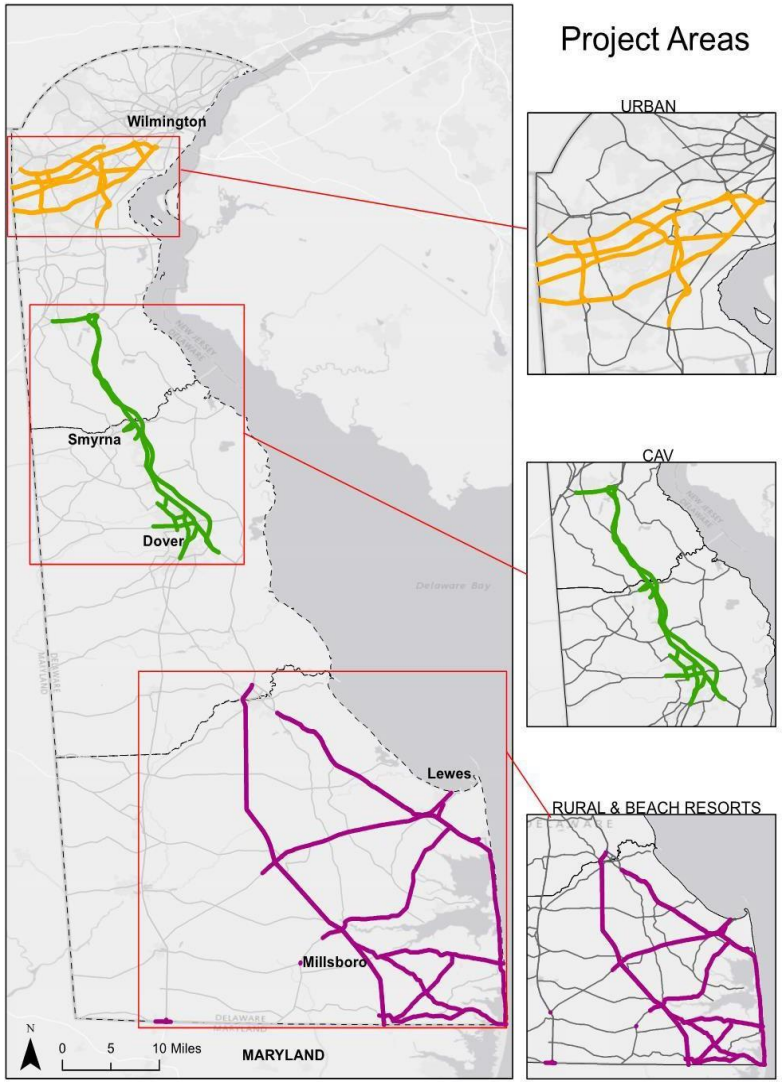
AI-ITMS Deployment Phases

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 DelDOT 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

