



Connected Vehicle: Road Service Safety Messages

Final Report



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FINAL REPORT

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This report has been prepared as part of the CY 2019-2020 work program for the ITS Resource Center at the New Jersey Institute of Technology. The project team and the authors of the report include:

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The New Jersey Department of Transportation would like to thank all personnel that participated in the pilot, especially the technical teams at iCone Products and TRANSCOM. All personnel exhibited a commitment to ensuring the pilot evaluated every variable since it presents an opportunity to bring awareness of the first responder being present on New Jersey roadways.

The New Jersey Department of Transportation would also thank the iCone Products technical staff and management team for their support at the ITS America annual meeting held in Washington DC. June 4-7, 2019. The iCone technical staff ensured that the equipment was functioning flawlessly as the Department's Safety Service Patrol vehicles was on display during the conference.

EXECUTIVE SUMMARY

The number one priority for the New Jersey Department of Transportation (NJDOT) is to improve highway safety. One such way is by alerting motorists to the presence of road service vehicles and personnel and enhancing awareness of the State's Move Over Law (New Jersey Statute 39:4-92.2). In July 2018, NJDOT commenced a pilot project to deploy iCone¹ connected vehicle devices on dozens of their Safety Service Patrol (SSP)² road service vehicles. These iCone devices utilize vehicle GPS location and wireless communication technology to disseminate the current NJDOT fleet vehicle location to Waze. This report presents the evaluation of the technology, analysis of the message communication latency between the iCone device and the Waze application, and documents equipment installation and repairs as well.

Evaluation of the technology was conducted by:

- ▶ Field testing - Activating the iCone-enabled SSP trucks lights and Dynamic Message Board (DMS) at two (2) mile intervals traversed along the entirety of the SSP's coverage area, and
- ▶ Remote testing – Monitoring the iCone and Waze Web-based Interfaces

Field testing showed that when the communication between the iCone-enabled SSP trucks device and iCone Data Server was successful at the beginning of the test (in the SSP yard):

- ▶ Successful communication with Waze was on an average of 76% of the time.
- ▶ The device only communicated with the iCone Data Server in 20% of the time.
- ▶ The device did not transmit its location to iCone Data Server or Waze in 4 % of the test.

¹ <http://iconeproducts.com/>

² <https://www.state.nj.us/transportation/commuter/motoristassistance/ssp.shtm>

- ▶ The communication latency³ was 02 minutes 41 seconds.
- ▶ On 2 days of testing along SSP beats the team observed no communication between the iCone device and iCone Data Server/Waze.

To supplement the field evaluation, the remote testing was conducted when an analyst was observing the iCone and Waze web portal on a PC. In eighty-five (85) instances of active iCone device, the results show:

- ▶ 41% (35 out of 85) of activity iCone notifications did not have a corresponding Waze notification.
- ▶ The detection rate that the iCone active device will be shown in Waze is close to 59% (51 out of 85).
 - In 29% (15 out of 51) of the observed instances, an exact timestamp appeared in iCone and Waze.

It is important to emphasize that the iCone can only notify Waze that the data is not showing in Waze and that certain delay exists. It is upon Waze to address these issues and thereby improve their service.

Of the thirty-two (32) iCone devices installed on NJDOT Safety Service Patrol (SSP) vehicles, by April of 2019, twelve (12) units were experiencing technical problems. These failures, according to iCone personnel, are attributed to exposure to the harsh winter weather conditions (winter precipitation and road salt, extreme cold exposure, etc.) experienced in New Jersey. iCone's engineering team showed the willingness to re-evaluate the design for devices and make sure that the replaced devices could withstand the winter weather conditions in New Jersey. A prototype of the newly-designed replacement devices was delivered to NJDOT in mid-December 2019.

³ defined as the time average time elapsed from the moment iCone device is activated to the time it appears in Waze.

INTRODUCTION

The popularity of crowdsourced navigation applications and connected vehicle technologies presents an opportunity for State DOT's to relay important safety information to the motoring public. More specifically, the New Jersey Department of Transportation can utilize this medium to increase awareness and improve the safety of their roadside personnel and to enhance awareness of the State's Move Over Law (New Jersey Statute 39:4-92.2)⁴. The Move Over Law, enacted in New Jersey in 2009, aimed at reducing death or injuries to first responders such as police officers, ambulance, fire personnel, and tow truck operators.

Ranging from helping motorists (giving directions, changing tires, providing gas, etc.), responding to incidents, clearing debris, etc., NJDOT's Safety Service Patrol (SSP), maintenance vehicles and Incident Management Response Team (IMRT) personnel are constantly present on the roadways. While they are operating vehicles designed with safety in mind (emergency lighting, dynamic message signs, etc.), their own safety working on the road is the agency's primary concern. That safety concern multiplies as personnel are frequently working outside of their vehicles, coordinating incident clearance, physically removing vehicles from travel lanes, providing directions to lost motorists, providing gasoline or performing small motor vehicle repairs.

Despite first responder-agency best efforts, personnel continues to be struck on New Jersey's roadways. Adverse weather conditions, traffic congestion or the one second a driver is not paying attention can lead to a first responder being struck when assisting a motorist in a lane or on a shoulder.

⁴ <https://www.nj.gov/oag/hts/move-over-law/move-over-law-text.html> Accessed March 1st, 2019.

According to the statistics⁵ the average number of responders struck and killed nationally while working in or near moving traffic each year are:

- ▶ Fire/Rescue and EMS: 6 to 8 each year
- ▶ Law Enforcement: 10 to 12 each year
- ▶ Tow/Recovery: 50 each year
- ▶ DOTs, Public Works, and Safety Service Patrols: 100 killed each year, and 20,000 injured

To bring awareness to the traveling public of its roadside activity and roadway workers, NJDOT commenced a pilot program of deploying of iCone connected vehicle devices on thirty-two (32) of their SSP vehicles. These devices, designed to utilize vehicle GPS location and communication technology to disseminate current Department vehicle locations to Waze in real-time, were installed with the intended purpose of alerting Waze application users via an in-app notification(s) of nearby engaged SSP vehicle(s).

⁵ <https://www.state.nj.us/transportation/about/press/2017/111317a.shtm> Accessed March 1st, 2019.

SCOPE

The advancement of technologies, and an increased number of users of crowdsourced GPS navigation services for mobile devices, presents a perfect opportunity to increase driver awareness of a first responder being present on New Jersey roadways. For that reason, NJDOT elected to improve the safety of its personnel by utilizing connected vehicle technology to inform the motoring public of their presence on the roadway. The overall goal of the proposed research was to investigate whether NJDOT's pilot deployment of the iCone connected vehicle technology device alerts motorists to the SSP activity promptly.

Therefore, the research focused on accomplishing the following objectives:

1. Analysis of message communication latency between the iCone device and the Waze application.
2. Examination of the Verizon 4G cellular network strength for potential coverage loss that can result in the iCone's wireless communication service disruption.
3. Analysis of the equipment when it is deployed via monitoring equipment logs for potential failures.

STAKEHOLDERS

NJDOT's Transportation Mobility and Statewide Traffic Incident Management (TIM) program

NJDOT's Statewide Traffic Incident Management (TIM) program is a systematic tool used for the command, control, and coordination of emergency response and represents a collaborative effort between NJDOT and the New Jersey State Police (NJSP). The program is used for managing the state's transportation infrastructure and for restoring lanes of traffic in a safe and expeditious manner in the event of traffic incidents. The TIM program employs several NJDOT resources including the Incident Management

Response Team (IMRT), Maintenance Operations, the Safety Service Patrol (SSP), Central Dispatch Unit (CDU) and the Mobility Operations Centers (MOC's).

Safety Service Patrol (SSP)

The NJDOT SSP program mission is to concentrate patrol of Safety Service Patrol vehicles on highway areas that have demonstrated the greatest need for motorist assists. The SSP program focuses on the core mission of mitigating roadway congestion and enhancing safety for the motoring public. The responsibilities of the SSP include the following:

- ▶ Utilize roaming vehicles to patrol congested sections of the statewide freeway network to quickly detect and respond to minor incidents;
- ▶ Assist with incident detection – SSP is routinely the first responder at an incident site;
- ▶ Assist NJSP and other secondary responders by safely diverting traffic around incident scenes;
- ▶ Assist, remove or relocate disabled vehicles and debris, and provide for safety until Maintenance Operations Personnel arrive on scene;
- ▶ Patrol the highway around the scene to prevent the occurrence of secondary incidents
- ▶ Handle containment of minor spills when necessary.

The SSP program covers over 225 center-lane miles of New Jersey's roadways, centered along high-traveled corridors (Appendix A), as follows:

- ▶ In the northern part of the state, SSP operates on I-78, I-80, I-280, I-287 and Route 440 (in Bergen, Essex, Hudson, Middlesex, Morris, Passaic, Somerset, and Union Counties).
- ▶ In the central and southern parts of the state, SSP operates on I-295, I-195, I-676, I-76 and Routes 29, 42 and 55 (in Burlington, Camden, Gloucester, and Mercer Counties).

Under certain circumstances that result in lane closure, or during inclement weather, the SSP will extend its coverage area by an additional 58 miles.⁶

SSP assists nearly 65,000 customers annually. Table 1 below shows the reason for an assist and total number of assists during the Year 2018.

Table 1. SSP Number of Assists by Type

Assist by Type	Statewide Average Yearly Totals
Disabled Vehicle	48,172
Debris	3,765
MVA	6,227
Abandoned Vehicle	2,930
Assistance	732
Fire	222
Pedestrian	113
Lost Motorist	42
Other	2,660
Totals	64,863

Central Dispatch Unit (CDU)

NJDOT's Central Dispatch Unit (CDU) is the 24/7 communications hub for the Department. The CDU's mission is to serve as the "single point of contact" to handle all emergency calls from agencies and citizens statewide. The CDU staff works alongside the New Jersey State Police's (NJSP) and the New Jersey Department of Environmental Protection's (NJDEP) Operational Dispatch Units at the NJSP Communications Center in Hamilton Township, New Jersey.

Mobility Operations Centers

NJDOT currently operates two Mobility Operations Centers:

- ▶ The Statewide Traffic Management Center (STMC) in Woodbridge, New Jersey. The STMC functions are:
 - Overseeing daytime operations for the northern part of the state (4 am - 8:30 pm, 7 days a week).
 - Overseeing Evening/weekend operations for the entire NJDOT transportation system (8:30 pm - 4 am, 7 days a week).
 - Coordination of any major traffic event that could impact both a toll road and/or a state jurisdiction highway.



Figure 1. The Statewide Traffic Management Center (STMC) in Woodbridge, New Jersey

- ▶ Mobility Operations Center South (MOC-South) in Cherry Hill, New Jersey. MOC-South's functions are

- Providing coverage of the southern region counties of Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Mercer, Monmouth, Ocean and Salem counties 16.5 hours a day (4 am to 8:30 pm), Monday through Friday
- Overseeing traffic into and out of the Philadelphia area as well as along the New Jersey Shore.
- MOC-South is also staffed during winter weather activations as well as special events.



Figure 2. Mobility Operations Center South (MOC-South) in Cherry Hill, NJ

Incident Management Response Team (IMRT)

An important component of the NJDOT/NJSP Incident Management Program are the Incident Management Response Teams (IMRT). The activities of the NJDOT and NJSP personnel at the incident scenes are managed and coordinated through the IMRT. These specially-trained teams respond to incidents that have a major impact on transportation

by providing technical, logistical, and incident management support to the Incident Commander (IC). A primary goal of the IMRT team is to keep the traffic moving safely by:

- ▶ Setting up traffic safety devices, demarcating diversion routes, and warning motorists.
- ▶ Serving as the resource mobilization liaison for NJDOT.
- ▶ Safely and quickly restoring traffic flow lanes.
- ▶ Expediting necessary repairs and roadway re-openings.



Figure 3. NJDOT and NJSP IMRT personnel

Maintenance Operations

NJDOT dispatches its Maintenance Operations personnel to major traffic incident sites with an expected incident duration greater than 60 minutes to address the traffic management aspect of roadway incident response. Maintenance Operations are part of a collaborative response from NJDOT that fulfills the requirements of the National Incident Management System (NIMS). When dispatched to traffic incident sites under the Incident Management Program, the responsibilities of the Maintenance Operations personnel include:

- ▶ Assistance with providing traffic control at the scene of major incidents;
- ▶ Providing containment of major spills;
- ▶ Determining incident clearance needs and resources (i.e., loaders, mobile sweepers, dump trucks, etc.) and other relevant equipment;
- ▶ Handling incident clearance activities (i.e., relocate fluid spills, relocate/remove spilled cargo/debris, and relocate damaged trucks and vehicles from the travel lanes);
- ▶ Assisting in the coordination of NJDOT resources (i.e., personnel, equipment) for incident clearance;
- ▶ Assisting NJSP with establishing alternate routes and diversion signing.



Figure 4. Maintenance Operations personnel – traffic control

iCone Products

iCone Products LLC is one of the nation's leaders in work zone traffic monitoring and operates the technology systems of hundreds of highway projects across North America each year. Since its founding in 2008, iCone has pushed efficiencies that have allowed the construction industry to go from a handful of 'smart' work zones in 2008 to thousands in 2017.

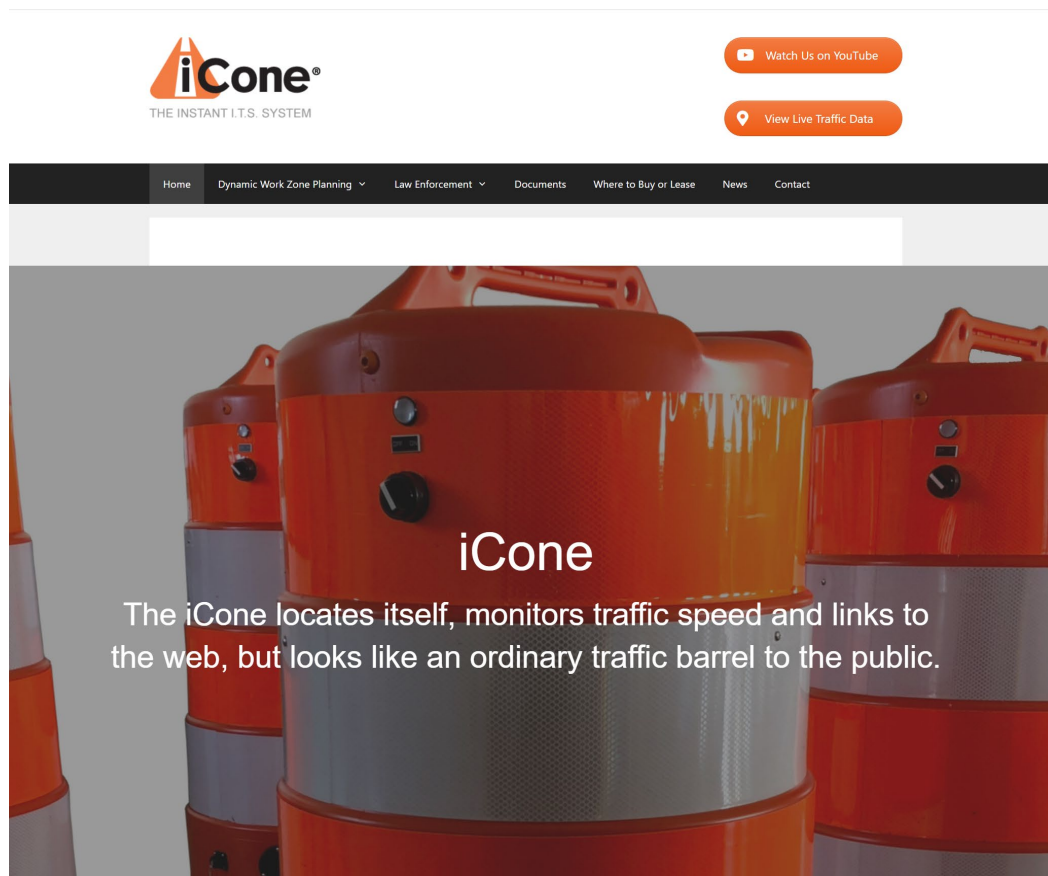


Figure 5. iCone Products webpage.

In 2016, iCone started teaming with the data providers for navigation apps and automated vehicles; companies like Waze, HERE, and SiriusXM, with the goal of providing roadway work zone information directly to motorists. iCone has developed technology applications for the following areas:

- ▶ Emergency Management
- ▶ Dynamic Work Zone Planning
- ▶ Law Enforcement
- ▶ Work Zone Management System
- ▶ Traffic Monitoring Devices
- ▶ ITS Beacon – Hazard Lights

TRANSCOM, Inc

TRANSCOM is a consortium of 16 agencies in New York, New Jersey, and Connecticut that shares roadway and other multi-modal transportation information. TRANSCOM collects and disseminates real-time incident and construction information, 24 hours-a-day, serving its member agencies and affiliated agencies and also provides traffic data during incidents to travel information companies and transportation application providers.