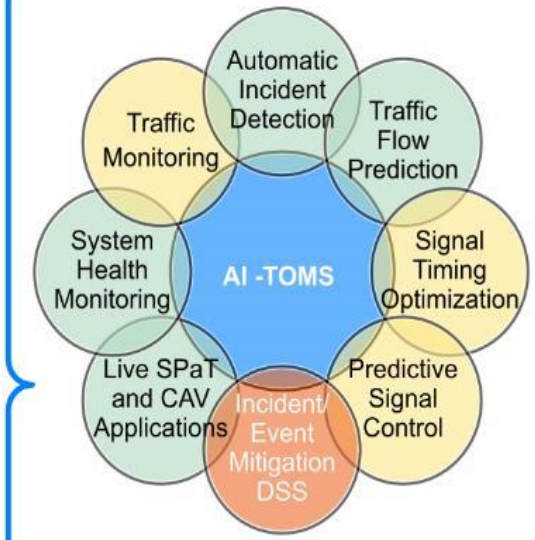

ATSPM and SPaT Data


Traffic Camera Videos

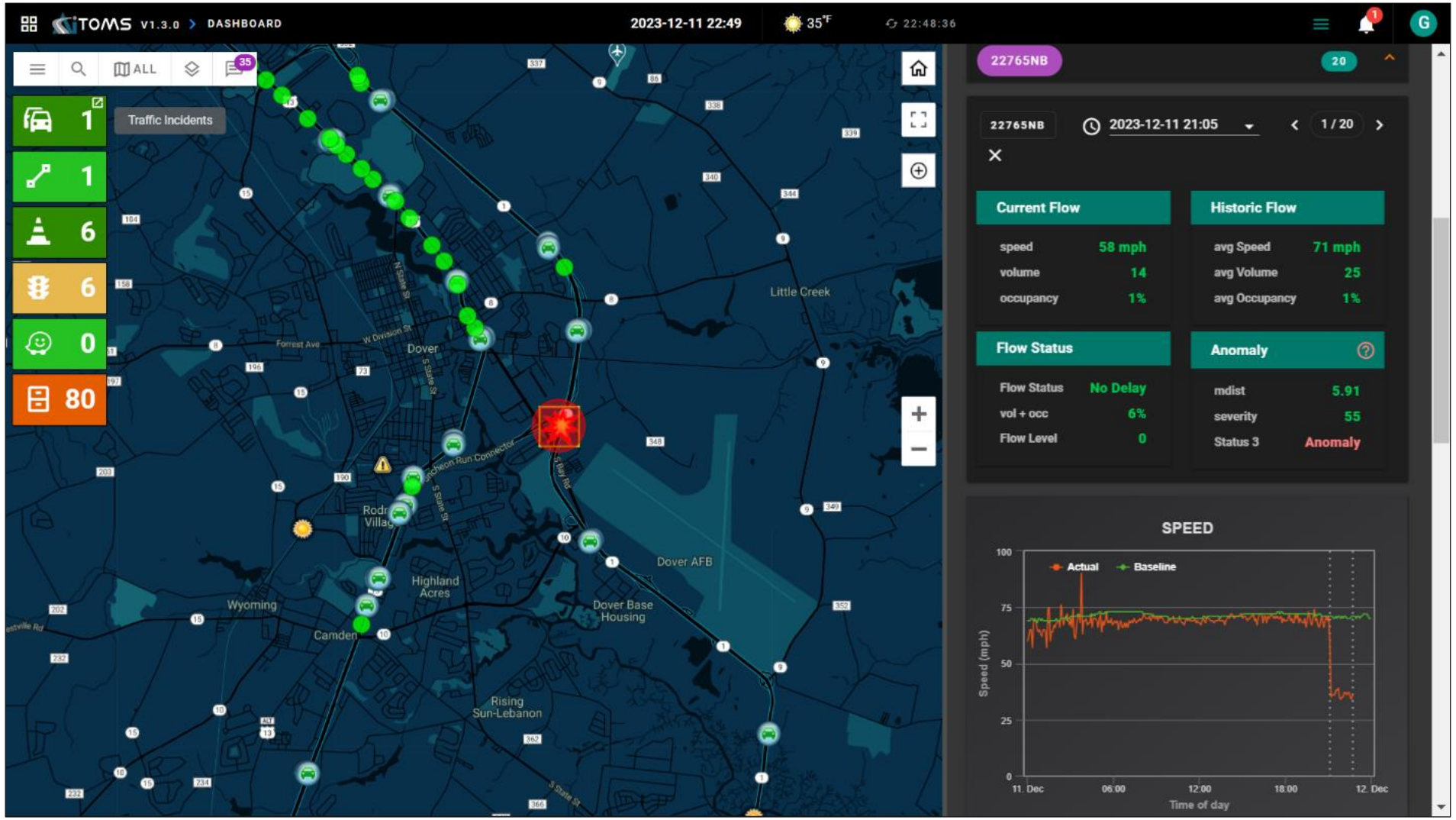

Travel Restrictions Data

CAV Data

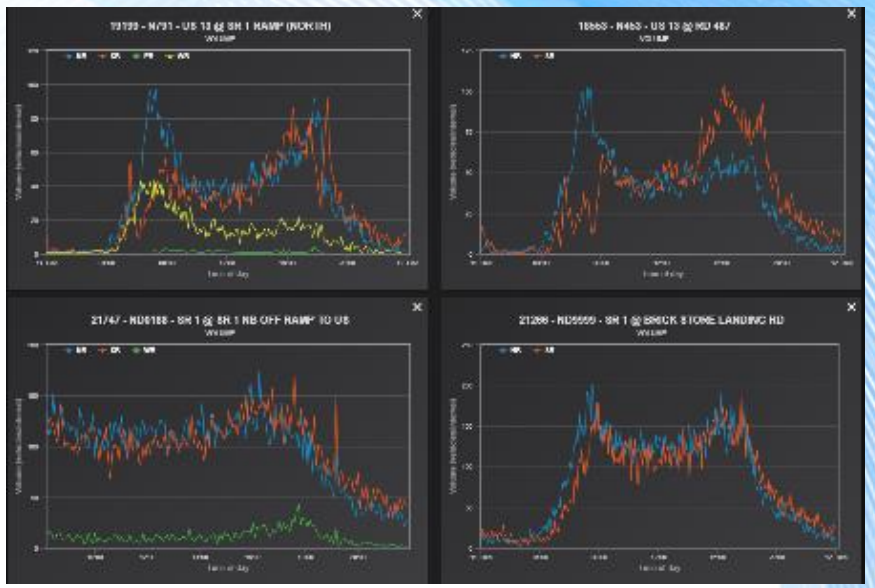

Social Media Data

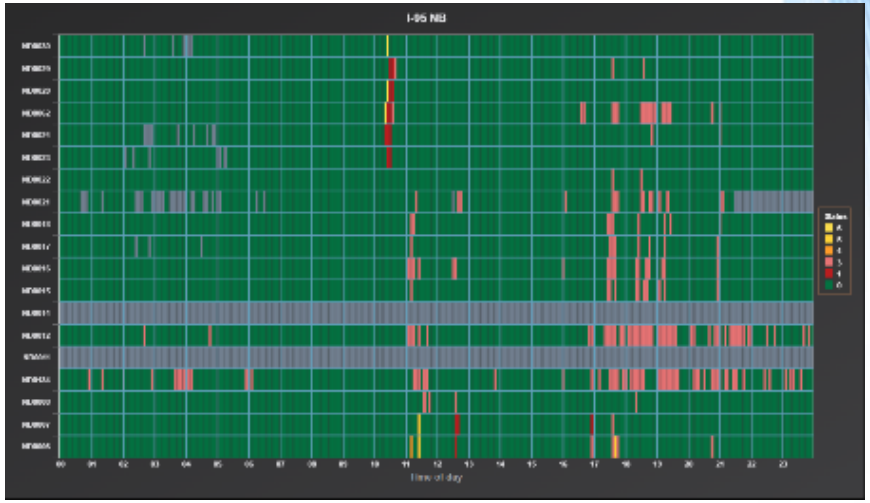


AI-TOMS Dashboard



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

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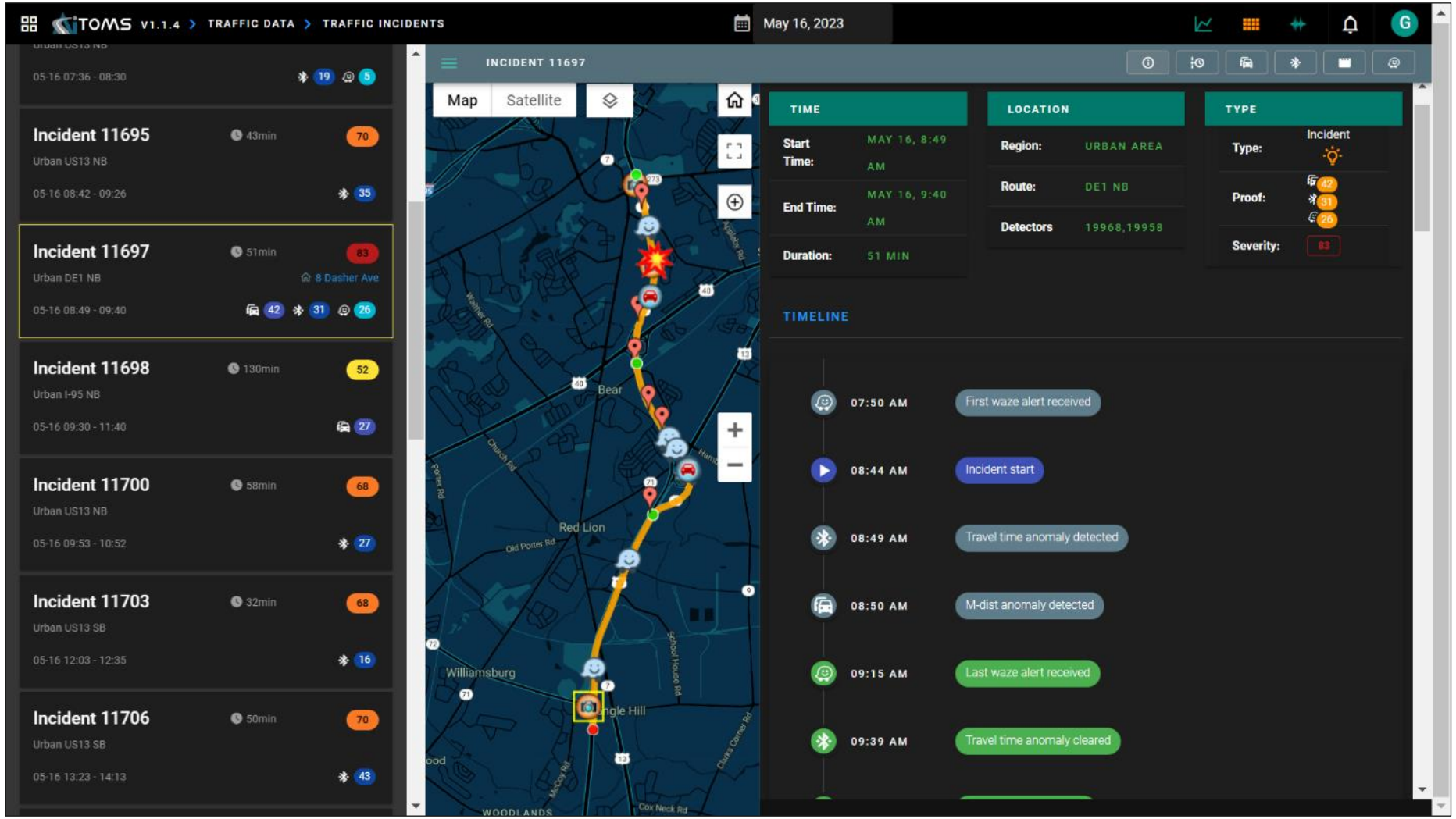
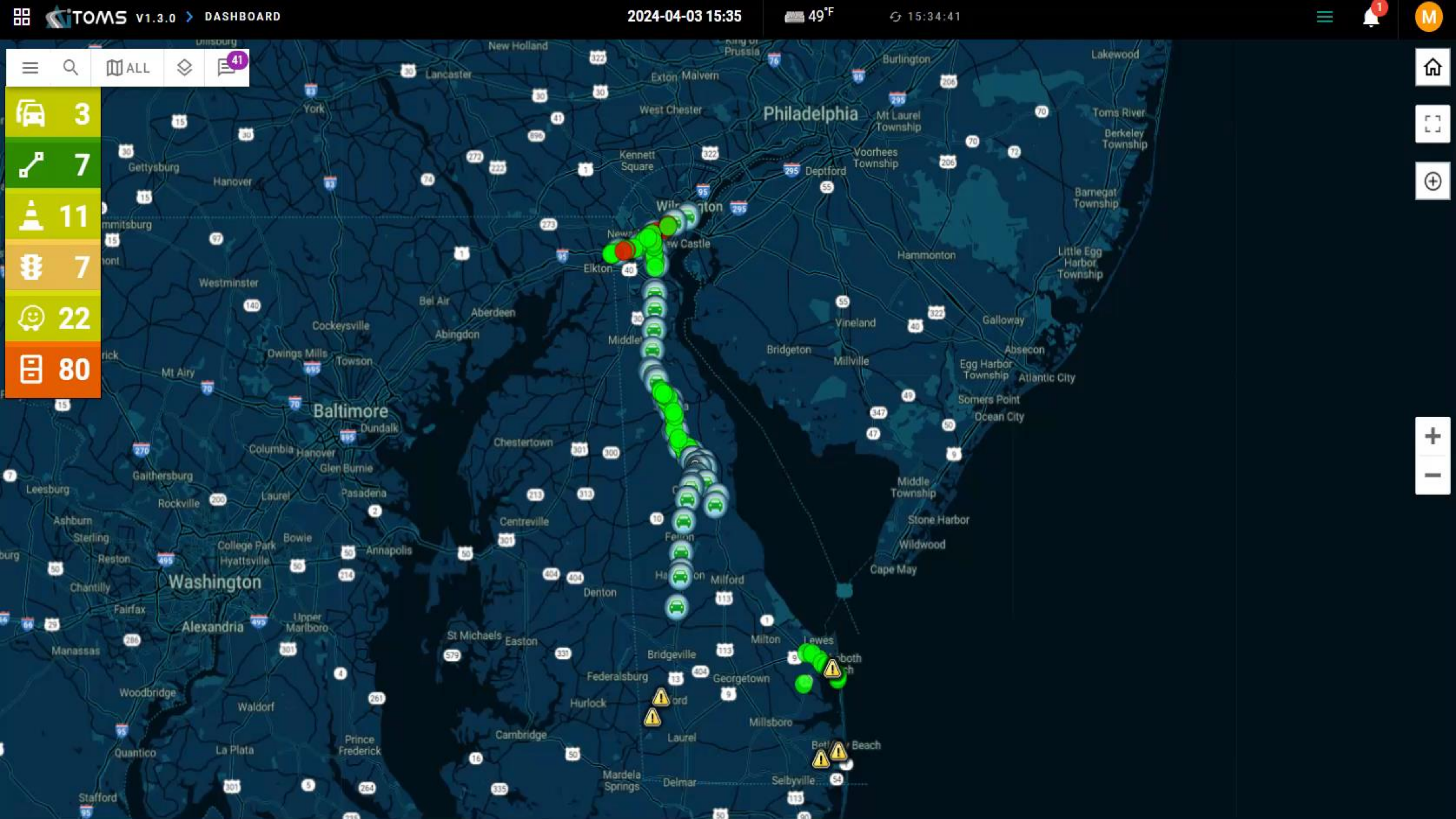
Traffic Incident Detection and Management