TRANSCOM's systems are:

- ▶ TRANSCOM OpenReach – a network of terminals and servers installed in member agency operations centers.
- ▶ TRANSCOM Data Fusion Engine – the data fusion engine collects real-time and historical information (e.g., speed and travel time) referenced to a single regional multimodal transportation network (links, nodes) model. The model exceeds 250,000 road and rail segments.
- ▶ TRANSCOM SPATEL (Selected Priorities Applied To Evaluated Links) Suite of Tools – an archive of historical speed and incident data analysis tools and performance measurement tools.
- ▶ TRANSCOM Middleware – provides an ITS standards-based interface for center-to-center communications.
- ▶ TRANSCOM Data Exchange – a secure API that allows agencies, including centers and devices, to access real-time transportation information gathered by TRANSCOM.



Figure 6. TRANSCOM Operations Information Center

New Jersey Institute of Technology (NJIT) Intelligent Transportation Systems Resource Center (ITSRC)

The ITSRC at NJIT is established as a premier technical, research and technology resource for NJDOT TOS&S' Transportation Mobility division. The main purpose of the Center is to conduct research studies of innovative ITS technologies and optimize strategies for their deployment within New Jersey's transportation system. This research includes system design, deployment, and operation of roadside sensing technologies, information technologies, and communication technologies, and their integration into traffic engineering and management practices with the goal of improving mobility, safety,

and efficiency of a transportation system while supporting sustainable regional growth and economic development.



Figure 7. New Jersey Institute of Technology, Newark, NJ

The State Transportation Innovation Council (STIC)

The State Transportation Innovation Council (STIC) National Network was initiated by the Federal Highway Administration's (FHWA) Every Day Counts program. The program aims to assist state DOTs in identifying and rapidly deploying proven innovations to shorten project delivery, enhance safety, reduce congestion, and improve environmental sustainability. Each state's STIC is charged with establishing a process in which ideas are developed and innovative techniques and processes to evaluate and implement the technologies quick and efficient.

NJ's STIC members (Figure 1) are various state and federal agencies, local governments, academia, and industry partners that collaborate on specific initiatives aimed to rapidly implement modern and advanced transportation system to New Jersey.

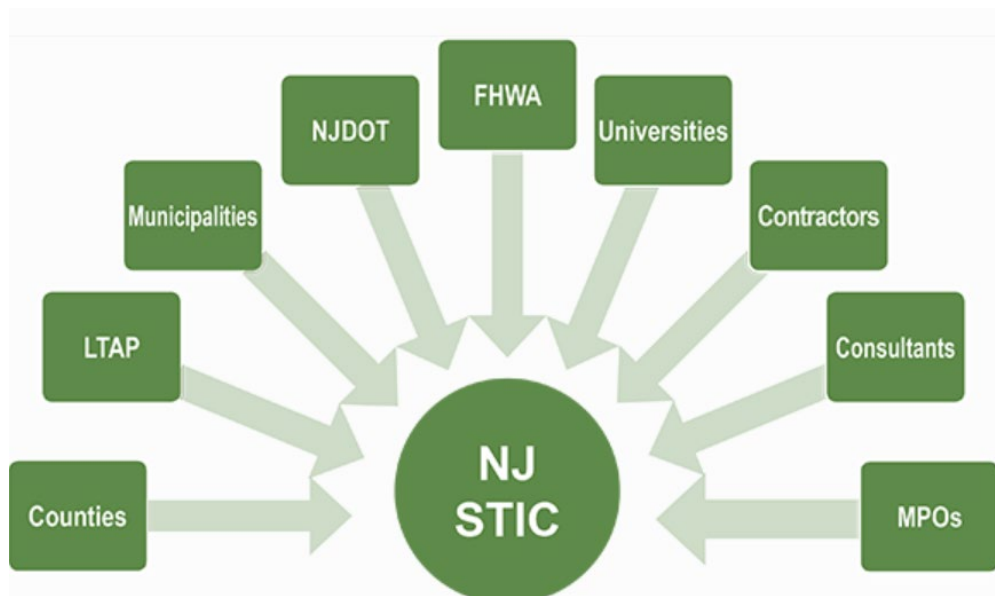


Figure 8.NJ STIC Members

TECHNOLOGY DESCRIPTION, PROCUREMENT, and SYSTEM OPERATION

iCone Products Technology - “ITS Beacon – Hazard Lights”

The iCone Products technology named “ITS Beacon – Hazard Lights” is designed to detect the activation of particular systems on an SSP vehicle. With the activation of the SSP’s Dynamic Message Board and emergency lights, the ITS Beacon – Hazard Lights device will cause the following events to occur:

- ▶ Transmit the vehicle location based on the GPS coordinates (longitude, latitude) to iCone Products’ Data Server using Verizon 4G Cellular Network.
- ▶ The iCone Products’ Data Server will, within 2 minutes, transmit a standardized message (XML Feed) over the internet to TRANSCOM, Inc. and also to Waze.
- ▶ The device will regularly conduct system updates and provide an update every 15 minutes if the vehicle has not moved
- ▶ If the vehicle moves more than 500 ft., the device will re-transmit the location of the vehicle.

Upon de-activation of the Dynamic Message Board and emergency lights on an SSP vehicle, the device will:

- ▶ Transmit location an ‘OFF’ status via the same protocols above.
- ▶ The OFF status is posted to the XML feed within 60 seconds.

Device Procurement and Installation

In July of 2018, NJDOT issued a purchase order totaling \$31,680.00. The order was for the purchase of 32 iCone devices and an accompanying wireless communication package for three years. The wireless 4G communication plan will expire on September

1st, 2021. iCone covers each unit under a 12-month standard and 12-month extended warranty. The extended warranty information is shown in Appendix F.

The funds for this effort were provided by the Federal Highway Administration (FHWA) through NJ's Statewide Transportation Improvement Council (STIC). The iCone devices were installed on:

- ▶ On 9/3/2018, iCone ITS Beacon – Hazard Lights devices were installed on 21 NJDOT SSP vehicles in the Southern Region of the State.
- ▶ On 9/8/2018, iCone ITS Beacon – Hazard Lights devices were installed on 11 NJDOT SSP vehicles in the Northern Region of the State.

The iCone's "ITS Beacon – Hazard Lights" device is shown in Figure 9



Figure 9. The iCone Device

The position of the device on an SSP vehicle is shown in Figure 10 and Figure 11.



Figure 10. The installation of the device on an SSP vehicle by iCone technician



Figure 11. The location of the device on an SSP vehicle

The technology uses less than 1 Amperes in peak load or on an annual basis less than 1KW. The very low power consumption of the device means that there is no need for an additional power source; the device can directly harvest the power from the vehicle battery. Figure 12 shows the technician connecting the device to the vehicle battery.



Figure 12. The device getting connected to the power source (vehicle battery)

Integrating SSP Vehicle Location into Waze and TRANSCOM's SPATEL Tool

In November of 2018, the message format was standardized and provided to Waze. Figure 13 and Figure 14 show the message in a Waze mobile application and on the Waze.com website.



Figure 13. The SSP location and message shown on the Waze mobile application

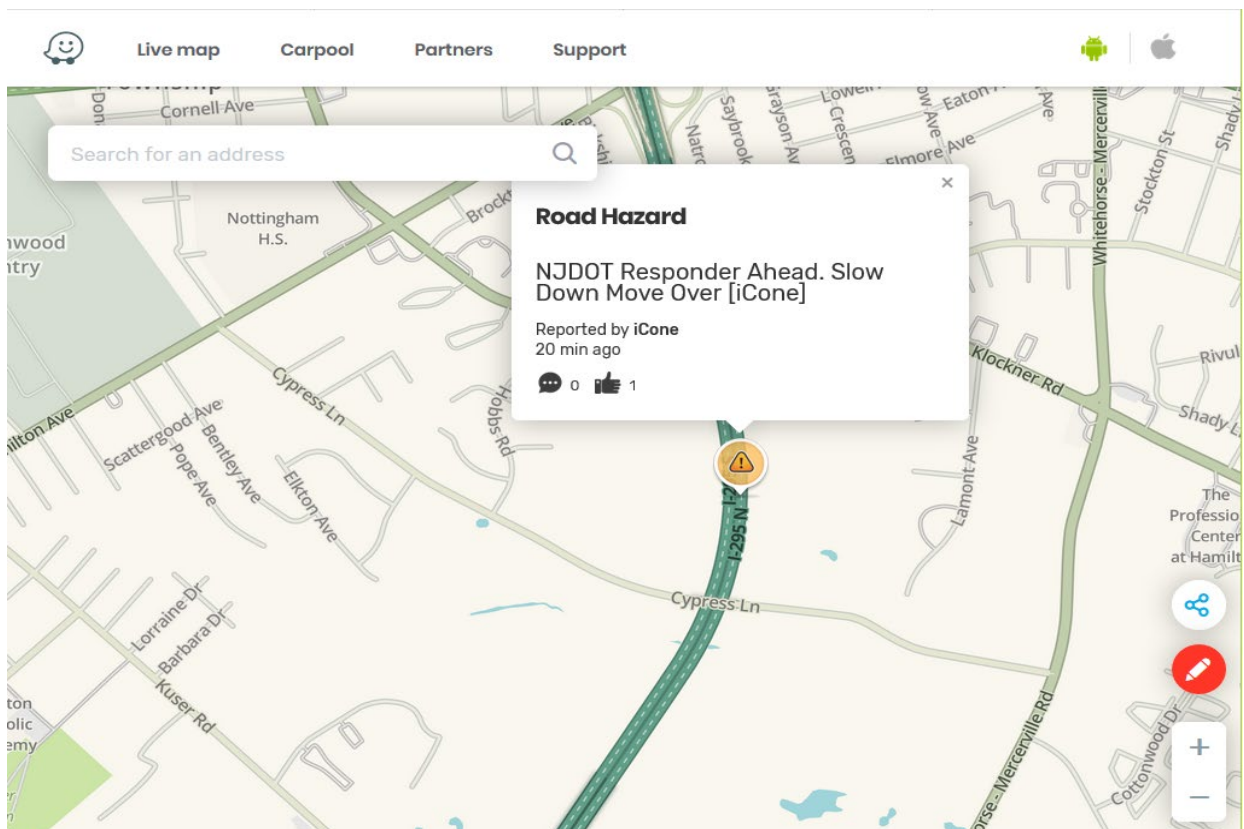


Figure 14. The SSP location and message shown on the Waze.com website.

iCone, TRANSCOM, and NJDOT personnel collaborated on integration and testing of the technology within the TRANSCOM's SPATEL tool. Since December 17th of 2018, NJDOT has been able, in real-time, to observe the location of the SSP vehicles on the map. The TRANSCOM SPATEL tool, with SSP vehicles on the map, is shown in Figure 15.

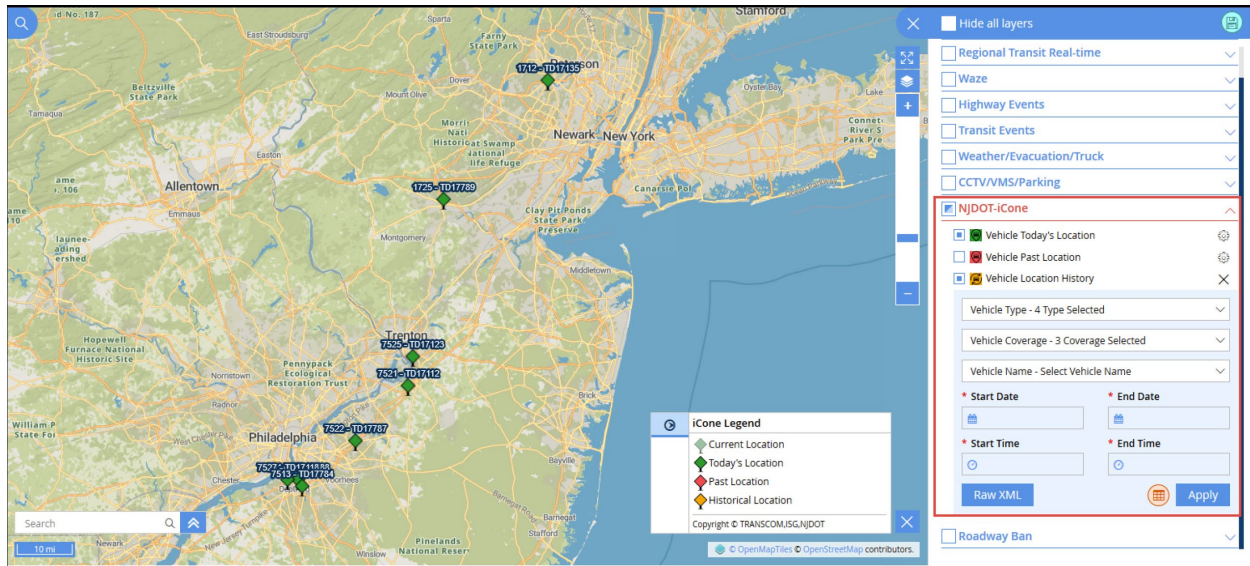


Figure 15. TRANSCOM's SPATEL tool with iCone-equipped NJDOT SSP vehicles displayed on a map

The detailed processes taken by TRANSCOM to integrate the device data into the SPATEL tool is shown in Appendix C.

Meetings/Project Team coordination activities:

The following iCone Program activities have been identified and shown in Table 2:

Table 2. iCone Program Activities

Date	Item
01/24/18	Funding request submitted to the FHWA NJ-Division

3/30/18	NJDOT received the notice that the project is awarded
07/1/18	Purchase order issued to iCone
07/10/18	NJDOT iCone project kick-off meeting held at NJDOT Trenton Headquarters.
08/10/18	Conference call conducted with iCone for database review to ascertain what elements will be available from iCone ITS Beacon feed for overlay onto SPATEL Regional Conditions Operational Map, as well as, to support NJDOT SSP activity reporting information.
08/24/18	iCone provided sample data service account for TRANSCOM to acquire iCone ITS Beacon information along with sample XML snippet and data element descriptions.
08/30/18	Based on the sample dataset provided by iCone, TRANSCOM submitted a scope of work for iCone integration and reporting capabilities to NJDOT.
08/31/18	NJDOT provided comments on TRANSCOM iCone Scope of Work.
09/05/18	TRANSCOM followed-up with iCone regarding the data feed provision and data feed poll frequency.
09/14/18	NJDOT approved TRANSCOM Scope of Work for iCone integration.
09/18/18	Production feed implemented by iCone and verified by TRANSCOM.

10/18/18	iCone and TRANSCOM conducted a review to troubleshoot the data feed poll issue, which was successfully addressed.
10/24/18	TRANSCOM notified NJDOT that they were ready with a prototype for review.
10/30/18	Prototype iCone review conducted with NJDOT and TRANSCOM. Follow-up items identified for both TRANSCOM and NJDOT to address for SSP vehicle types, assignment levels, and locations. Updates to include additional filtering capabilities for both real-time and historical data.
11/26/18	TRANSCOM updated iCone display and historical data query tool and provided it to NJDOT for final acceptance.
12/05/18	Final iCone review conducted with NJDOT. All tools and services were accepted by NJDOT.
Jan-Oct 2019	Testing and evaluation of equipment
08/20/19	iCone Pilot - Status Report webinar between NJDOT, NJIT, iCone and TRANSCOM
10/10/19	iCone Pilot - Status Report webinar between NJDOT, NJIT, iCone and TRANSCOM

EVALUATION RESULTS

Evaluation Methodology #1: Field Tests

Evaluations took place between January and October of 2019. Testing was conducted by activating the iCone-enabled SSP truck's lights and Dynamic Message Board (DMS) at two (2) mile intervals traversed along the entirety of the SSP's coverage area. The testing routes, or beats, were predetermined before proceeding to the testbed field sites. The SSP vehicle would stop on a shoulder and activate the on-vehicle DMS Sign, triggering the iCone device to send the data to the iCone data server and consequently the Waze application server. The NJIT ITSRC analysts and NJDOT Staff would record:

- ▶ When the on-vehicle DMS sign is activated (date/time)
- ▶ When the iCone's data sever received the signal (date/time)
- ▶ When the Waze map displayed the location of the SSP vehicle (date/time)

The NJIT analysts following the SSP vehicle were equipped with three mobile devices using Verizon 4G Wireless Network:

1. Huawei Mediapad M5 was used for monitoring iCone's interface activity
2. Huawei Mediapad M5 was used for monitoring Waze interface activity
3. Samsung Galaxy Note 9 was used, for monitoring cellular strength & activity.

Upon each stop, the iCone and Waze interfaces were both monitored for the notifications of active iCone device to appear.

The specific times reported in each interface were recorded. The differences in time reported between iCone and Waze determined the measurement of notification delay. If no notification activity occurred after five (5) minutes of the DMS board activation, the SSP vehicle and analyst would move to the next location and information would be recorded by the analyst as a null result. If the iCone web portal showed the SSP vehicle

location upon DMS board activation, the analysts would monitor the Waze web portal for up to 15 minutes to identify the time when the SSP vehicle location would appear.