iTOMS V1.3.0
DASHBOARD
2024-04-03 15:35
49°F
15:34:41
ALL
41
3
7
11
7
22
80
Philadelphia
Baltimore
Washington
Alexandria
Wilmington
Atlantic City
Cape May
Annapolis
Vineland
Millville
Bridgeton
Hammonton
Lancaster
York
Gettysburg
Elkton
Chestertown
Easton
Cambridge
Milford
Georgetown
Lewes
Millsboro
Selbyville
Delmar
Laurel

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%

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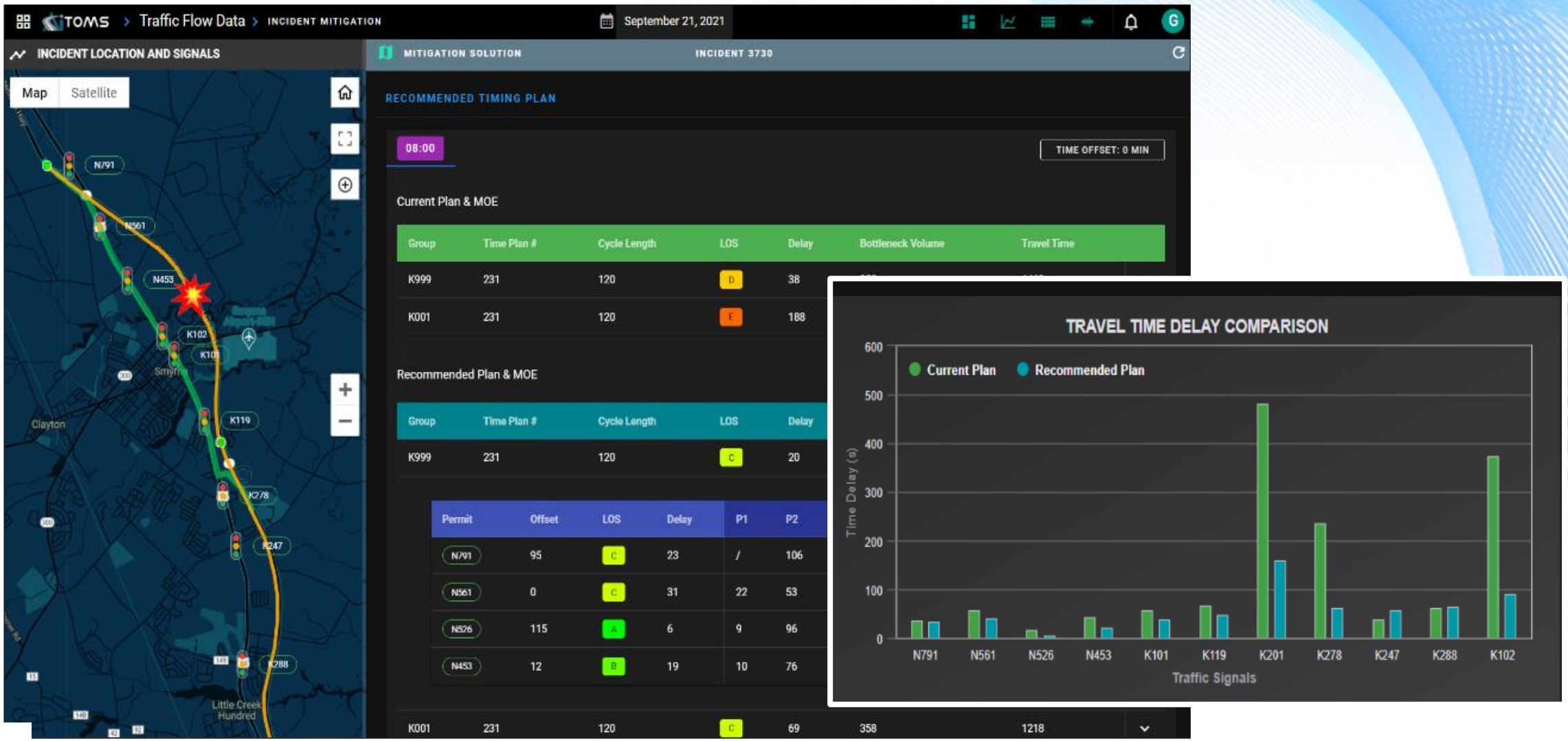
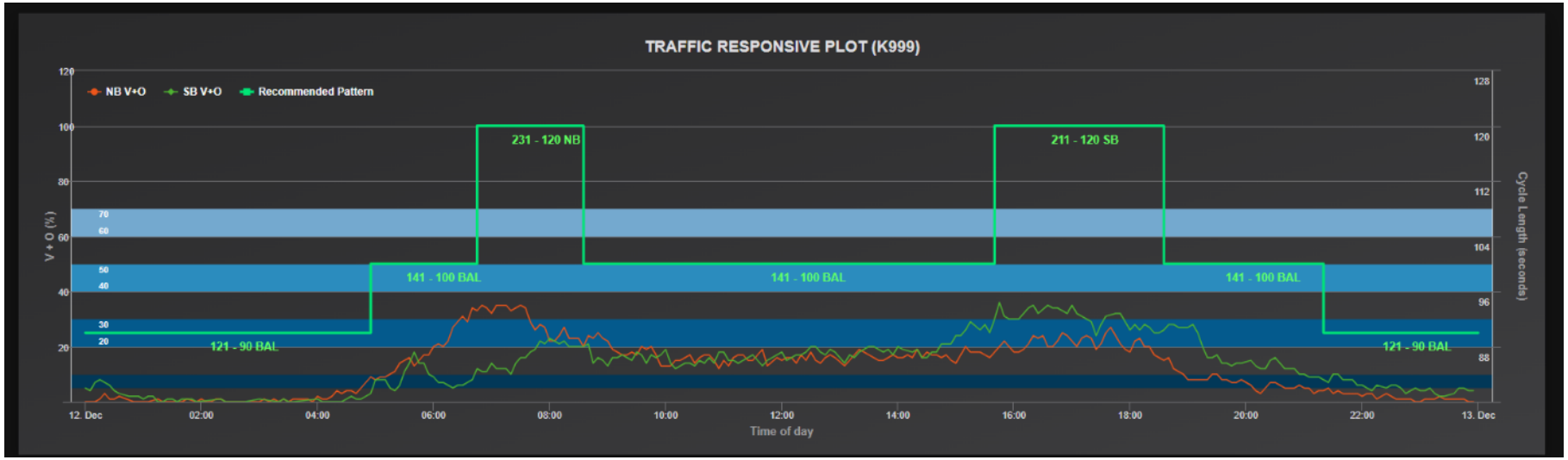
Response Plan Recommendation and Implementation

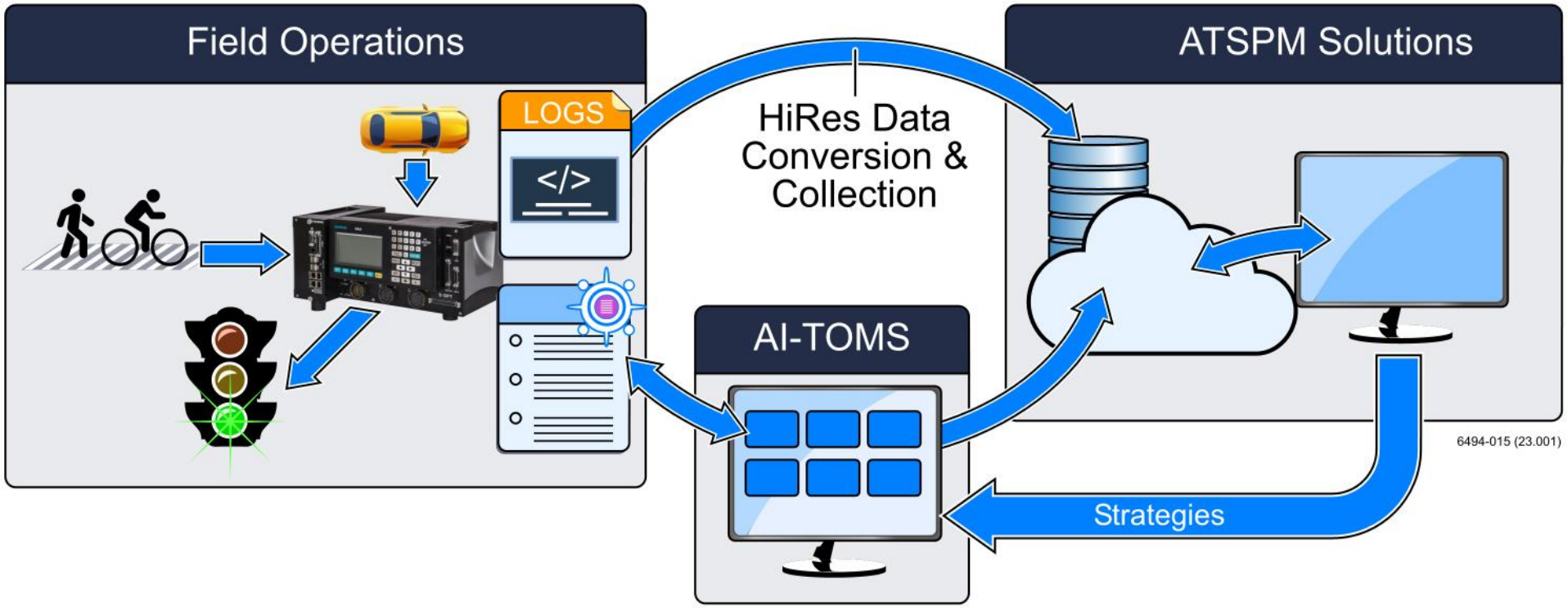


Adaptive/Predictive Signal Timing

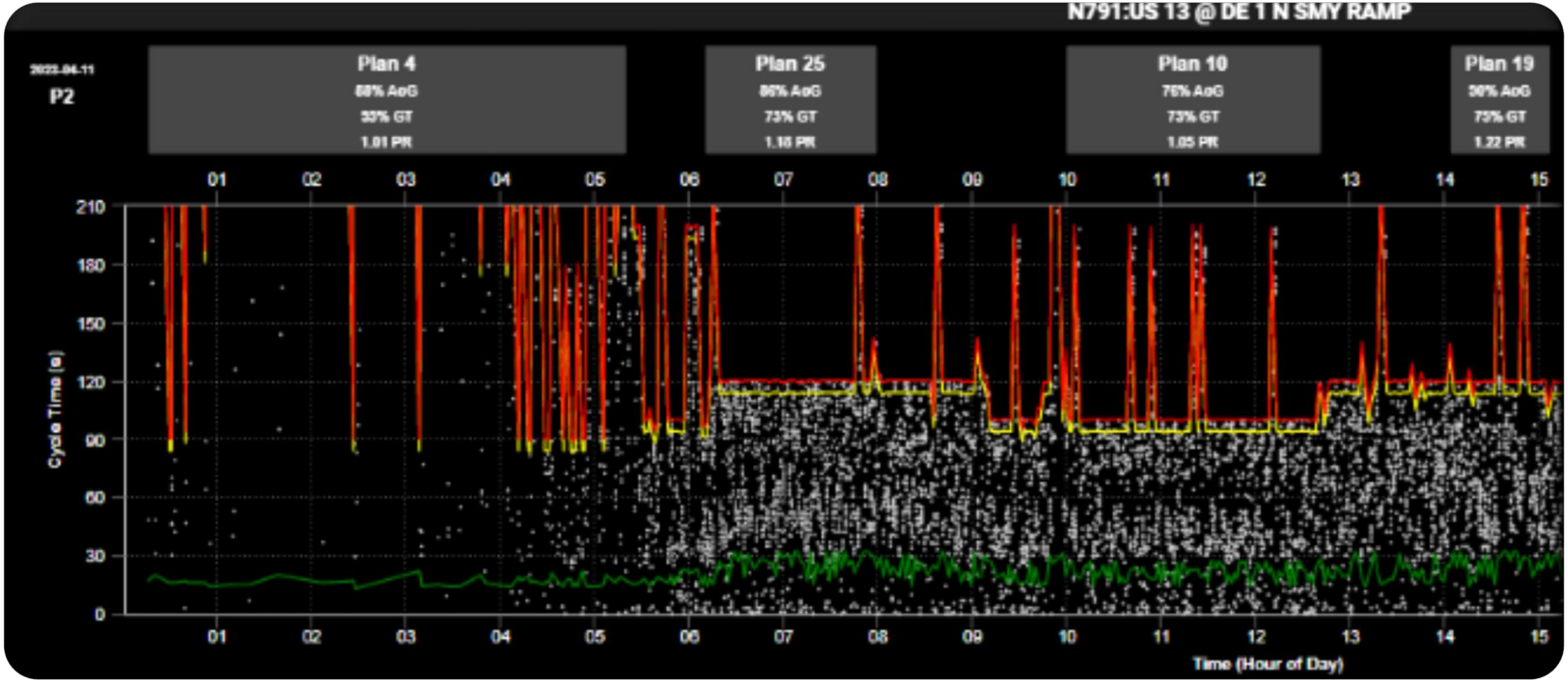
- Three control modes:
  - AI-TOMS: Recommends signal patterns based on real-time demand
  - Time-of-Day: Issues signal patterns based on a pre-determined schedule
  - Manual: Allows technicians to issue manual signal pattern changes
  - Third Party: AI-TOMS does not issue changes
- Allow group-based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