Results

The evaluation covered over two hundred eighty roadway miles encompassing the Safety Service Patrol coverage area. Field testing was conducted by activating the iCone-enabled SSP truck's lights and Dynamic Message Board (DMS) at two (2) mile intervals traversed along the entirety of the SSP's coverage area. When the communication between the iCone-enabled SSP truck device and iCone Data Server was successful at the beginning of the test (in the SSP yard) the test showed:

- ▶ Successful communication to Waze was on an average of 76% of the time.
- ▶ The device communicated with the iCone Data Server, but the message did not pass through to the Waze application in 20% of the time.
- ▶ The device did not transmit its location to either the iCone Data Server or Waze in 4 % of the time.

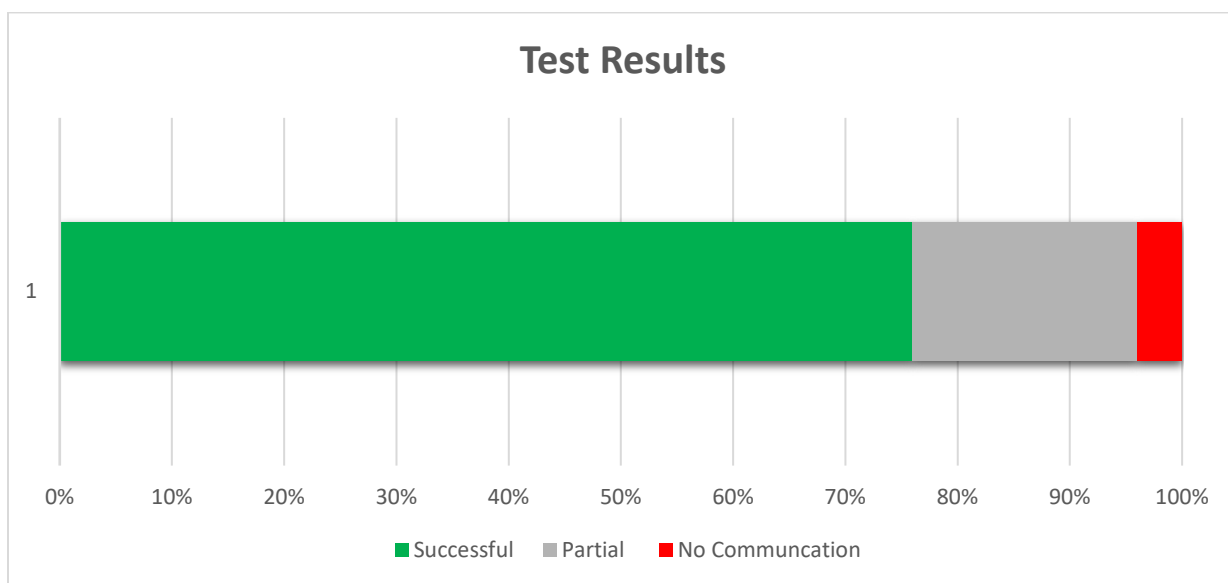


Figure 16. Test Results

- ▶ The communication latency was 02 minutes 41 seconds.
- ▶ For the notification to transfer from the DMS board ACTIVE to the iCone interface it took an average of approximately 44 seconds.
- ▶ Both delay times, that is DMS board to Waze and DMS board to iCone, had notification transfers stops that took as little as less than a minute.
- ▶ For maximum delay times, the DMS board to Waze and DMS board to iCone had shown 5-minute and 3-minute transfer times respectively.

On 8/26 and 8/27 of 2019, the team observed no communication between the iCone device and iCone Data Server/Waze. The iCone-enabled SSP truck lights and Dynamic Message Board (DMS) were activated along the coverage area but the connection between the device and iCone's Data Server hasn't been successful. The test with the same SSP vehicle was repeated on 8/28 of 2019 and the location connection communication between the iCone-enabled SSP truck device and iCone Data Server was successful.

The Verizon 4G cellular signal strength was measured along the SSP coverage area. Table 3 shows the quality of the communicational signal based on the signal strength.

Table 3. Cellular Signal Strength Categorization⁷

Signal Strength in dBm	Definition
Greater Than -60 or 5 Bars.	Excellent signal.
-60 to -75 or 4 Bars.	Very good signal.
-76 to -90 or 3 Bars.	Good signal
-91 to -100 or 2 Bars.	Fair signal. However, voice quality and data transfer speed may be noticeably affected. Dropped calls are more common.

⁷ <https://www.signalbooster.com/blogs/news/differences-between-3g-1x-vs-4g-lte-signal-strength-in-dbm>

-101 to -110 or 1 Bar.	Poor signal. Dropped calls and extremely slow wireless data transfer speed are constant problems.
Less Than -110 or No Bars / No Service.	Dead Zone. There's no wireless connectivity

Based on the data collected, the conclusion is that the cellular strength did not appear to have detrimental effects on the communication performance of the iCone device. Over 82% of the signal strength is being reported as either good or excellent coverage, as shown in Figure 17.

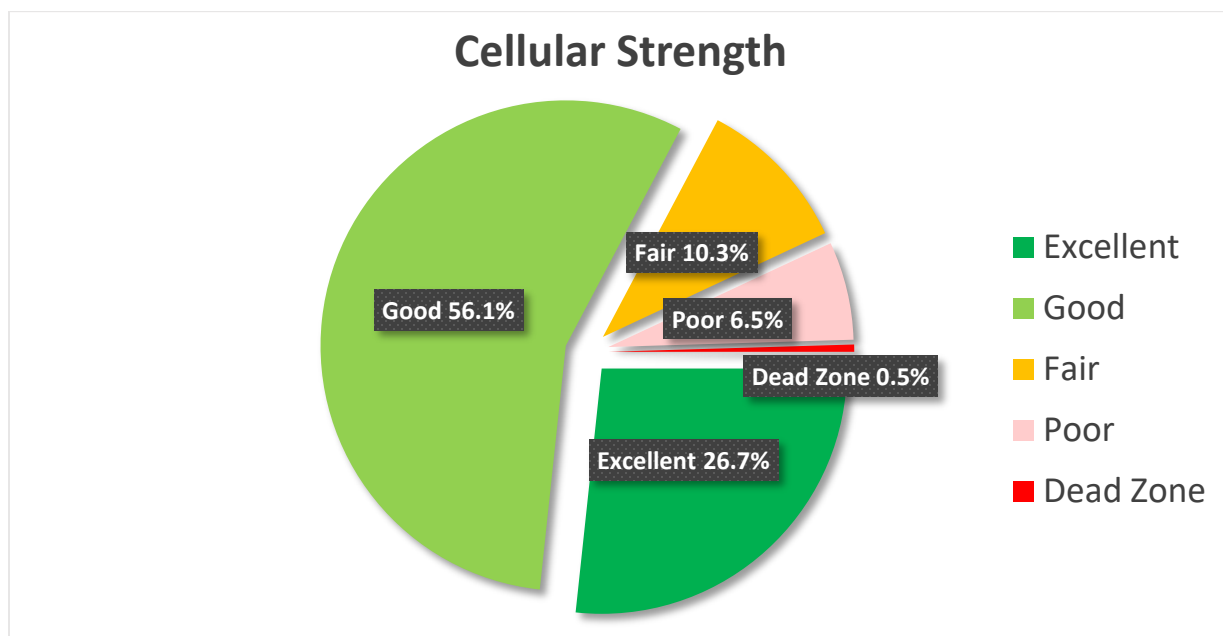


Figure 17. Testing Site Cellular Strength Distribution

The iCone devices for nine (9) iCone-enabled SSP trucks were intentionally activated for at least one instance per day between October 1st and 9th of 2019. The NJIT analyst used the iCone downloadable historical activity report for each device to observe the activity. If a device ID did not register as being activated by the end of the day, the device was flagged as inactive. This test showed that only 65% of the time the iCone database had a record of the device being active (Figure 18) when SSP on-vehicle DMS sign is active.

The same data visualized as by SSP truck device instead of by day is provided in Figure 19. Three units (7515, 7522, and 7529) showcased perfect detection whereas one other device (7533) presented zero activity for the testing dates. The recognized detection rates for other devices varied for each day of testing.

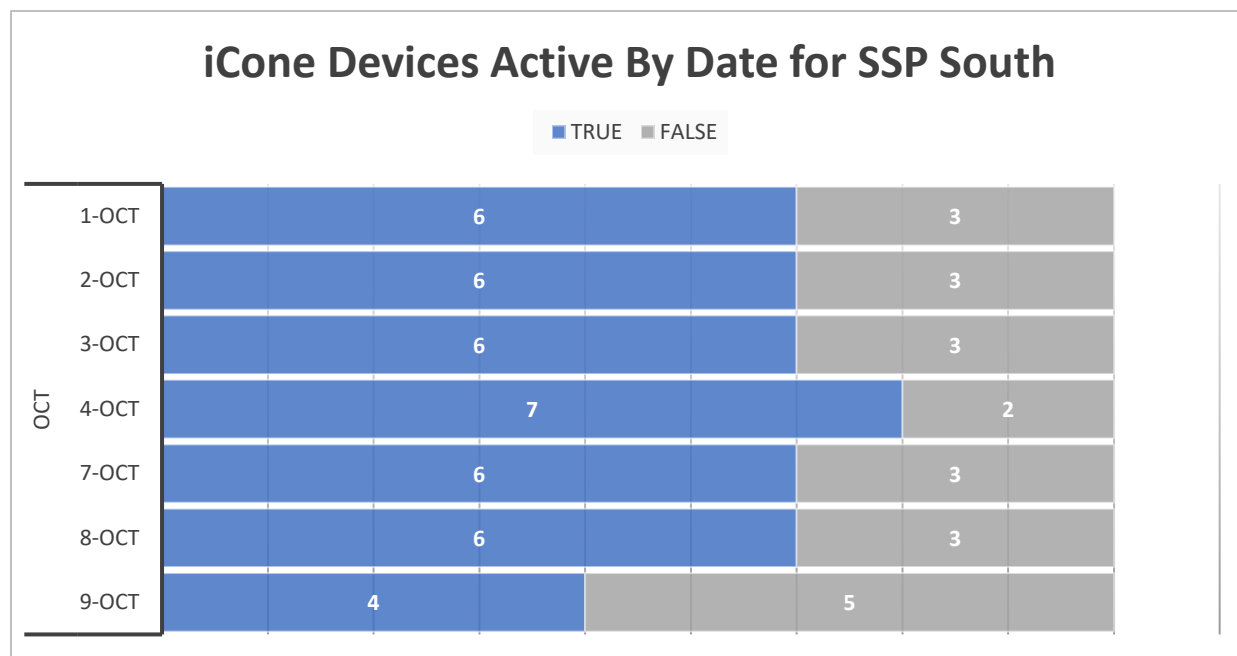


Figure 18. iCone Devices Recognized as Active by Date for SSP South

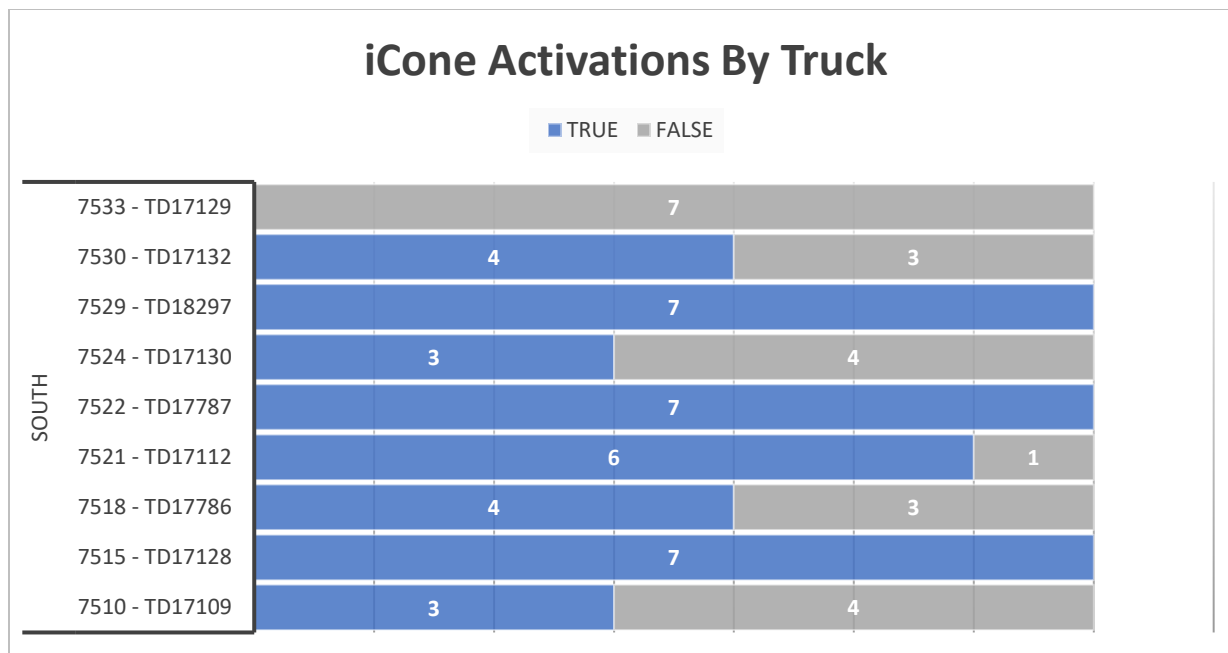


Figure 19. iCone Devices Recognized As Active Dates by Truck for SSP South

Evaluation Methodology #2: Remote Testing and Validation

To supplement the field evaluation, where the analyst was physically present with an SSP truck, the iCone and Waze web-based interfaces were studied remotely. An NJIT analyst proceeded by having the two interfaces open side-by-side on a desktop computer at NJIT. Similarly, the analyst would identify an active device notification in the iCone interface then proceed to match that device activity within a similar location on the Waze live map interface. An example of this pairing can be seen in Figure 20.

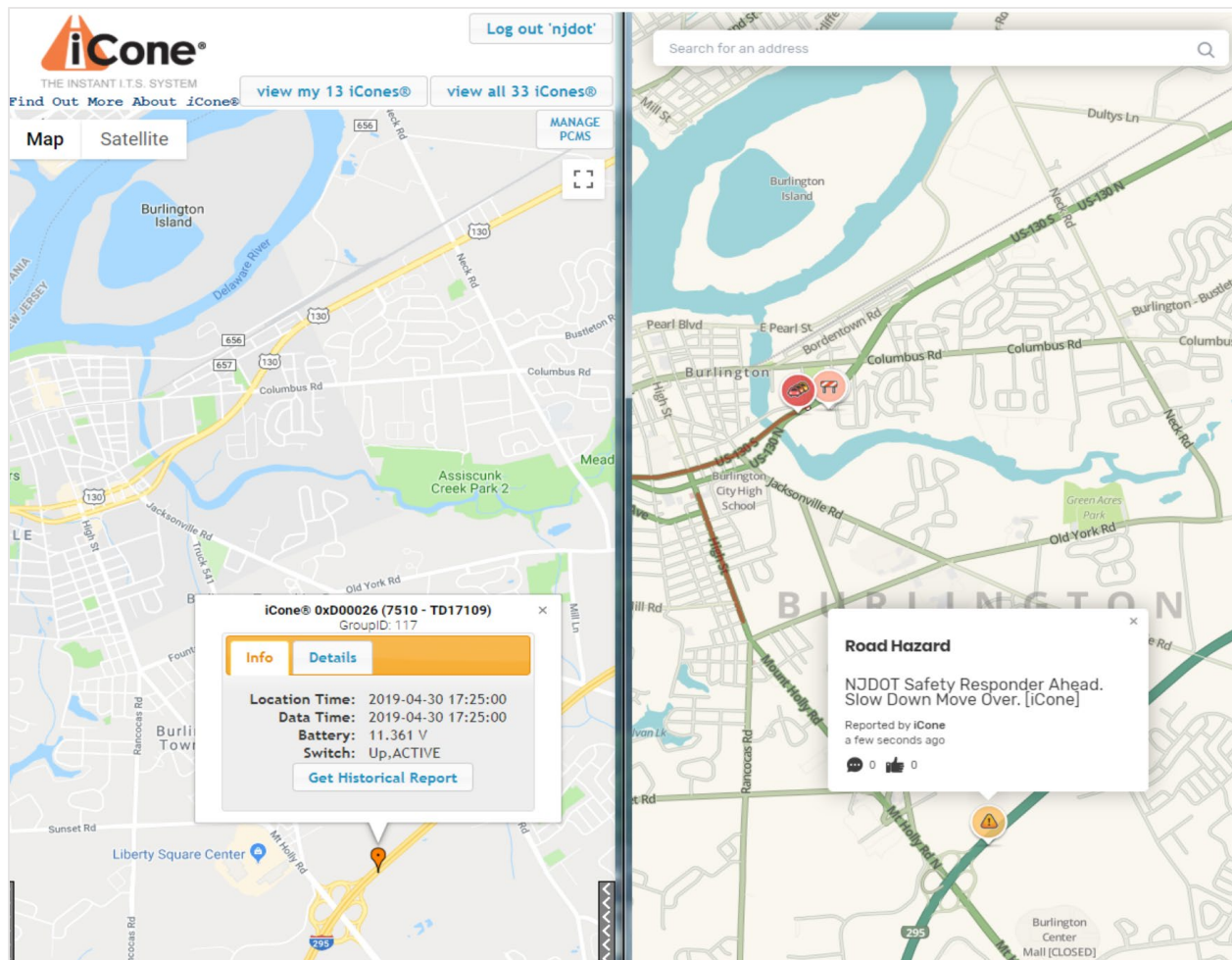


Figure 20. iCone & Waze Web-based Interfaces

Results

During the study timeframe, a total of eighty-five (85) instances of active iCone devices were observed:

- ▶ 20% of the observed instances had an exact timestamp in iCone and Waze.
- ▶ 25 % of the observed instances had 1 to 3-minute delay.
- ▶ 41% of activity iCone notifications did not have a corresponding Waze notification.

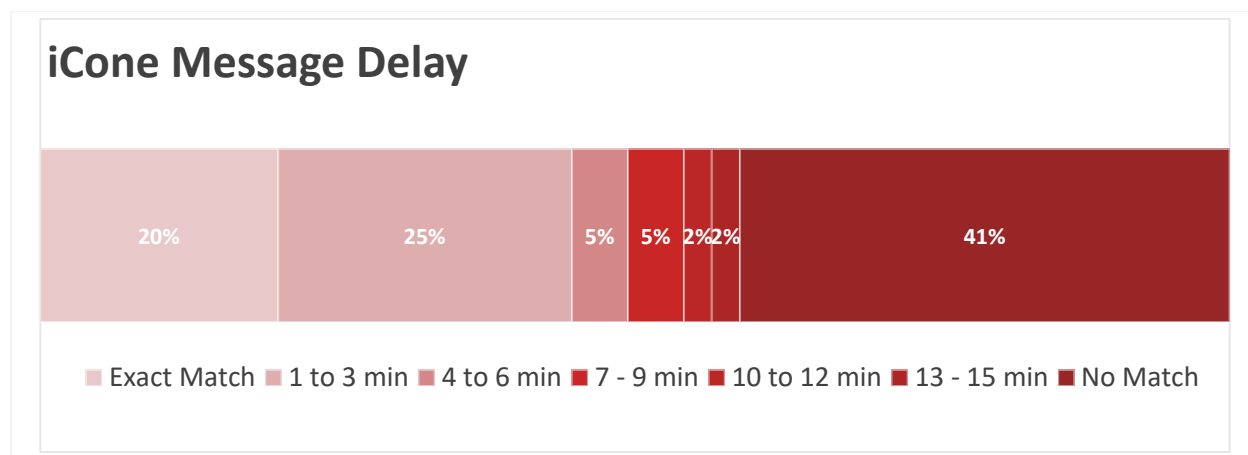


Figure 21. Message Delays between iCone and Waze, % Distribution

The analysis shows a 74% detection rate of iCone-enabled SSP truck being registered in the iCone and Waze web-based interfaces.

The graph in Figure 22 below shows the delay for the fifty (50 of 85) records that have had corresponding matches in both Waze and iCone. The average delay time for the message to transmit from the iCone interface to the Waze interface was 2 minutes 36 seconds.

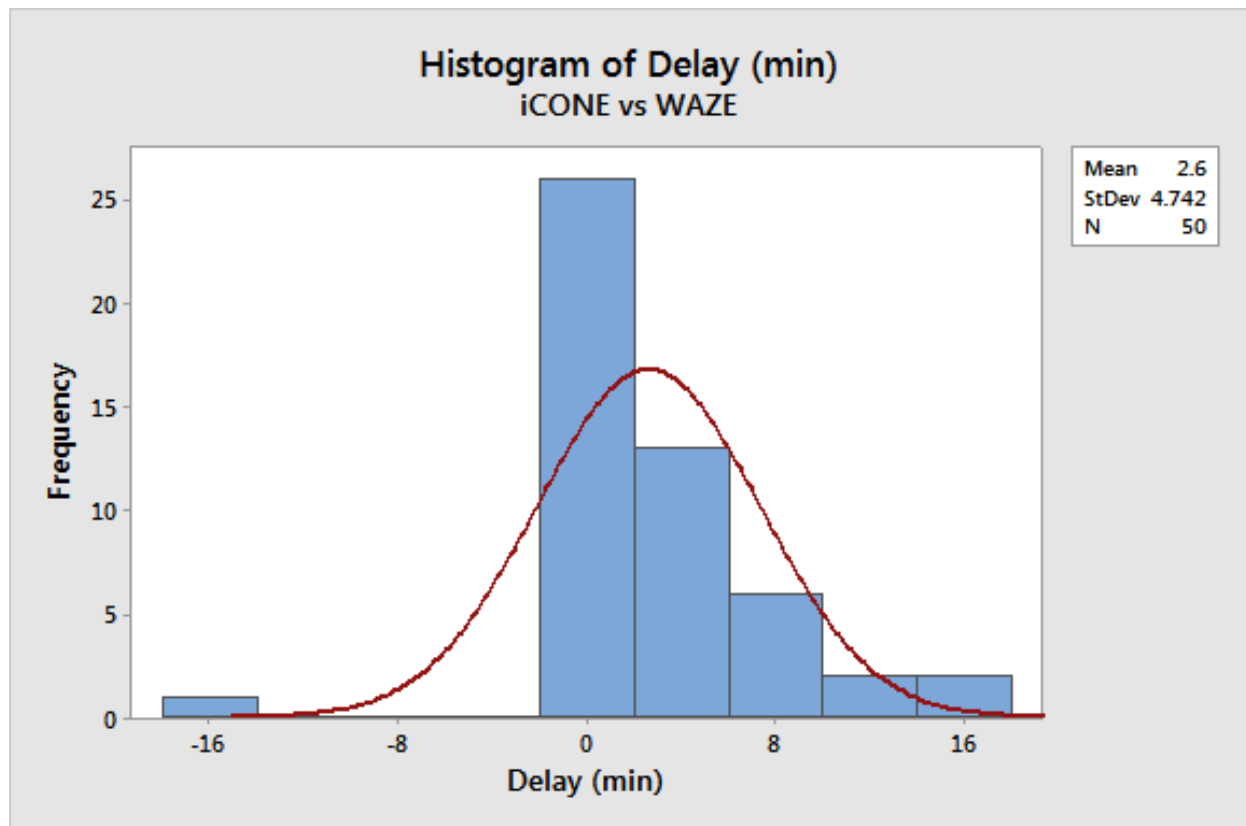


Figure 22. Histogram of Delay (min)

Evaluation Methodology #3: Correlating CDU and iCone Report Logs

The third part of the analysis was to examine the matching records between the CDU radio log and the iCone log. The CDU is responsible for dispatching SSP personnel, via two-way radio communication, during the hours of SSP operation. The CDU log was obtained for the following SSP vehicles for the period Jan 1, 2019, until May 31st, 2019:

- ▶ 1718 – TD17116 (patrols on I-280)
- ▶ 1720 - TD17133 (patrols on I-80)

The analysis entailed matching the dates, times, device and truck IDs, and locations between each log. Both logs included the date, time, and IDs. However, the location record fields within the CDU radio log do not easily or consistently indicate the exact location of the responding instance, whereas the iCone log details the geolocation

(latitude & longitude) of the active device. Therefore, a less conventional strategy had to be considered due to the variable location data from the CDU radio log. It can be expected that the time component from the CDU radio log and the iCone device can to be varied due to many factors. For instance, the CDU radio log time is the time when a physical two-way radio communication between the CDU operator and SSP driver occurred. For example, when a driver approaches a disabled vehicle, he/she would pull up to the incident scene while activating the DMS board and emergency lights and then call information into CDU over the two-way radio system. The iCone time log represents the electronic timestamp of the iCone device activity log. Because of this variation, trying to match the exact timestamp in both logs has the possibility of presenting limited or erroneous results. Thus, the time ranges were expanded to capture the most closely accurate yield of matches.

Results

The +/- fifteen-minute time range at 74% was identical to the 74% matched success of the iCone vs. CDU. Thus, was subsequently preferred for use for the remainder of this analysis to have the most comprehensive matched selection of data.

Table 4. iCone and SSP Radio Log Matched Records for 2 SSP Vehicles between January 1 and May 31st, 2019

Time Radius [+/-]	Exact Match	Within 1 minute	Within 5 minutes	Within 10 Minutes	Within 15 Minutes
Matching Records	105	528	888	950	1,004
Total Records	1,353	1,353	1,353	1,353	1,353
Match %	8%	39%	66%	70%	74%

Time Difference Between the CDU and iCone Log

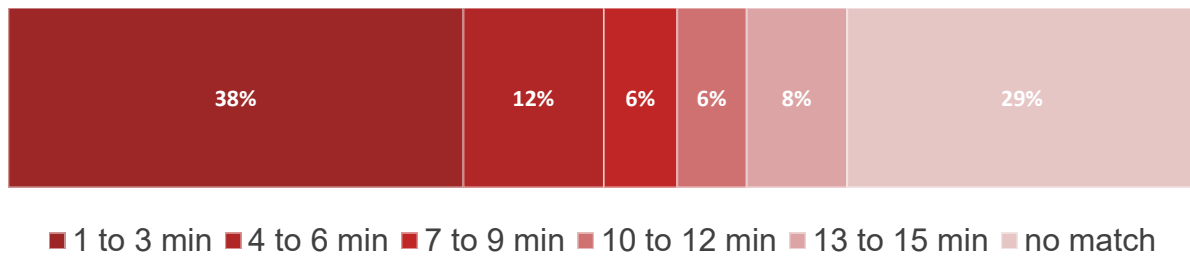


Figure 23. Time difference between the CDU and iCone log, percent distribution

From the distribution of the fifteen-minute time range in Figure 23 above, it is shown that 38%, also the highest percentage, of the radio log calls were within one to three minutes to the iCone timestamp. 29% of the iCone logs that did not have a corresponding CDU radio log match.

In summary, the analysis of CDU records vs iCone logs for two SSP trucks (1717 and 1720) for the period Jan 1, 2019, until May 31st, 2019 shows:

- ▶ Within 1 minute of the activation of the SSP DMS board, 39% of these events were registered in the iCone log.
- ▶ Within 5 minutes of the activation of the SSP DMS board, 66% of these events were registered in the iCone log.
- ▶ 29% of the iCone logs tied to these two SSP trucks did not have a corresponding radio log match.

Equipment Life Cycle/Technical Issues

Equipment Life Cycle

The daily inspection of iCone devices revealed that twelve (12) iCone devices were experiencing technical issues in March of 2019 (Table 5). NJDOT subsequently contacted iCone personnel who suggested that the severe weather exhibited in New Jersey may be the cause of the issues. These extreme winter weather conditions (winter precipitation, road salt, extreme cold exposure, etc.) justified iCone to redesign and warrant reissuing of new devices. Table 5 below shows the list of devices with technical issues.

Table 5. Faulty iCone Devices

Truck#	TD#	iCone Install Date	iCone Serial	Status Check Date
7518	17786	09/13/18	OxD0002C	03/22/19
7519	17136	09/13/18	OxD00029	03/20/19
7525	17123	09/13/18	OxD0002B	03/20/19
7534	17126	09/13/18	OxD0002A	03/21/19
7512	17114	09/26/18	OxD00035	04/11/19
7513	17784	09/26/18	OxD00037	03/22/19
7526	17117	09/26/18	Ox000036	03/22/19
7511	11958	10/10/18	OxD00041	03/22/19
7520	17120	10/10/18	OxD00043	03/22/19
7527	17118	10/10/18	Ox000044	02/22/19
7528	17115	10/10/18	OxD00045	03/20/19
7529	11961	10/10/18	OxD00042	03/20/19

Experienced Technical Issues during Testing

NJIT and TRANSCOM monitored iCone's Data Transmission Log daily and in case of any issues immediately notified iCone's staff. It was observed that on May 20th of 2019, the iCone's Data Transmission Log was not reporting any activity. iCone personnel were notified and the iCone data server issue was resolved on May 29th of 2019. The device log is included in Appendix E.

During two of the planned field-testing dates, August 9th and August 26th of 2019, technical issues were encountered with iCone devices. On August 9th, during the entire day, the location of the SSP truck was not transmitting to iCone and / or Waze. The NJIT analyst reached out to iCone but the reason for the technical issue with the device was not identified. The device had power but there was no communication between the device and iCone's Data Server. On August 29th, no active communication was again observed for several iCone-enabled SSP trucks located in the SSP yard in Harding, NJ. Upon speaking with iCone support, the iCone device for one of the trucks regained communication with the iCone's server but was not showing the GPS location. Two other iCone devices remained inactive and had no working LED light(s) on the iCone device box of each SSP truck. iCone support was made aware of these issues.

On each day of testing (August 28th, 29th, and 30th, 2019) it was observed that in the afternoon after the entire day of testing, suddenly the location of the iCone-enabled SSP truck would become "frozen". In other words, although the DMS board is no longer active and the SSP vehicle has moved further down the roadway to a new location, the iCone device would continue to send notification to the iCone interface that the DMS was still active at the previous location. Consequently, any subsequent activity and location of the SSP truck after the occurrence of this malfunction was not recorded in the iCone interface. Since Waze relies on device activity information being sent from iCone, Waze notifications will also cease to update and continue to ping the last working location. This issue occurred once per day. Upon discussion with iCone support, the iCone evaluation team was informed that the iCone device would need to undergo a reprocessing of the

data stream. To facilitate this restart, the iCone device required a power-down of at least thirty minutes. This power-down will refresh the iCone device's location and expectantly start to properly transfer the data location and activity to the iCone interface. iCone staff has been investigating the causes of these malfunctions since inception.

SUMMARY

In 2018, NJDOT procured thirty-two (32) iCone devices and installed them on their Safety Service Patrol vehicles to provide awareness for the safety of these roadway workers. This awareness effort was delivered to motorists via Waze GPS in-app notifications. From January through October of 2019, multiple analyses were performed to evaluate the effectiveness of the pilot deployment by examining the iCone communication reliability and equipment life cycle.

Evaluation of the technology was conducted by:

- ▶ A field test was conducted by activating the iCone-enabled SSP trucks' lights and Dynamic Message Board (DMS) at two (2) mile intervals traversed along the entirety of the SSP's coverage area, and
- ▶ Remote testing – Monitoring the iCone and Waze Web-based Interfaces

The field test showed that when the communication between the SSP truck iCone device and iCone Data Server was successful at the beginning of the test (in the SSP yard):

- ▶ Successful communication with Waze was on an average of 76% of the time.
- ▶ The device only communicated with the iCone Data Server in 20% of the time.
- ▶ The device did not transmit its location to iCone Data Server or Waze in 4 % of the test.
- ▶ The communication latency⁸ was 02 minutes 41 seconds.
- ▶ On 2 days of testing along SSP beats the team observed no communication between the iCone device and iCone Data Server/Waze.

To supplement the field evaluation, remote testing was conducted when the analyst was observing the iCone and Waze web portals on a PC. In eighty-five (85) instances of active iCone device, the results show:

⁸ defined as the time average time elapsed from the moment iCone device is activated to the time it appears in Waze.

- ▶ 41% (35 out of 85) of activity iCone notifications did not have a corresponding Waze notification.
- ▶ The detection rate that the iCone active device will be shown in Waze is close to 59% (51 out of 85).
 - In 29% (15 out of 51) of the observed instances an exact timestamp in iCone and Waze.

Of the thirty-two (32) iCone devices installed on NJDOT Safety Service Patrol (SSP) vehicles, by April of 2019, twelve (12) units were experiencing technical problems. These failures, according to iCone personnel, are attributed to exposure to the harsh winter weather conditions (winter precipitation and road salt, extreme cold exposure, etc.) experienced in New Jersey. iCone's engineering team showed the willingness to re-evaluate the design for devices and make sure that the replaced devices could withstand the winter weather conditions in New Jersey. A prototype of the newly-designed replacement devices was delivered to NJDOT in mid-December 2019.

CONCLUSIONS

The immense audience that various crowdsourcing GPS navigation applications such as Waze, Google and Apple Maps have has not been yet explored to bring awareness of the constant presence of first responders and maintenance workers on roadways. Based on our knowledge, this pilot is the first attempt of any State DOT to inform the public of the location of SSP patrols with one objective, to increase their safety. Giving motorists an advance warning that first responders are ahead, gives hope that the public will be more vigilant and pay attention.

But as with any new technology, there is always room for improvement. As the evaluation was performed, both, NJDOT and iCone learned valuable lessons. The technology went through extensive testing through the winter season that resulted in a redesigned and improved housing for the iCone device that should better withstand the harsh winter conditions of New Jersey. The redesigned iCone device enclosure is expected to be deployed during the 2019-2020 winter season and presents another opportunity to test its endurance during winter weather conditions.

As this report solely focused on the testing of the equipment, a great deal of effort was vested in testing the communication path and latency of the message from the source (iCone device) to its destination (Waze). The reasons for some disruption in services should be investigated further. Additional coordination with each technical partner is appropriate during every step of the testing process to discover any causes of service disruption. As NJDOT's procurement of these devices comes with a warranty period and cellular service for 3 years since the procurement began, it is expected that all installed devices, and replacements where made, will be up and running until September 1, 2021. Additional testing of the system, as well as all the downstream recipients, will be further analyzed during this time.