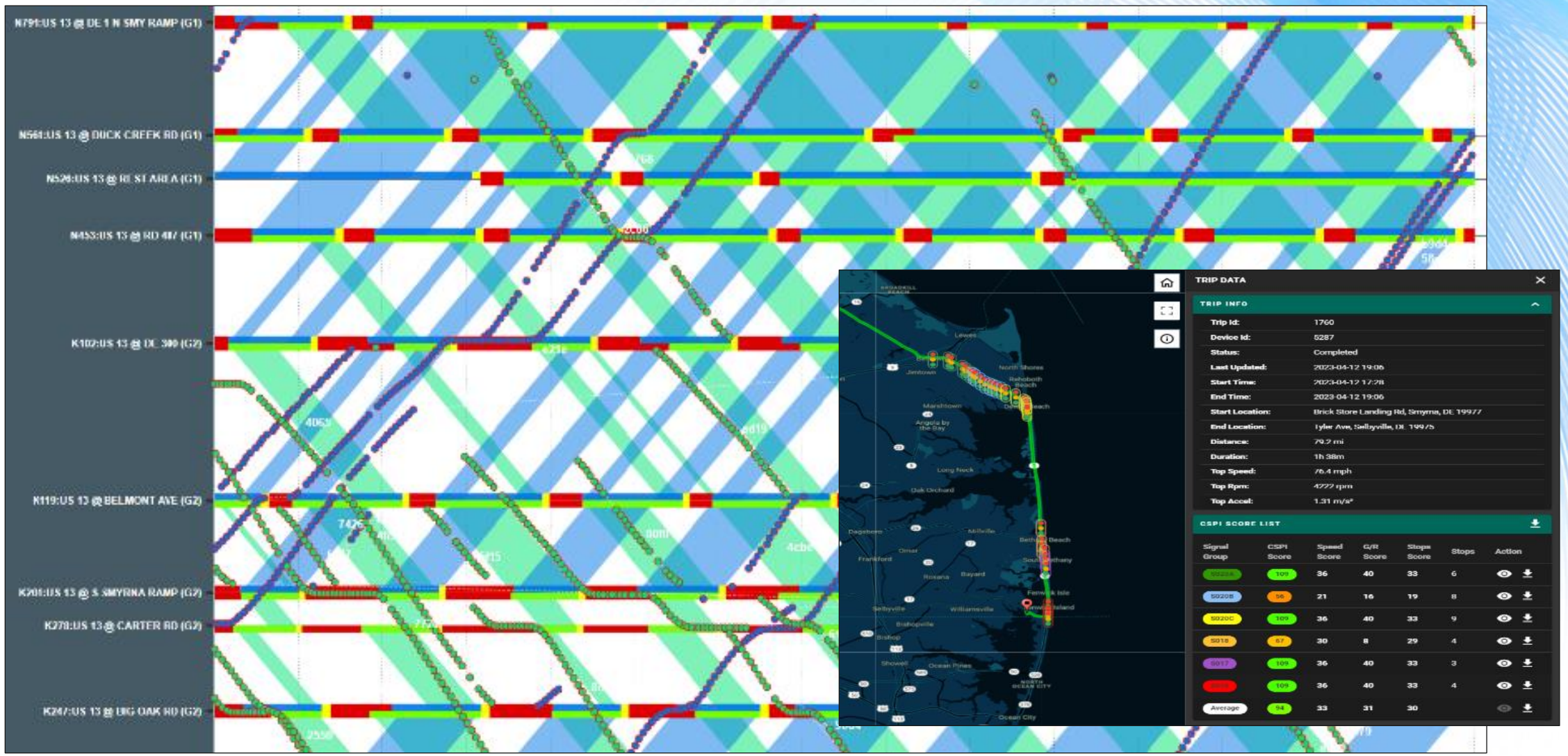
Automated Traffic Signal Performance Measures (ATSPM)



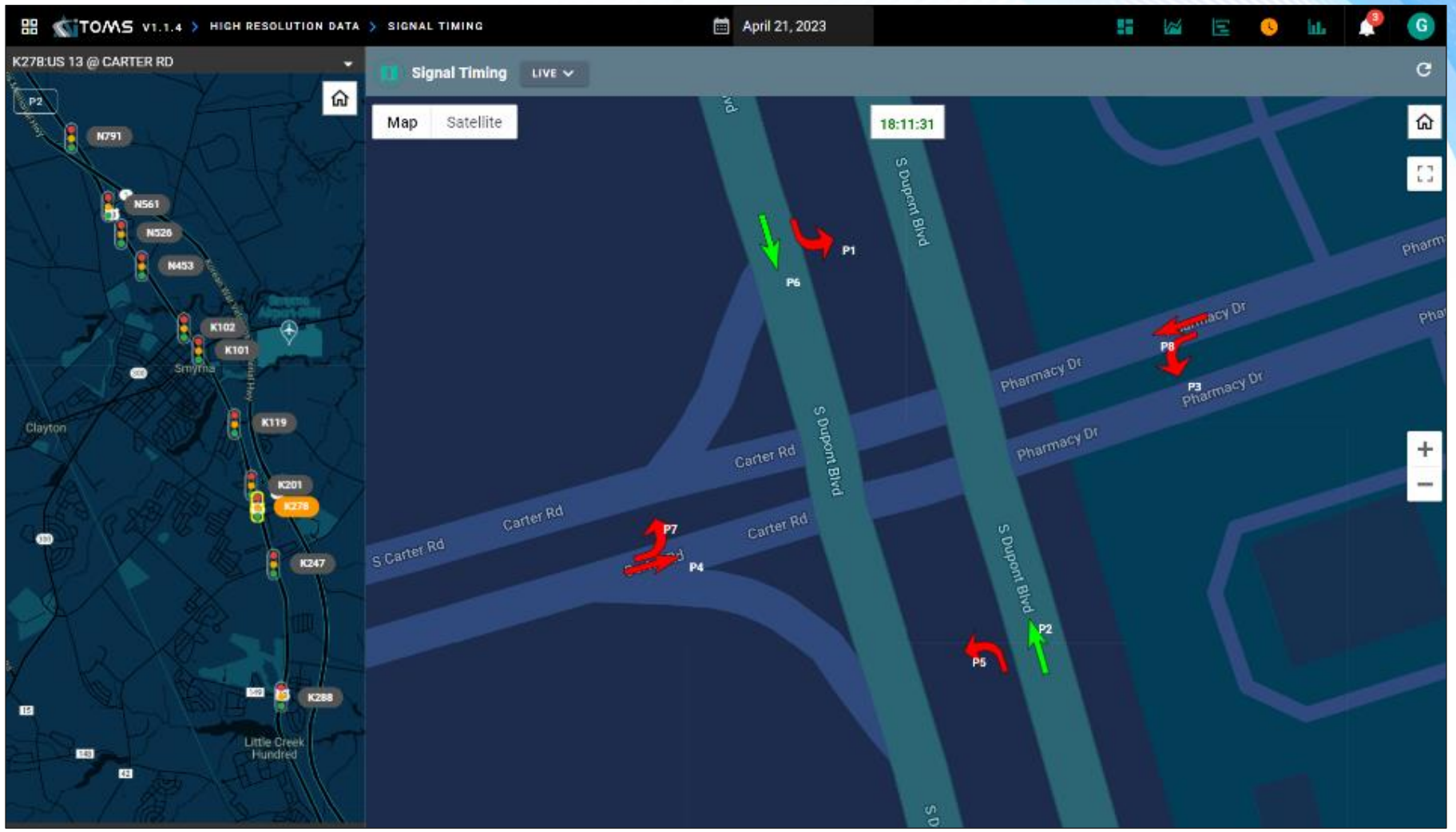
Advanced Traffic Signal Performance Measures



Connected Vehicle Data

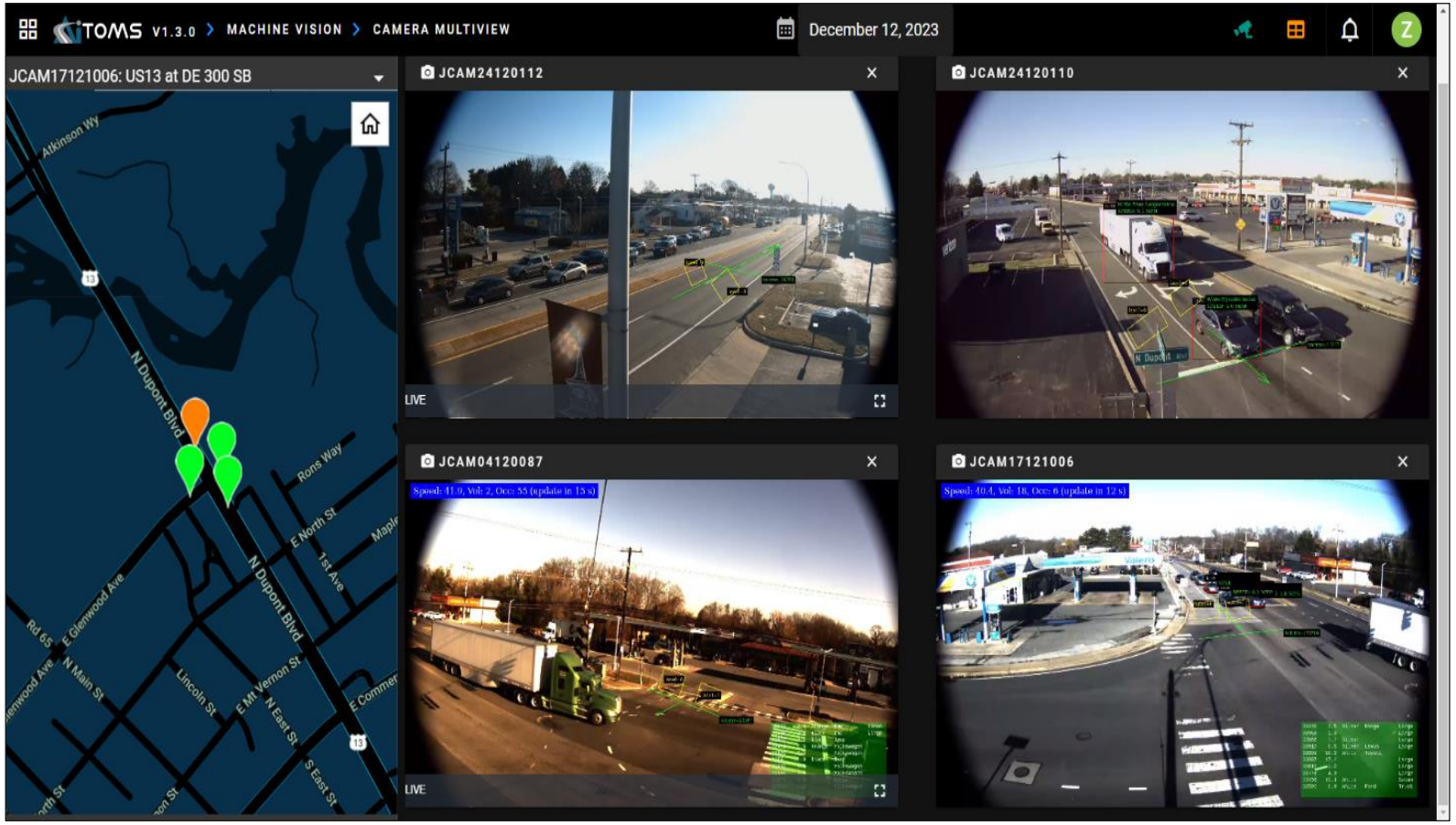


Live Signal Phase and Timing (SPaT) Broadcasting



Machine Vision for Traffic Monitoring

US-13 @ DE-300



AI-TOMS Interface for Machine Vision Cameras and Data Analysis

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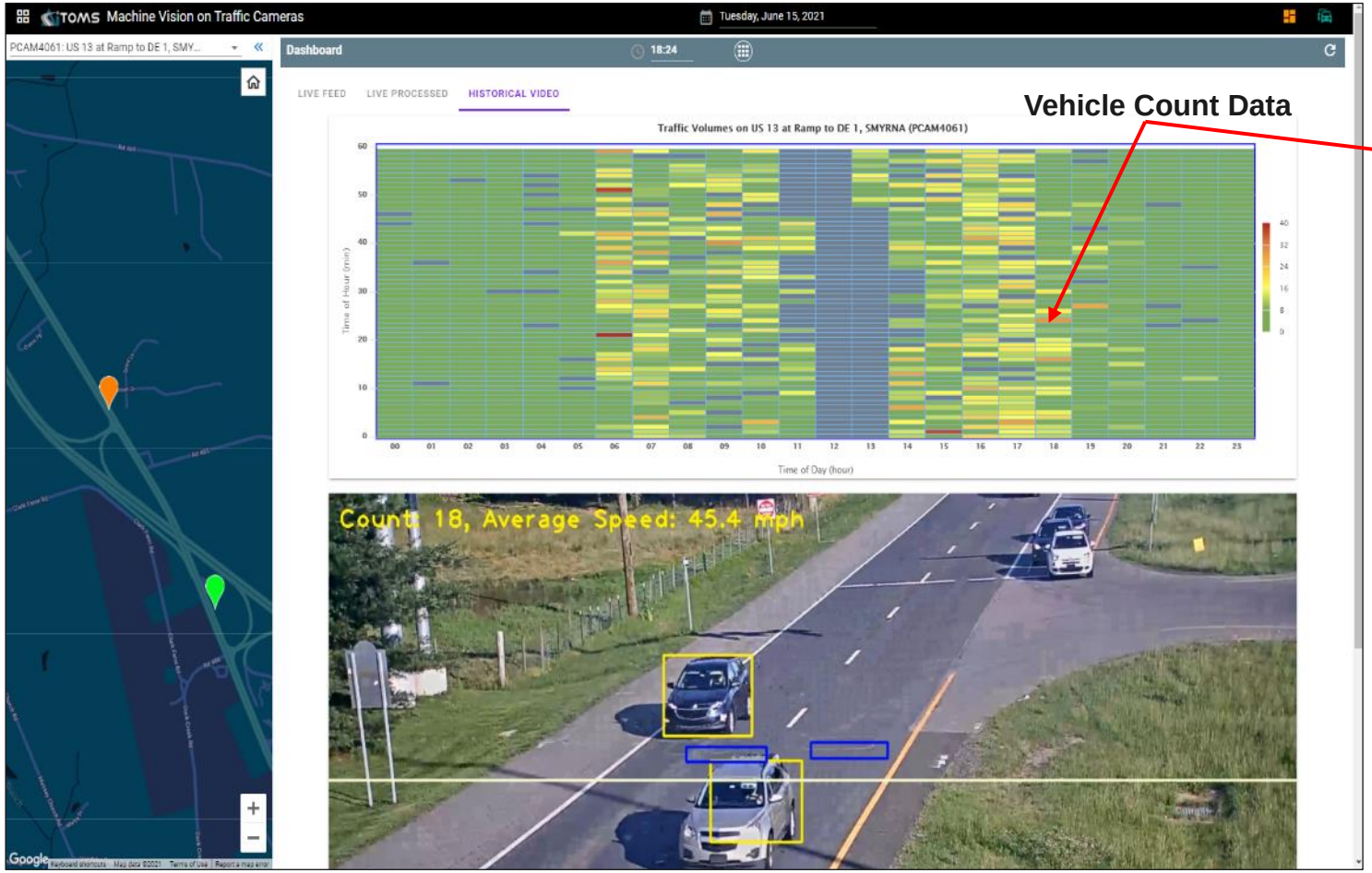
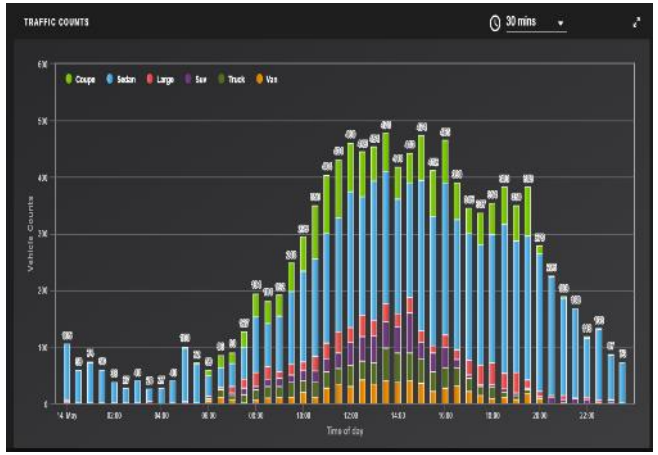
Machine Vision for Traffic Monitoring