The one aspect that is missing in this report, and it is crucial, is how the motoring public reacted to the notifications in the Waze application. The effort made to obtain Waze data (“thumbs up” or how many people recognized the message) by NJIT and iCone were unsuccessful. The recommendation is to explore the possibility of engaging crowdsourcing GPS navigation providers, establish a partnership and discover how the drivers are reacting. Part of the discussion with GPS navigation providers should be as well the data transfer process and having a conversation on how to reduce the latency between the iCone data server and Waze.

Appendix A: SSP Roadway Coverage by Yard

SSP Roadway Coverage by Yard

SSP North (Harding, NJ)

The SSP operates on sections of the following roads in northern New Jersey in Bergen, Passaic, Hudson, Essex, Union, Morris, Somerset, and Middlesex counties:

- ▶ I-78
- ▶ I-80
- ▶ I-280
- ▶ I-287
- ▶ NJ 440



Figure 24. Safety Service Patrol Coverage Area (North)

Table 6. Northern New Jersey Normal SSP Coverage

Highway Coverage Area	From Milepost to Milepost	Total Miles of Coverage
I - 78	27.11 to 58.32	31.21 miles
I - 80	35.30 to 68.10	32.80 miles
I - 280	00.0 to 17.0	17.00 miles
I - 287	00.0 to 45.0	45.00 miles
NJ 440	00.0 to 05.15	5.15 miles
Total miles covered		131.16 miles

Table 7. Northern New Jersey Extended SSP Coverage

Highway Coverage Area	From Milepost to Milepost	Total Miles of Coverage
I - 78	17.60 to 27.11	9.51 miles
I - 80	27.19 to 35.3	8.11 miles
I - 287	45.00 to 53.14	8.14 miles
Total miles covered		25.76 miles

SSP South (Cherry Hill, NJ)

The SSP operates on sections of the following roads in southern New Jersey in Mercer, Burlington, Camden, and Gloucester counties:

- ▶ I-195
- ▶ I-295
- ▶ I-76
- ▶ I-676
- ▶ NJ 29
- ▶ NJ 42
- ▶ NJ 55

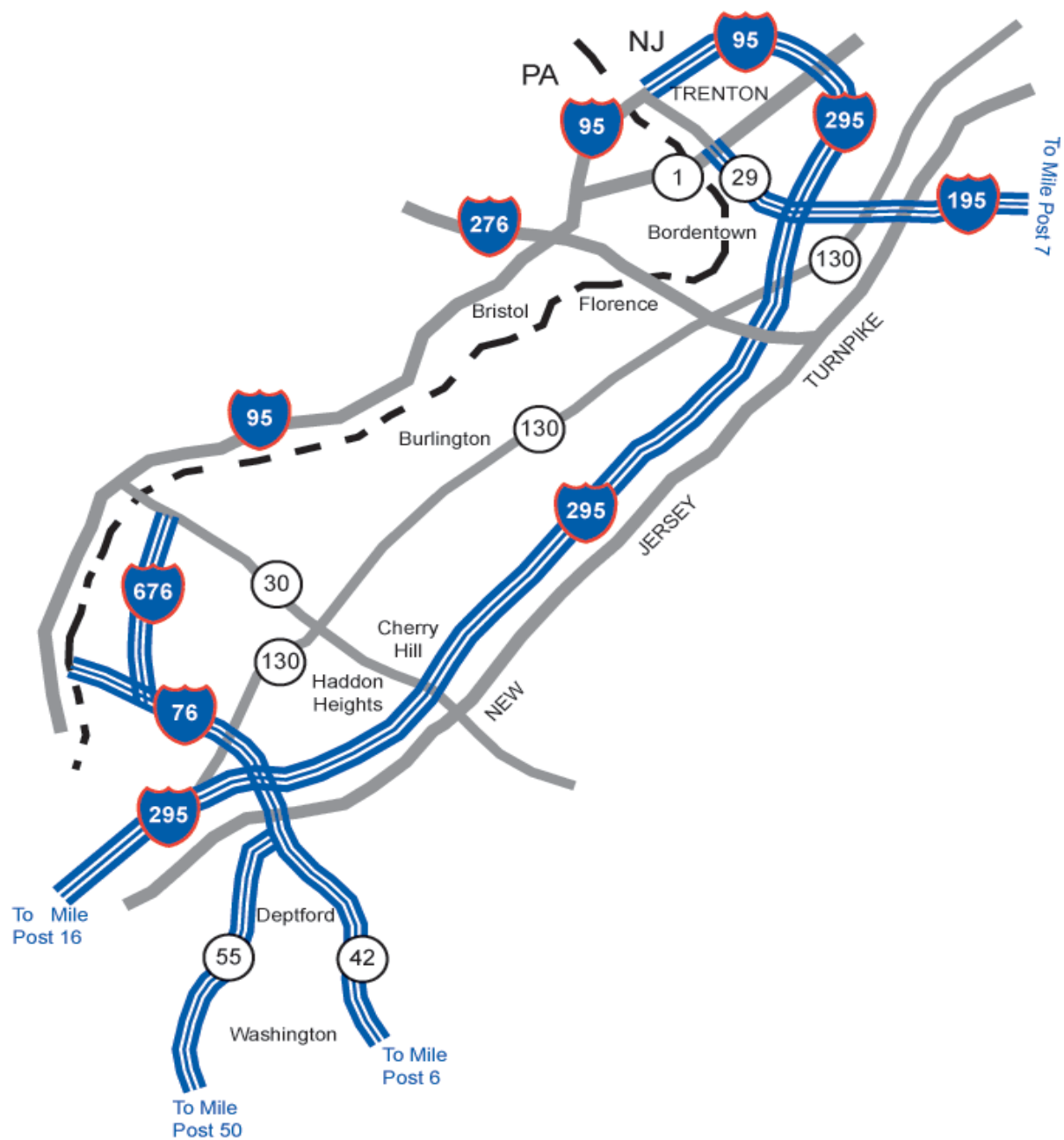


Figure 25. Safety Service Patrol Coverage Area (South)

Table 8. Southern New Jersey Normal SSP Coverage

Highway Coverage Area	From Milepost to Milepost	Total Miles of Coverage
I-295+	0.00 to 8.77	8.77 miles
I-195	0.00 to 7.3	7.3 miles
I-295	16.42 to 67.79	51.37 miles
I-76	0 to 2.2	2.2 miles
I-676	0 to 3.7	3.7 miles
NJ 29	0 to 2.94	2.94 miles
NJ 42	6.2 to 14.28	8.08 miles
NJ 55	50.5 to 60.49	9.99 miles
Total miles covered		94.35 miles

Table 9. Southern New Jersey Extended SSP Coverage

Highway Coverage Area	From Milepost to Milepost	Total Miles of Coverage
I - 195	8.77 to 16.71	7.94 miles
I - 295	0.00 to 16.42	16.42 miles
NJ 29	2.94 to 9.13	6.19 miles
NJ 55	39.66 to 50.5	10.84 miles
Total miles covered		41.39 miles

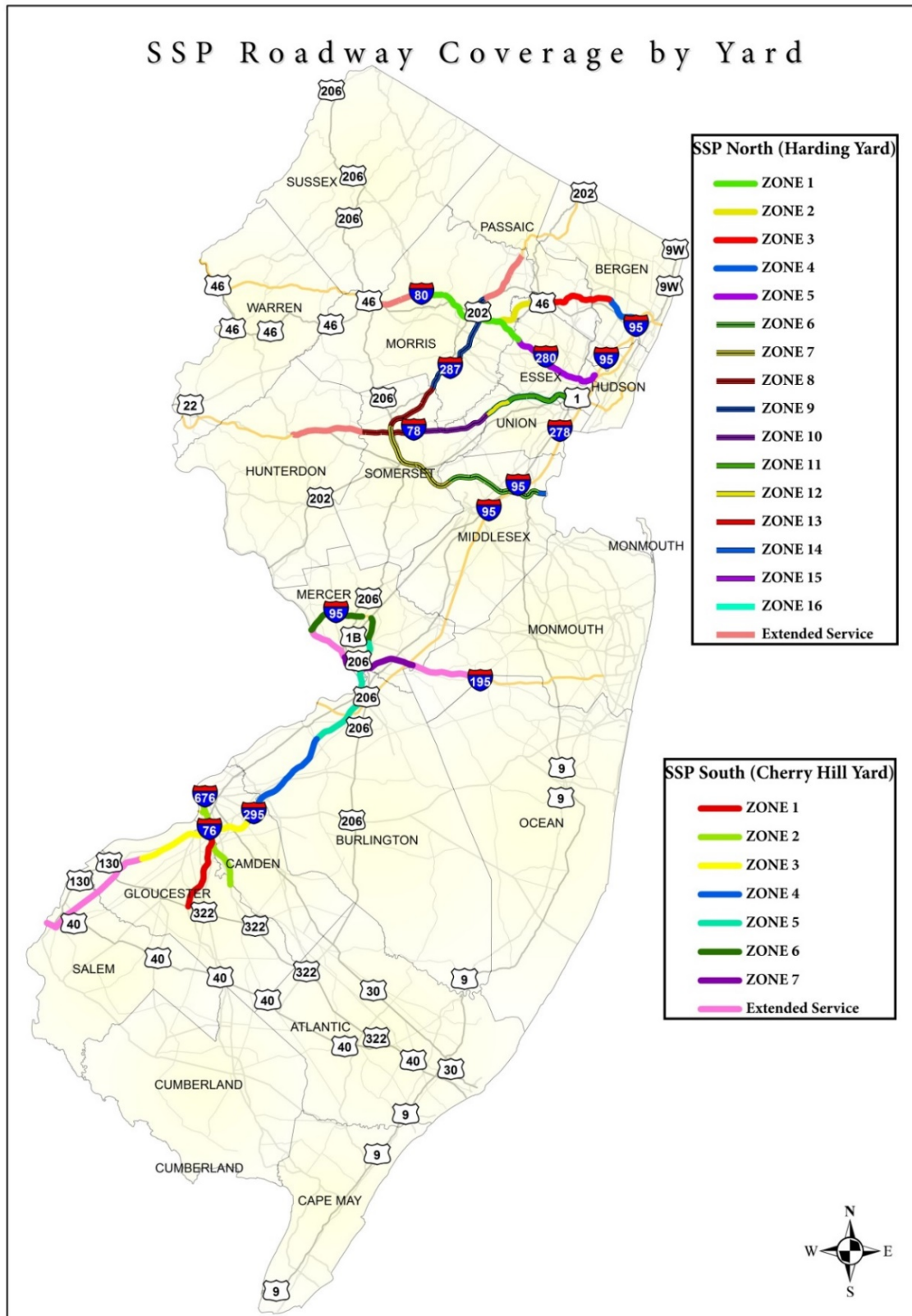


Figure 26. SSP roadway coverage by yard and zone

Table 10. SSP Zones by yard


Harding Yard

ZONE	LIMITS
1	I-80: 35.3 – 46.1 EX I-280: 0.0-exit 4
2	I-80: 42.0 – 54 Local
3	I-80: 52.0 – 63 Local
4	I-80: 61-68 Express and Local
5	I-280 4.0-17
6	NJ 440: 0-4.2 I-287: 0-9.0
7	I-287: 9.0 – 22.0
8	I-287: 22.0- 30.0 I-78: 27.1- 33.0
9	I-287: 30.0-45.0
10	I-78: 33.0-44.5
11	I-78: 48.2- 58.3 Local
12	I-78: 44.5- 58.3 Express
13	Roamer: I-80: Exit 42 to Exit 63
14	Roamer 440:0-5.2 I-287: Exit 0 to Exit 22
15	15= Roamer 280: Exit 1 to Exit 17
16	Roamer: I-78: Exit 44.5 to 58.3 Local & Express
SUPERVISION	Shift Supervisor Area: I-80 and I-280
	Shift Supervisor Area: I-78 and I-287
	Shift Supervisor Area: I-287 and I-80

Cherry Hill Yard

ZONE	LIMITS
1	NJ 55: Exit 50 to Exit 60
2	I-76: 0.0 to 2.3
	I-676: 0.0 to 3.7
	NJ 42: 6.2 to 14.3
3	I-295: Exit 16 to Exit 32
4	I-295: Exit 32 to Exit 47
5	I- 295: Exit 47 to Exit 63
6	I- 295: Exit 61 to Exit 67
	I- 95: 0.0 to Exit 8
7	NJ 29: 0.0 to 3.0
	I-195: 0.0 to Exit 7
Daily Roamer	Covers Zone 2 & 3
Roamer # 2	Covers Zone 6 & 7
	10:30 am to 8:30 pm
Roamer # 3	Covers Zone 4 & 5
	10:30 am to 12:30 pm
Roamer # 4	Covers Zone 1 & 2
	10:30 am to 12:30 pm
Roamer # 5	Covers Zone 2 & 3
	10:30 am to 12:30 pm
	Friday Only
Shift Supervisor	Zones 1, 2 & 3
Shift Supervisor	Zones 4, 5, 6 & 7
Shift Supervisor	Zones 3, 4, 5 & 6

Appendix B: iCone Products – “ITS Beacon – Hazard Light” Brochure



ITS Beacon — Hazard Lights Vehicle Hazard Light Radio Adaptation

Posts GPS location and ‘hazard light status’ to XML feeds for access by transportation departments and major navigation data services.*

Upon activation of the hazard lights:

- ♦ Transmits vehicle ID, location and ‘ON’ status.
- ♦ Status posted to XML within 2 minutes.
- ♦ Updates status every 15 minutes.
- ♦ Re-transmits location if the vehicle moves more than 500 ft.

Upon de-activation:

- ♦ Transmits location and ‘OFF’ status.
- ♦ Status posted to XML within 60 seconds.
- ♦ Periodically updates location and ‘OFF’ status.

Reporting:

- ♦ XML posting for agency data centers
- ♦ Waze reporting

Technology:

- ♦ 5-13 VDC, less than 1 Amp peak
- ♦ 4G Cellular
- ♦ GPS geolocation
- ♦ 6x4x2 inch NEMA 4 enclosure

Installation:

- ♦ Wires to 12 VDC power and flasher switch
- ♦ Internal antennas must be exposed to a sky view
- ♦ Dash-top or cab-exterior installation

*iCone Products has well established data sharing arrangements with Waze/Google and HERE.

- No training required
- No changes to operational procedures
- Three-year Data/Comm service included in purchase
- One-Year Limited Warranty

iCone Products LLC
3279 Cottrell Road
Cato, NY 13033
(315) 626-6800
www.iconeproducts.com
www.iconetraffic.com




Figure 27. iCone Products – “ITS Beacon – Hazard Light” Brochure

Appendix C: TRANSCOM Activities

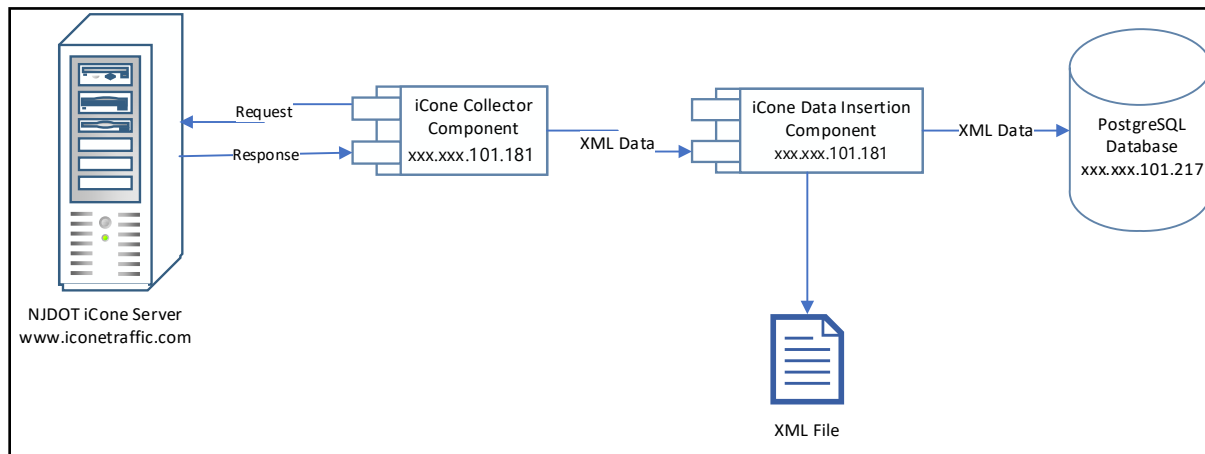
The following activities have been conducted:

- Secured data set from iCone. Reviewed sample XML feed and base documentation provided by iCone. Based on this review, the following table was developed which identifies each data element, how the element is provided and a description/definition of each element:

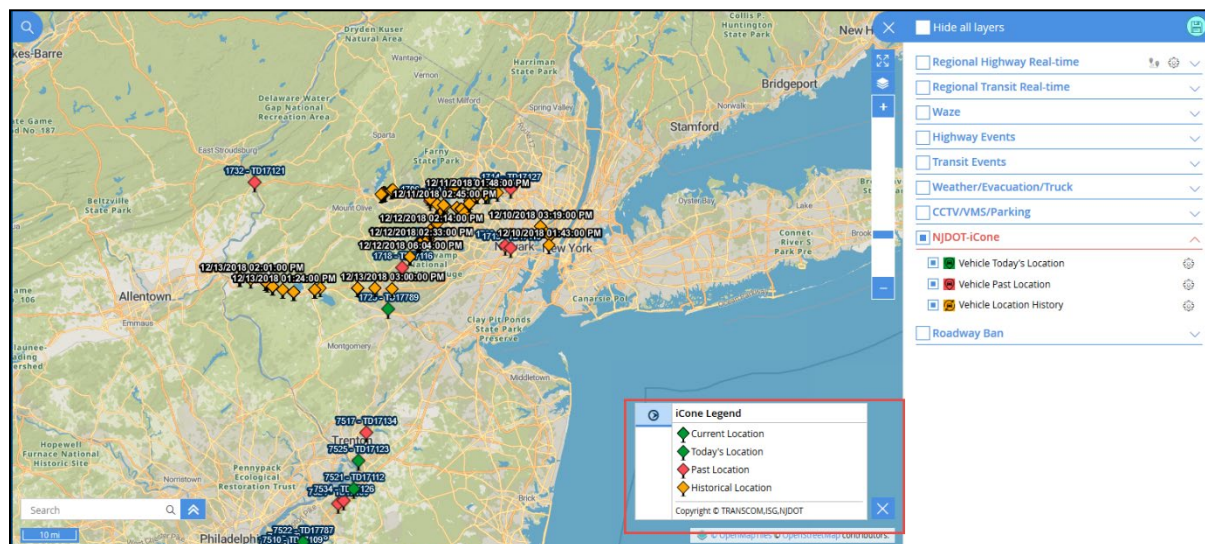
Field Name	Type	Field Description
assetid	integer	Contains the unique ID of the device as per the look up table
starttime	timestamp without time zone	The timestamp that this status was first activated
updated	timestamp without time zone	The latest timestamp that this status was confirmed
lat	numeric(12,8)	The reported latitude from the device
lon	numeric(12,8)	The reported longitude from the device
loctime	timestamp without time zone	The timestamp that the latitude / longitude was determined
arrow	integer	Master ID of arrow
beacon	boolean	Will be TRUE if it is ACTIVE else FALSE for OFF
flashers	boolean	Will be TRUE if it is ACTIVE else FALSE for OFF
geom	geometry	Contains geom of asset's location
linkid	bigint	Contains link ID on which asset's location is
pullid	bigint	Contains pull ID
pulltimestamp	timestamp without time zone	Contains pull timestamp
xmlfiletimestamp	timestamp without time zone	Contains file's path
updown	boolean	Contains TRUE if it is "Up" else FALSE for "Down"

- Secured data feed from iCone. Per review with iCone, the iCone appliance sends data via a SOAP service in XML format. TRANSCOM generated an iCone Data Interface (DI) that collects the NJDOT iCone data and stores the XML files, and then converts the content into java objects to insert the data into the TRANSCOM DFE database. This service call runs with a poll interval of two (2) minutes.

Below is a diagram of the data feed service in place to acquire the NJDOT iCone ITS Beacon data:



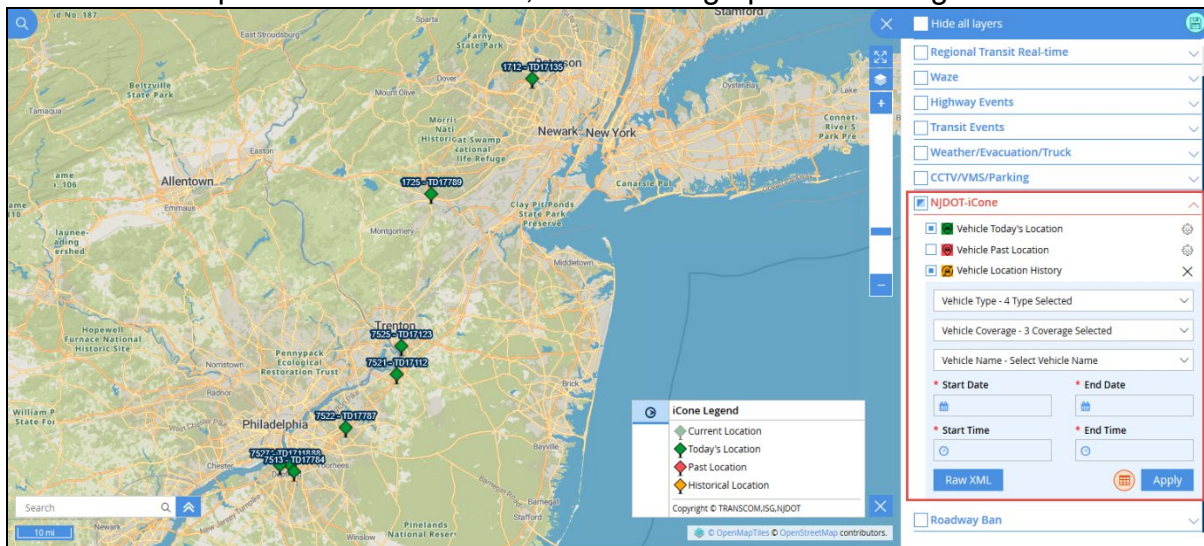
- Rendered iCone Data on SPATEL Regional Conditions Operational Map. Based upon queries established to secure data and data mappings to identify content being provided, the TRANSCOM team worked to create a visualization of the NJDOT iCone information. An example of the initial development result is presented below:



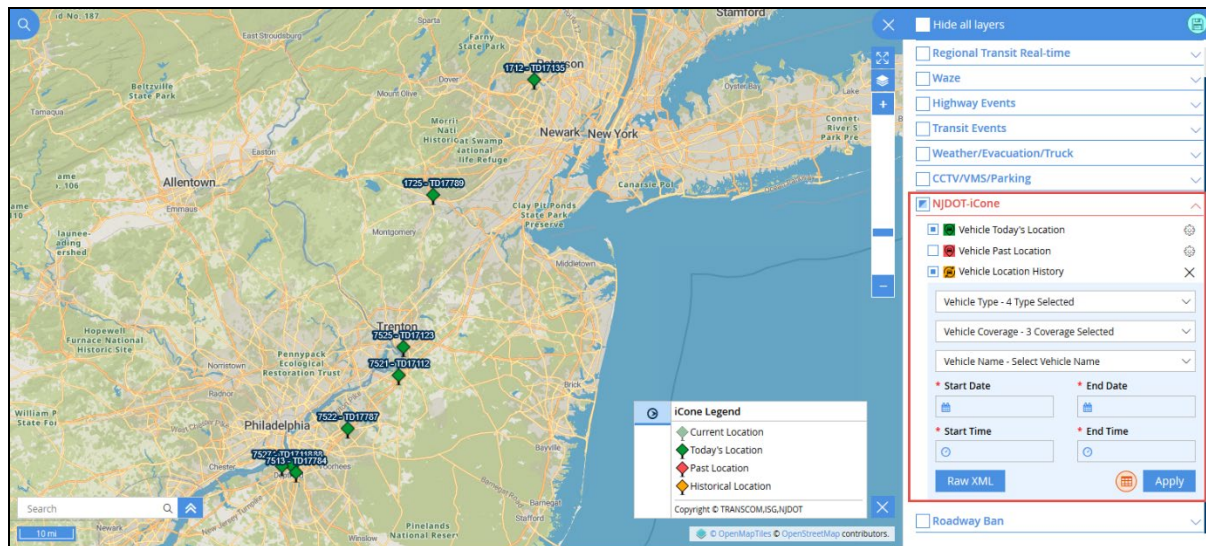
- Prototype provided to NJDOT for review in October 2018 and webinar conducted to ascertain NJDOT comments and feedback.

- Comments included:
 - Ability to filter by NJDOT SSP types:
 - Supervisor
 - Shift Supervisor
 - Operator
 - Other
 - Ability to filter by NJDOT SSP assignment location:
 - NJDOT North
 - NJDOT South
 - NJDOT Other
 - Ability to search for an individual vehicle by unit ID (e.g., 1725-TD17189)
 - Ability to pull an extended report for individual vehicle report that provides a history of Beacon Activations.

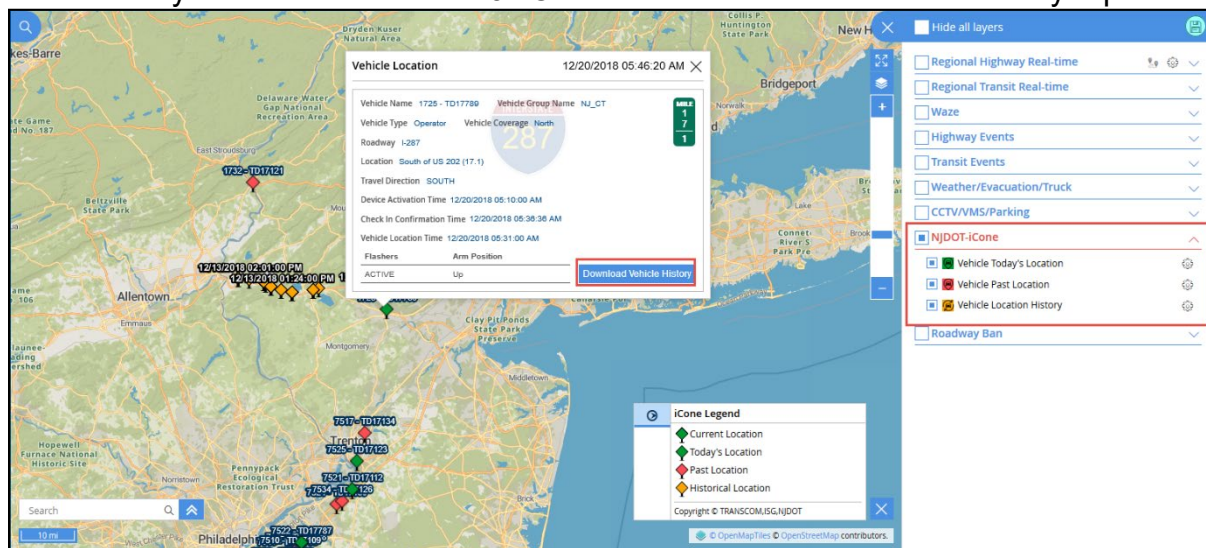
- Based upon NJDOT feedback, the following updates were generated:



- Ability to filter NJDOT SSP vehicles by type and location.



- Ability to select individual NJDOT SSP vehicle and download history report.



When the history report is selected, the user receives an Excel spreadsheet that enables them to view SSP vehicle status as reported by iCone.

Field Definition	
XML Received Time	XML Received Time
Vehicle name	Name of the vehicle
Vehicle Type	Vehicle type (Operator/Shift Supervisor/Supervisor/Other)
Vehicle Coverage	Vehicle coverage (North/South/Other)
Device activation time	The timestamp that this status was first activated (regardless of location - e.g. the flashers were turned on)
check-in confirmation time	The latest timestamp that this status was confirmed (i.e. a "check-in" message was received)
Vehicle location time	The timestamp that the lat/lon was determined
Flashers	(optional) if this asset contains a flasher, the status of the flasher ("ACTIVE" or "OFF")
Arm Position	(optional) if this asset contains an Up/Down sensor, the position of the arm ("Up" or "Down")
lat	The reported latitude from the device
lon	The reported longitude from the device

Vehicle Name	1706 - TD17138						
Vehicle Type	Shift Supervisor						
Vehicle Coverage	North						
XML Received Time	Device Activation Time	Check-In Confirmation Time	Vehicle Location Time	Flashers	Arm Position	Lat	Lon
02/25/2019 09:43:00 AM	02/25/2019 09:41:00 AM	02/25/2019 09:41:12 AM	02/25/2019 09:41:00 AM	ACTIVE	Down	40.618512	-74.6358272
02/25/2019 09:43:00 AM	02/25/2019 09:41:00 AM	02/25/2019 09:41:12 AM	02/25/2019 09:41:00 AM	ACTIVE	Down	40.618512	-74.6358272
02/25/2019 09:43:00 AM	02/25/2019 09:41:00 AM	02/25/2019 09:41:12 AM	02/25/2019 09:41:00 AM	ACTIVE	Down	40.618512	-74.6358272
02/25/2019 09:43:00 AM	02/25/2019 09:41:00 AM	02/25/2019 09:41:12 AM	02/25/2019 09:41:00 AM	ACTIVE	Down	40.618512	-74.6358272
02/25/2019 09:45:01 AM	02/25/2019 09:41:00 AM	02/25/2019 09:42:00 AM	02/25/2019 09:41:00 AM	ACTIVE	Up	40.618512	-74.6358272
02/25/2019 09:45:01 AM	02/25/2019 09:41:00 AM	02/25/2019 09:42:00 AM	02/25/2019 09:41:00 AM	ACTIVE	Up	40.618512	-74.6358272
02/25/2019 09:45:01 AM	02/25/2019 09:41:00 AM	02/25/2019 09:42:00 AM	02/25/2019 09:41:00 AM	ACTIVE	Up	40.618512	-74.6358272
02/25/2019 09:45:01 AM	02/25/2019 09:41:00 AM	02/25/2019 09:42:00 AM	02/25/2019 09:41:00 AM	ACTIVE	Up	40.618512	-74.6358272
02/25/2019 09:48:02 AM	02/25/2019 09:41:00 AM	02/25/2019 09:44:00 AM	02/25/2019 09:44:00 AM	ACTIVE	Up	40.6187616	-74.6360576
02/25/2019 09:48:02 AM	02/25/2019 09:41:00 AM	02/25/2019 09:44:00 AM	02/25/2019 09:44:00 AM	ACTIVE	Up	40.6187616	-74.6360576
02/25/2019 09:48:02 AM	02/25/2019 09:41:00 AM	02/25/2019 09:44:00 AM	02/25/2019 09:44:00 AM	ACTIVE	Up	40.6187616	-74.6360576
02/25/2019 09:48:02 AM	02/25/2019 09:41:00 AM	02/25/2019 09:44:00 AM	02/25/2019 09:44:00 AM	ACTIVE	Up	40.6187616	-74.6360576
02/25/2019 09:50:02 AM	02/25/2019 09:41:00 AM	02/25/2019 09:44:00 AM	02/25/2019 09:44:00 AM	ACTIVE	Up	40.6187616	-74.6360576
02/25/2019 09:50:02 AM	02/25/2019 09:41:00 AM	02/25/2019 09:44:00 AM	02/25/2019 09:44:00 AM	ACTIVE	Up	40.6187616	-74.6360576
02/25/2019 09:50:02 AM	02/25/2019 09:41:00 AM	02/25/2019 09:44:00 AM	02/25/2019 09:44:00 AM	ACTIVE	Up	40.6187616	-74.6360576
02/25/2019 09:50:02 AM	02/25/2019 09:41:00 AM	02/25/2019 09:44:00 AM	02/25/2019 09:44:00 AM	ACTIVE	Up	40.6187616	-74.6360576
02/25/2019 09:51:01 AM	02/25/2019 09:41:00 AM	02/25/2019 09:49:00 AM	02/25/2019 09:44:00 AM	ACTIVE	Up	40.6187616	-74.6360576
02/25/2019 09:51:01 AM	02/25/2019 09:41:00 AM	02/25/2019 09:49:00 AM	02/25/2019 09:44:00 AM	ACTIVE	Up	40.6187616	-74.6360576
02/25/2019 09:51:01 AM	02/25/2019 09:41:00 AM	02/25/2019 09:49:00 AM	02/25/2019 09:44:00 AM	ACTIVE	Up	40.6187616	-74.6360576
02/25/2019 09:51:01 AM	02/25/2019 09:41:00 AM	02/25/2019 09:49:00 AM	02/25/2019 09:44:00 AM	ACTIVE	Up	40.6187616	-74.6360576
02/25/2019 09:53:02 AM	02/25/2019 09:41:00 AM	02/25/2019 09:49:00 AM	02/25/2019 09:44:00 AM	ACTIVE	Up	40.6187616	-74.6360576
02/25/2019 09:53:02 AM	02/25/2019 09:41:00 AM	02/25/2019 09:49:00 AM	02/25/2019 09:44:00 AM	ACTIVE	Up	40.6187616	-74.6360576
02/25/2019 09:53:02 AM	02/25/2019 09:41:00 AM	02/25/2019 09:49:00 AM	02/25/2019 09:44:00 AM	ACTIVE	Up	40.6187616	-74.6360576
02/25/2019 09:53:02 AM	02/25/2019 09:41:00 AM	02/25/2019 09:49:00 AM	02/25/2019 09:44:00 AM	ACTIVE	Up	40.6187616	-74.6360576
02/25/2019 09:55:06 AM	02/25/2019 09:41:00 AM	02/25/2019 09:54:00 AM	02/25/2019 09:44:00 AM	ACTIVE	Up	40.6187616	-74.6360576
02/25/2019 09:55:06 AM	02/25/2019 09:41:00 AM	02/25/2019 09:54:00 AM	02/25/2019 09:44:00 AM	ACTIVE	Up	40.6187616	-74.6360576
02/25/2019 09:55:06 AM	02/25/2019 09:41:00 AM	02/25/2019 09:54:00 AM	02/25/2019 09:44:00 AM	ACTIVE	Up	40.6187616	-74.6360576

Appendix D: Data Sources

iCone Data Transmission Log

An XML feed of the activities of the iCone devices was provided to NJIT. The feed contains time and location information of the iCone device as shown in Table 11.

Per review with iCone, the iCone appliance sends data via a SOAP service in XML format. TRANSCOM generated an iCone Data Interface (DI) that collects the NJDOT iCone data and stores the XML files and then converts the content into java objects to insert the data into the TRANSCOM DFE database. This service call runs with a poll interval of two (2) minutes.

The iCone device activity database of these records is stored and managed by NJIT. Specifically, the feed provides the following:

- ▶ ID: Record, Device, Truck, Group
- ▶ Device Name
- ▶ Group Name
- ▶ Time: Start, Update, Local
- ▶ Location: Latitude, Longitude
- ▶ Flasher: ON/OFF
- ▶ Sign Board: Up/Down

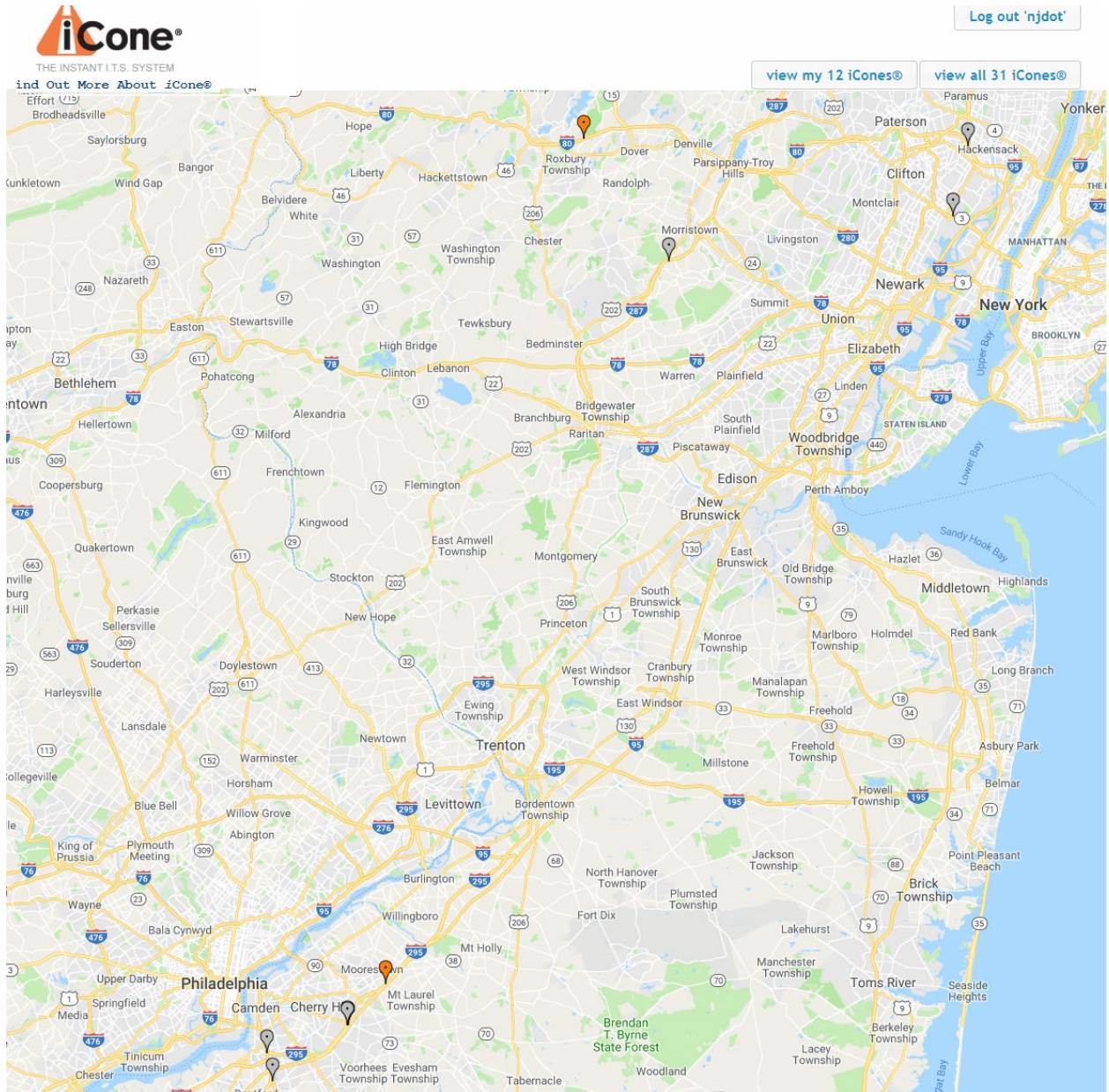


Figure 28. iCone Live Map Interface

Table 11. iCone Device Activity Log

Record ID	DEVICE ID	DEVICE NAME	TRUCK ID	GRP_ID	GRP_NAME	START DATE TIME	UPDATE TIME	LAT	LNG	LOC TIME	FLASHER	UPDOWN
95-1720	13631562	1720 - TD17133	1720 117	NJ_CT		1/2/2019 10:04:00 AM	1/2/2019 10:25:00 AM	40.7608256	-74.5116864	1/2/2019 10:01:00 AM	OFF	Up
96-1720	13631562	1720 - TD17133	1720 117	NJ_CT		1/2/2019 10:04:00 AM	1/2/2019 10:25:00 AM	40.7607808	-74.5117504	1/2/2019 10:06:00 AM	OFF	Up
97-1720	13631562	1720 - TD17133	1720 117	NJ_CT		1/2/2019 10:04:00 AM	1/2/2019 10:25:00 AM	40.7608	-74.511712	1/2/2019 10:25:00 AM	OFF	Up
98-1720	13631562	1720 - TD17133	1720 117	NJ_CT		1/2/2019 11:01:00 AM	1/2/2019 11:01:03 AM	40.8959424	-74.2566912	1/2/2019 10:49:00 AM	OFF	Up
99-1720	13631562	1720 - TD17133	1720 117	NJ_CT		1/2/2019 11:16:00 AM	1/2/2019 11:16:03 AM	40.8103488	-74.0841536	1/2/2019 11:03:00 AM	OFF	Up
73-1718	13631524	1718 - TD17116	1718 117	NJ_CT		1/2/2019 2:54:00 PM	1/2/2019 2:54:00 PM	40.8299232	-74.3173568	1/2/2019 2:41:00 PM	OFF	Up
101-1720	13631562	1720 - TD17133	1720 117	NJ_CT		1/2/2019 4:16:00 PM	1/2/2019 4:22:00 PM	40.74888	-74.13488	1/2/2019 4:04:00 PM	OFF	Up
74-1718	13631524	1718 - TD17116	1718 117	NJ_CT		1/2/2019 4:24:00 PM	1/2/2019 4:24:04 PM	40.8979584	-74.2290176	1/2/2019 4:15:00 PM	OFF	Up
75-1718	13631524	1718 - TD17116	1718 117	NJ_CT		1/2/2019 4:24:00 PM	1/2/2019 4:28:00 PM	40.8979584	-74.2290176	1/2/2019 4:15:00 PM	OFF	Down
100-1720	13631562	1720 - TD17133	1720 117	NJ_CT		1/2/2019 4:16:00 PM	1/2/2019 4:22:00 PM	40.7424608	-74.1525824	1/2/2019 4:17:00 PM	OFF	Up
102-1720	13631562	1720 - TD17133	1720 117	NJ_CT		1/2/2019 4:47:00 PM	1/2/2019 4:47:00 PM	40.7424512	-74.1536384	1/2/2019 4:27:00 PM	OFF	Down
103-1720	13631562	1720 - TD17133	1720 117	NJ_CT		1/2/2019 5:21:00 PM	1/2/2019 5:21:05 PM	40.7971296	-74.2623296	1/2/2019 5:09:00 PM	OFF	Up
104-1720	13631562	1720 - TD17133	1720 117	NJ_CT		1/2/2019 6:32:04 PM	1/2/2019 6:48:00 PM	40.7667968	-74.2259648	1/2/2019 6:25:00 PM	OFF	Up
105-1720	13631562	1720 - TD17133	1720 117	NJ_CT		1/2/2019 6:32:04 PM	1/2/2019 6:48:00 PM	40.7555584	-74.1991168	1/2/2019 6:33:00 PM	OFF	Up
106-1720	13631562	1720 - TD17133	1720 117	NJ_CT		1/2/2019 8:29:00 PM	1/2/2019 8:31:00 PM	40.89776	-74.2479808	1/2/2019 8:12:00 PM	OFF	Up
107-1720	13631562	1720 - TD17133	1720 117	NJ_CT		1/2/2019 8:29:00 PM	1/2/2019 8:31:00 PM	40.9085344	-74.1821696	1/2/2019 8:31:00 PM	OFF	Up
108-1720	13631562	1720 - TD17133	1720 117	NJ_CT		1/2/2019 8:37:00 PM	1/2/2019 8:37:00 PM	40.9052992	-74.1605312	1/2/2019 8:37:00 PM	OFF	Down
110-1720	13631562	1720 - TD17133	1720 117	NJ_CT		1/2/2019 9:01:05 PM	1/2/2019 9:02:00 PM	40.8761632	-74.0622272	1/2/2019 8:57:00 PM	OFF	Up
109-1720	13631562	1720 - TD17133	1720 117	NJ_CT		1/2/2019 9:01:05 PM	1/2/2019 9:02:00 PM	40.9035648	-74.0967168	1/2/2019 9:02:00 PM	OFF	Up
111-1720	13631562	1720 - TD17133	1720 117	NJ_CT		1/2/2019 9:12:00 PM	1/2/2019 9:13:00 PM	40.9014752	-74.1393728	1/2/2019 9:09:00 PM	OFF	Up
112-1720	13631562	1720 - TD17133	1720 117	NJ_CT		1/2/2019 9:12:00 PM	1/2/2019 9:13:00 PM	40.9015392	-74.1393344	1/2/2019 9:13:00 PM	OFF	Up
113-1720	13631562	1720 - TD17133	1720 117	NJ_CT		1/2/2019 10:50:00 PM	1/2/2019 10:50:00 PM	40.8913152	-74.073152	1/2/2019 10:00:00 PM	OFF	Up
114-1720	13631562	1720 - TD17133	1720 117	NJ_CT		1/3/2019 12:33:00 AM	1/3/2019 12:33:00 AM	40.7607904	-74.5117504	1/3/2019 12:33:00 AM	OFF	Down

Safety Service Patrol Radio Log

The Safety Service Patrol radio log is entered and maintained by CDU. The information about the Safety Service Patrol driver activity is recorded by the dispatch. The Safety Service Patrol radio log records are entered manually via a physical communication between the SSP operator and dispatch rather than electronic input. The logs contain information that includes:

- ▶ Record Number
- ▶ Date of Incident
- ▶ Time Call Reported
- ▶ Called Us/We Called
- ▶ ID Number
- ▶ Dispatcher
- ▶ Reason for Call
- ▶ Description of call
- ▶ Aid number

Record Number	Date of Incident	Time Call Reported	Called Us/We Called	ID Number	Dispatcher	Reason for Call	Description of call
1125840	1/2/2019	11:03:00 AM	Called Us	1720	M LOWE	Disabled	3 EAST 7.2 BLACK HON NJ N96DVZ
1125919	1/2/2019	2:56:00 PM	Called Us	1720	J HENNESSEY	Disabled	280 WEST 8.4
1125921	1/2/2019	2:58:00 PM	Called Us	1720	J HENNESSEY	Disabled	280 WEST 8.4 GRAY FORD NJ C53JSY
1125941	1/2/2019	4:17:00 PM	Called Us	1720	J HENNESSEY	Disabled	280 WEST 15.2 BLUE HONDA
1125966	1/2/2019	5:22:00 PM	Called Us	1720	J HENNESSEY	MVA	280 EAST X14 SILVER HYUNDAI NJ YDM89N
1125981	1/2/2019	6:33:00 PM	Called Us	1720	J HENNESSEY	Disabled	280 WEST 12.6 WHITE VAN
1126006	1/2/2019	8:31:00 PM	Called Us	1720	J HENNESSEY	Disabled	80 EAST 57.8
1126014	1/2/2019	9:02:00 PM	Called Us	1720	J HENNESSEY	Disabled	80 WEST X62 RED FORD VA CNSTNTQ
1126016	1/2/2019	9:11:00 PM	Called Us	1720	J HENNESSEY	Disabled	80 WEST 60.2 BLACK BUICK NJ J65KGG
1126026	1/2/2019	10:49:00 PM	Called Us	1720	J HENNESSEY	Disabled	80 WEST 52.8 RED TOY PA KNN5960
1126185	1/3/2019	11:21:00 AM	Called Us	1720	J DOHERTY	Disabled	3 EAST 9.6 WHITE CHY NY DAA4059
1126263	1/3/2019	3:13:00 PM	Called Us	1720	M BOCZKOWSKI	Debris	78 WEST loc exit 52
1126297	1/3/2019	5:00:00 PM	Called Us	1720	J HENNESSEY	Disabled	78 EAST 45.5 RED FORD NJ
1126299	1/3/2019	5:08:00 PM	Called Us	1720	J HENNESSEY	Disabled	78 EAST LOC 51.2 WHITE
1126306	1/3/2019	5:26:00 PM	Called Us	1720	J HENNESSEY	Disabled	78 EAST 52 SILVER KIA NJ L46HYM
1126751	1/5/2019	2:30:00 PM	Called Us	1720	J MAFFEI	MVA	287 SOUTH x37
1126785	1/5/2019	3:41:00 PM	Called Us	1720	J MAFFEI	Disabled	287 SOUTH 41.9 BLACK CADDY PA GJX3853
1126801	1/5/2019	4:39:00 PM	Called Us	1720	S SIMMONS	MVA	287 x37
1126806	1/5/2019	5:01:00 PM	Called Us	1720	S WERENSLEY	MVA	287 NORTH 41B BLUE TOYOTA PRUS NY HUW5531
1126936	1/6/2019	12:26:00 PM	Called Us	1720	D CASTELLANO	Debris	78 WEST 36.4

Figure 29. SSP Radio Log Sample

The radio log field ‘Reason for Call’ informs dispatch of multiple drivers’ activities. These include:

- ▶ On Air
- ▶ Off Air
- ▶ On Location
- ▶ Debris
- ▶ Disabled
- ▶ Abandoned
- ▶ MVA
- ▶ Assistance
- ▶ Other
- ▶ Disregard
- ▶ Unable to Locate
- ▶ Enroute
- ▶ Clear
- ▶ Pedestrian
- ▶ Break
- ▶ Lunch
- ▶ Stepping Out
- ▶ Stuck in Mud/Snow
- ▶ Truck Repair
- ▶ Duplicate Call

Waze

Waze is a navigation application that provides users with real-time traffic and roadway information. Information within the application is usually provided by the users themselves alerting other users of roadway activity. ICone has partnered with WAZE to push iCone notifications directly to the application of. An example of this notification is shown below in Figure 22, as its mobile interface and in Figure 23, as its web-based interface.