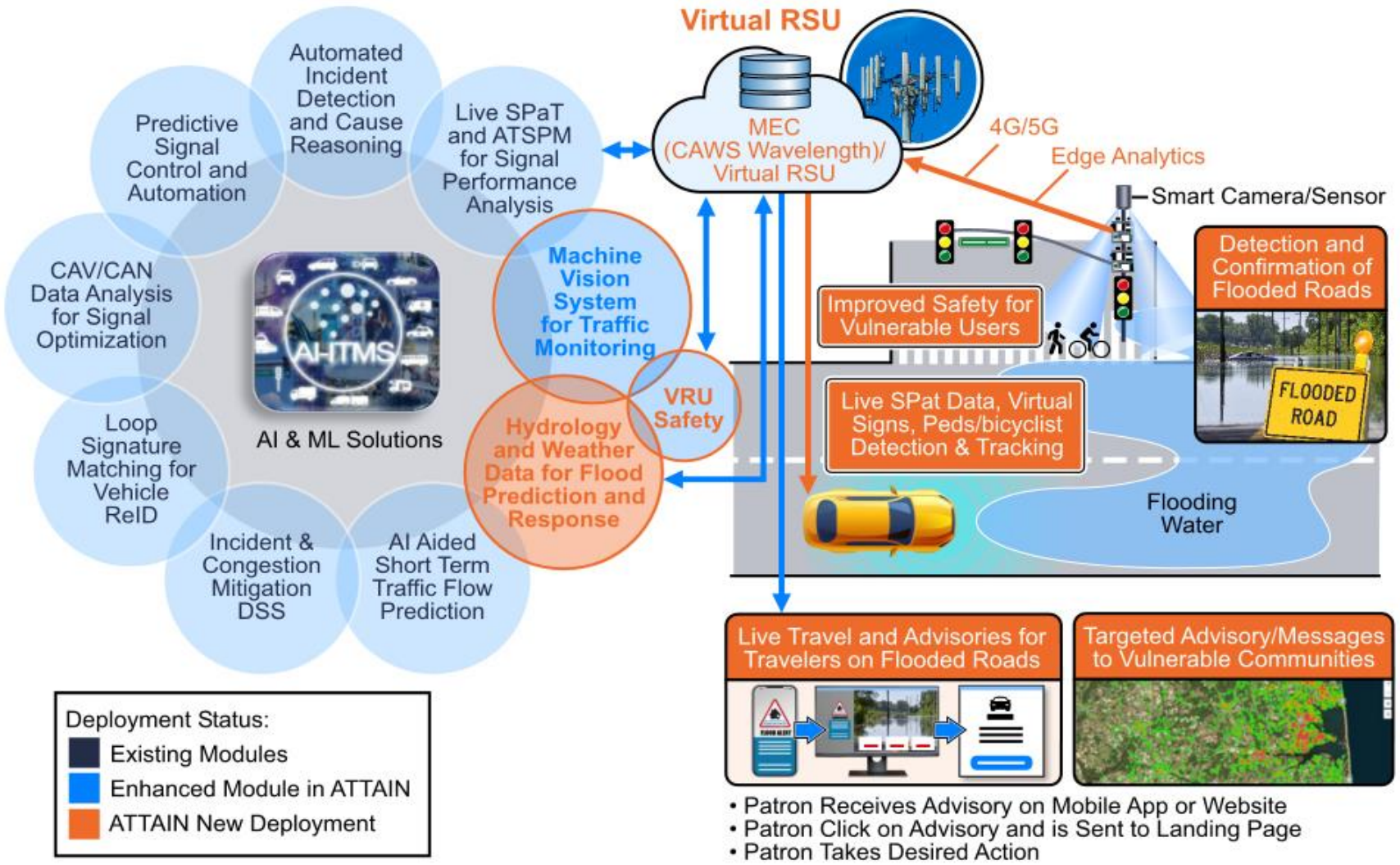
Count, Speed and Occupancy



Vehicle Count Data



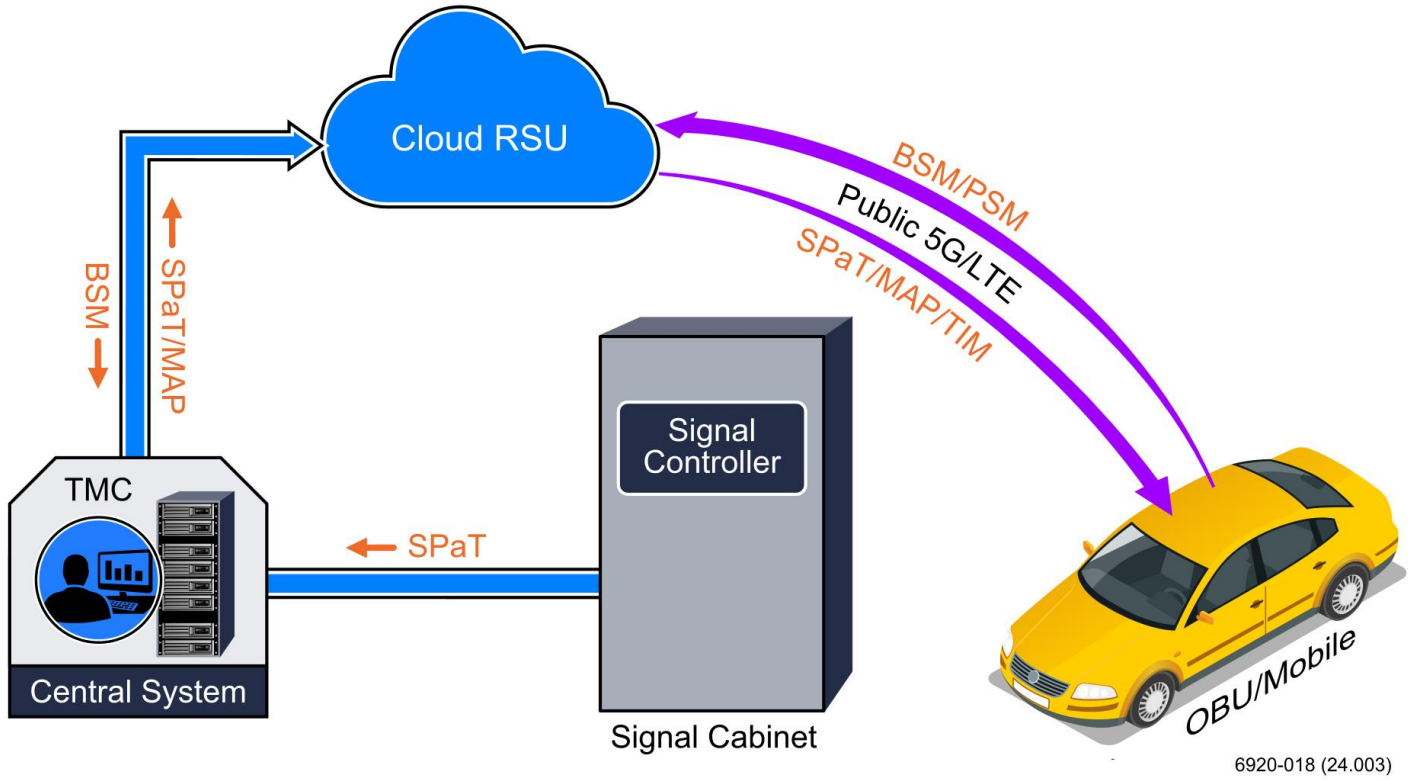
Follow on Efforts – ATTAIN Grant



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

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

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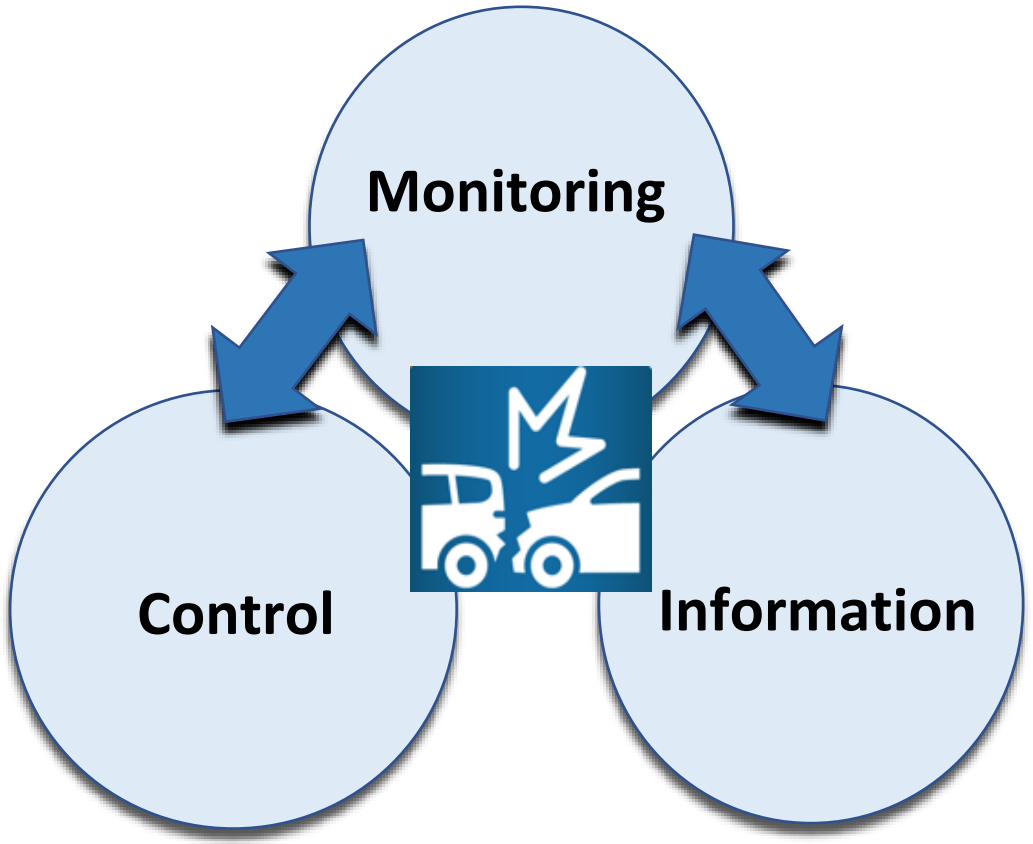
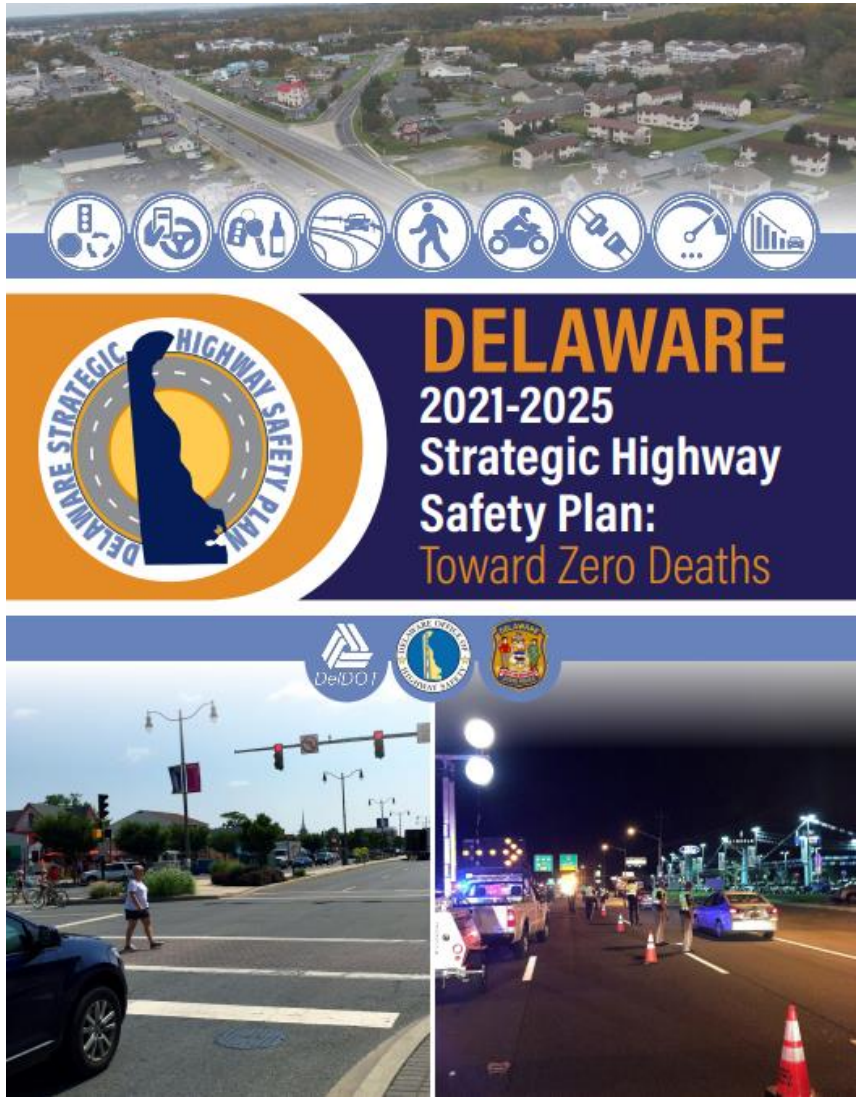
Statewide Deployment of AI-ITMS

- 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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