Figure 30. Waze Mobile Application

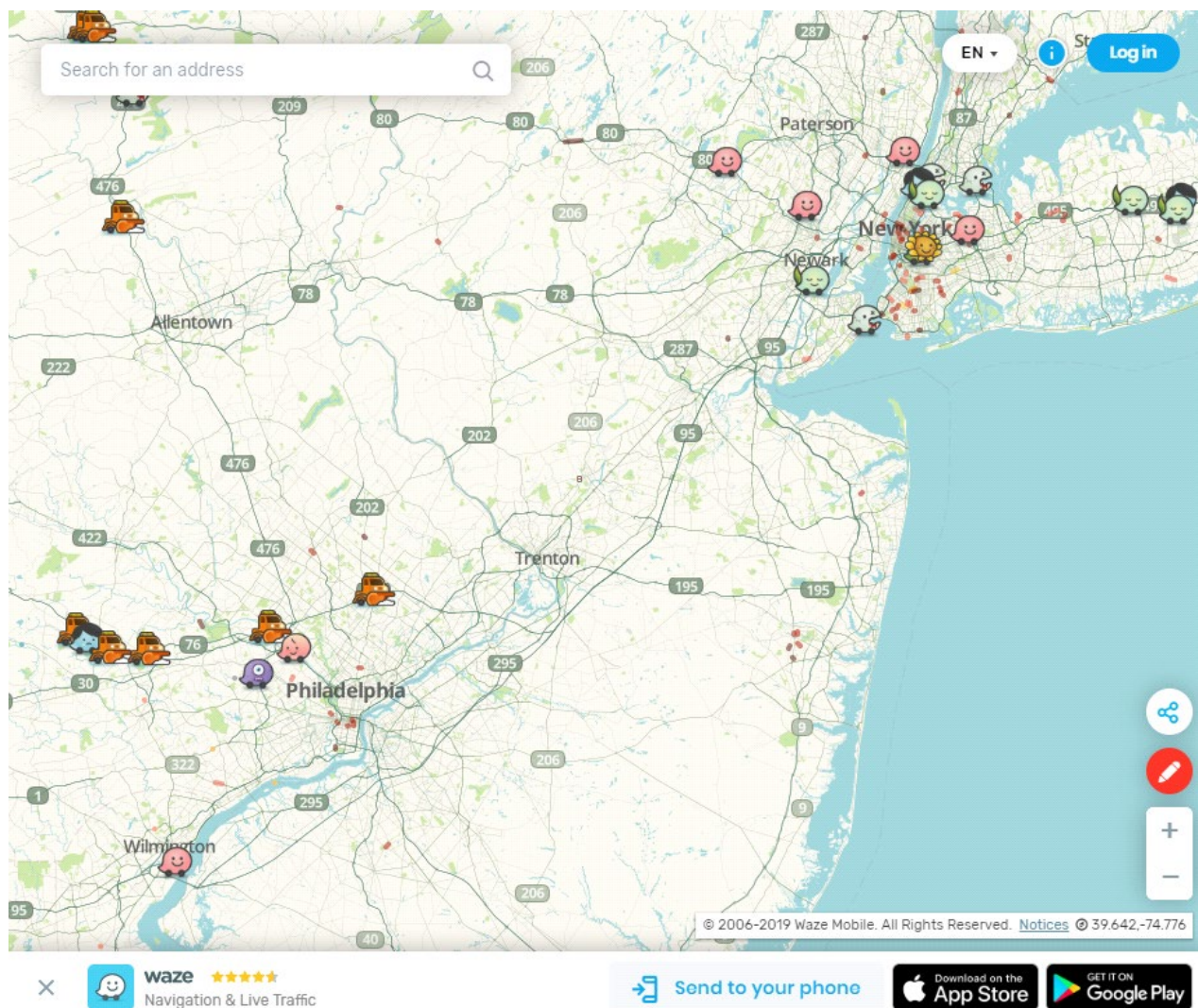


Figure 31. Waze Web Interface

NJDOT/NJIT Data Table that Identifies Location and Time of iCone and Waze Notifications

Table 12. iCone, Waze Data Capture & Evaluation Log

Date	Road	MM	DMS Active	iCone Alert	iCone Report	Waze Alert	Waze Report	Delay Alert, DMS-Active vs. Waze	Delay - Alert, iCone vs. Waze
8/9/19	42	2	11:02	11:04	11:02	-	-	-	-
8/9/19	42	4	11:03	11:06	11:03	-	-	-	-
8/9/19	42	6	11:11	11:14	11:11	-	-	-	-

Date	Road	MM	DMS Active	iCone Alert	iCone Report	Waze Alert	Waze Report	Delay Alert, DMS-Active vs. Waze	Delay - Alert, iCone vs. Waze
8/9/19	42	8	11:12	11:15	11:12	-	-	-	-
8/9/19	42	10	11:25	11:28	11:25	-	-	-	-
8/9/19	42	12	11:27	11:30	11:27	-	-	-	-
8/9/19	42	14	11:34	11:37	11:34	-	-	-	-
8/9/19	76	0	11:36	11:39	11:36	-	-	-	-
8/9/19	76	2	11:40	11:43	11:40	-	-	-	-
8/9/19	676	1	11:47	11:50	11:47	-	-	-	-
8/9/19	676	3	11:54	11:57	11:54	-	-	-	-
8/15/19	29	1	12:40	-	-	-	-	-	-
8/15/19	29	3	12:34	12:34	12:34	12:35	12:34	0:01	0:01
8/15/19	195	6	13:36	13:39	13:36	13:40	13:36	0:04	0:01
8/15/19	195	8	13:42	13:44	13:42	13:46	13:42	0:04	0:02
8/15/19	195	10	13:49	13:50	13:49	13:51	13:49	0:02	0:01
8/15/19	195	12	13:53	13:54	13:53	13:55	13:53	0:02	0:01
8/15/19	195	14	13:58	13:59	13:58	14:01	13:58	0:03	0:02
8/15/19	295	37	10:38	10:41	10:38	-	-	-	-
8/15/19	295	39	10:44	10:45	10:44	-	-	-	-
8/15/19	295	41	10:50	10:52	10:50	10:53	10:49	0:03	0:01
8/15/19	295	43	10:59	11:01	10:59	-	-	-	-
8/15/19	295	45	11:09	-	-	-	-	-	-
8/15/19	295	47	11:14	11:14	11:14	11:14	11:13	-	0:00
8/15/19	295	49	11:17	11:18	11:17	11:18	11:17	0:01	0:00
8/15/19	295	51	11:21	11:22	11:21	11:22	11:21	0:01	0:00
8/15/19	295	53	11:31	11:33	11:31	11:34	11:31	0:03	0:01
8/15/19	295	55	11:37	11:38	11:37	11:38	11:37	0:01	0:00
8/15/19	295	57	11:43	11:45	11:43	11:46	11:41	0:03	0:01
8/15/19	295	59	11:50	11:52	11:50	11:52	11:50	0:02	0:00
8/15/19	295	61	11:59	12:01	11:59	12:01	11:59	0:02	0:00

Date	Road	MM	DMS Active	iCone Alert	iCone Report	Waze Alert	Waze Report	Delay Alert, DMS-Active vs. Waze	Delay - Alert, iCone vs. Waze
8/15/19	295	63	12:04	12:05	12:04	12:07	12:05	0:03	0:02
8/15/19	295	65	12:11	12:13	12:11	12:13	12:10	0:02	0:00
8/15/19	295	67	12:16	12:17	12:16	12:17	12:16	0:01	0:00
8/15/19	295	69	12:22	12:22	12:22	12:23	12:21	0:01	0:01
8/15/19	Yard	Yard	10:18	10:19	10:18	10:21	10:18	0:03	0:02
8/19/19	42	4	11:20	11:20	11:20	11:22	11:19	0:02	0:02
8/19/19	42	6	11:12	11:13	11:12	11:15	11:13	0:03	0:02
8/19/19	42	8	11:08	11:08	11:08	11:10	11:08	0:02	0:02
8/19/19	42	10	11:02	11:03	11:02	-	-	-	-
8/19/19	42	12	10:57	10:58	10:57	11:00	10:57	0:03	0:02
8/19/19	55	20	14:07	14:10	14:07	14:10	14:07	0:03	0:00
8/19/19	55	22	14:02	14:02	14:02	14:03	14:02	0:01	0:01
8/19/19	55	24	13:56	13:56	13:56	13:59	13:56	0:03	0:03
8/19/19	55	26	13:51	13:52	13:51	13:53	13:51	0:02	0:01
8/19/19	55	28	13:46	13:47	13:46	13:48	13:46	0:02	0:01
8/19/19	55	30	13:42	13:43	13:42	13:43	13:42	0:01	0:00
8/19/19	55	32	13:38	13:38	13:38	13:40	13:39	0:02	0:02
8/19/19	55	34	13:33	13:34	13:33	13:35	13:33	0:02	0:01
8/19/19	55	36	13:30	13:30	13:30	13:31	13:30	0:01	0:01
8/19/19	55	38	13:26	13:26	13:26	13:27	13:26	0:01	0:01
8/19/19	55	40	13:21	13:22	13:21	13:23	13:21	0:02	0:01
8/19/19	55	42	13:17	13:18	13:17	13:19	13:17	0:02	0:01
8/19/19	55	44	13:13	13:14	13:13	13:15	13:13	0:02	0:01
8/19/19	55	46	13:09	13:10	13:09	13:11	13:09	0:02	0:01
8/19/19	55	48	13:03	13:04	13:03	13:07	13:03	0:04	0:03
8/19/19	55	50	12:52	12:53	12:52	12:53	12:52	0:01	0:00
8/19/19	55	52	14:43	14:44	14:43	14:48	14:43	0:05	0:04
8/19/19	55	54	14:50	14:51	14:50	14:53	14:50	0:03	0:02

Date	Road	MM	DMS Active	iCone Alert	iCone Report	Waze Alert	Waze Report	Delay Alert, DMS-Active vs. Waze	Delay - Alert, iCone vs. Waze
8/19/19	55	56	14:56	14:57	14:56	14:57	14:56	0:01	0:00
8/19/19	55	58	15:00	15:01	15:00	15:04	15:00	0:04	0:03
8/19/19	55	60	11:58	11:59	11:58	12:01	11:57	0:03	0:02
8/19/19	76	0	11:32	11:33	11:32	11:34	11:32	0:02	0:01
8/19/19	76	2	11:36	11:37	11:36	11:38	11:36	0:02	0:01
8/19/19	295	28	10:53	10:53	10:53	10:54	10:52	0:01	0:01
8/19/19	295	30	10:48	10:49	10:48	10:50	10:47	0:02	0:01
8/19/19	295	32	10:42	10:43	10:42	10:44	10:42	0:02	0:01
8/19/19	295	34	10:38	10:39	10:38	10:39	10:38	0:01	0:00
8/19/19	676	0	11:40	11:41	11:40	11:42	11:40	0:02	0:01
8/19/19	676	2	11:44	11:45	11:44	11:46	11:44	0:02	0:01
8/19/19	Yard	Yard	10:21	10:23	10:21	10:25	10:21	0:04	0:02
8/27/19	78	25	11:35	11:37	11:35	11:37	11:35	0:02	0:00
8/27/19	78	27	11:42	11:43	11:42	11:45	11:42	0:03	0:02
8/27/19	78	29	11:47	11:48	11:47	11:50	11:47	0:03	0:02
8/27/19	78	31	14:55	14:55	14:55	14:57	14:52	0:02	0:02
8/27/19	78	32	14:53	14:55	14:51	14:57	14:51	0:04	0:02
8/27/19	78	34	14:59	15:00	14:57	15:01	14:57	0:02	0:01
8/27/19	78	36	15:03	15:05	15:02	15:05	15:02	0:02	0:00
8/27/19	78	38	15:08	15:11	15:06	15:11	15:06	0:03	0:00
8/27/19	78	40	15:14	15:16	15:12	15:18	15:12	0:04	0:02
8/27/19	78	44	15:29	15:28	15:27	15:29	15:27	0:00	0:01
8/27/19	78	46	15:32	15:35	15:30	15:37	15:30	0:05	0:02
8/27/19	78	48	15:39	15:41	15:37	15:43	15:37	0:04	0:02
8/27/19	78	50	15:46	15:46	15:44	15:49	15:44	0:03	0:03
8/27/19	78	52	16:09	16:12	16:07	16:14	16:07	0:05	0:02
8/27/19	78	54	16:17	16:23	16:15	16:24	16:15	0:07	0:01
8/27/19	78	56	16:26	16:28	16:24	16:32	16:24	0:06	0:04

Date	Road	MM	DMS Active	iCone Alert	iCone Report	Waze Alert	Waze Report	Delay Alert, DMS-Active vs. Waze	Delay - Alert, iCone vs. Waze
8/27/19	78	58	16:34	16:35	16:34	16:38	-	0:04	0:03
8/27/19	287	0	14:06	14:06	14:04	14:07	14:05	0:01	0:01
8/27/19	287	2	13:38	-	-	-	-	-	-
8/27/19	287	4	13:28	13:29	13:27	13:33	13:27	0:05	0:04
8/27/19	287	6	13:23	13:24	13:22	13:24	13:22	0:01	0:00
8/27/19	287	8	13:20	13:20	13:18	13:21	13:18	0:01	0:01
8/27/19	287	10	13:14	13:14	13:12	13:17	13:12	0:03	0:03
8/27/19	287	12	12:22	12:22	12:19	12:23	12:19	0:01	0:01
8/27/19	287	14	12:15	12:16	12:13	12:19	12:13	0:04	0:03
8/27/19	287	16	12:08	12:09	12:06	12:12	12:06	0:04	0:03
8/27/19	287	18	12:01	12:03	11:59	12:04	11:59	0:03	0:01
8/27/19	287	20	11:54	11:56	11:52	11:57	11:52	0:03	0:01
8/27/19	440	2	14:10	14:11	14:09	14:14	14:09	0:04	0:03
8/27/19	440	4	14:17	14:18	14:15	14:22	14:15	0:05	0:04
8/27/19	Yard	Yard	10:35	10:37	10:35	10:40	10:35	0:05	0:03
8/28/19	80	28	12:37	12:37	12:37	12:40	12:36	0:03	0:03
8/28/19	80	30	12:42	12:43	12:42	12:45	12:42	0:03	0:02
8/28/19	80	32	12:48	12:48	12:48	12:51	12:48	0:03	0:03
8/28/19	80	34	12:55	12:56	12:55	12:58	12:56	0:03	0:02
8/28/19	80	36	13:00	13:01	13:00	13:03	13:00	0:03	0:02
8/28/19	80	38	13:06	13:06	13:06	13:08	13:06	0:02	0:02
8/28/19	80	40	13:13	13:14	13:13	13:16	13:12	0:03	0:02
8/28/19	80	42	13:20	13:20	13:20	13:21	13:20	0:01	0:01
8/28/19	80	44	13:25	13:26	13:25	13:27	13:25	0:02	0:01
8/28/19	80	46	14:13	14:14	14:13	14:15	14:13	0:02	0:01
8/28/19	80	48	14:19	14:20	14:19	14:22	14:17	0:03	0:02
8/28/19	80	50	14:24	14:25	14:24	-	-	-	-
8/28/19	80	52	14:33	14:33	14:33	-	-	-	-

Date	Road	MM	DMS Active	iCone Alert	iCone Report	Waze Alert	Waze Report	Delay Alert, DMS-Active vs. Waze	Delay - Alert, iCone vs. Waze
8/28/19	80	54	14:40	-	-	-	-	-	-
8/28/19	80	56	14:48	-	-	-	-	-	-
8/28/19	80	60	15:29	15:29	15:29	-	-	-	-
8/28/19	80	62	15:37	15:37	15:37	-	-	-	-
8/28/19	80	64	15:45	15:45	15:45	-	-	-	-
8/28/19	80	66	13:56	13:56	13:56	-	-	-	-
8/28/19	80	68	14:03	14:04	14:03	-	-	-	-
8/28/19	280	2	17:33	17:33	17:33	-	-	-	-
8/28/19	280	4	17:42	17:42	17:42	-	-	-	-
8/28/19	280	6	17:52	17:53	17:52	-	-	-	-
8/28/19	280	8	17:58	17:58	17:58	-	-	-	-
8/28/19	280	10	18:03	18:04	18:03	-	-	-	-
8/28/19	280	12	18:10	18:11	18:10	-	-	-	-
8/28/19	280	15	18:29	18:30	18:29	-	-	-	-
8/28/19	280	17	18:34	18:34	18:34	-	-	-	-
8/28/19	287	33	10:33	10:34	10:33	10:36	10:33	0:03	0:02
8/28/19	287	35	10:38	10:39	10:38	10:41	10:38	0:03	0:02
8/28/19	287	37	10:43	10:43	10:41	10:46	10:41	0:03	0:03
8/28/19	287	39	10:49	10:49	10:47	10:52	10:47	0:03	0:03
8/28/19	287	41	10:54	10:54	10:52	10:56	10:52	0:02	0:02
8/28/19	287	42	15:22	15:22	15:19	15:24	15:19	0:02	0:02
8/28/19	287	43	10:59	10:59	10:57	11:03	10:57	0:04	0:04
8/28/19	287	45	11:06	11:04	11:05	11:09	11:05	0:03	0:05
8/28/19	287	47	11:13	11:13	11:13	11:17	11:13	0:04	0:04
8/28/19	287	49	11:20	11:22	11:20	11:22	11:20	0:02	0:00
8/28/19	287	51	11:25	11:25	11:25	11:29	11:25	0:04	0:04
8/28/19	287	53	11:32	11:33	11:32	11:35	11:31	0:03	0:02
8/28/19	Yard	Yard	10:12	10:13	10:12	10:16	10:12	0:04	0:03

Table 13. iCone Observation Log

Test Date	Day	Location	County	City	iCone Notification Time	Waze Notification Time	Delay (min)	Device Name	Device inactive	SSP Jurisdiction
03-06	Wed	I-295	Mercer	Ewing	11:50 AM	12:48 PM	-0:02	7510 - TD17109	N	South
03-06	Wed	I-295	Mercer	Ewing	12:53 PM	-	-	7510 - TD17109	N	South
03-06	Wed	NJ-42	Camden	Cherry Hill	01:52 PM	01:55 PM	0:03	7515 - TD17128	N	South
03-06	Wed	I-295	Mercer	Hamilton Twp.	04:19 PM	04:27 PM	0:08	7510 - TD17109	N	South
03-06	Wed	I-295	Mercer	Hamilton Twp.	04:40 PM	04:44 PM	0:04	7510 - TD17109	N	South
03-06	Wed	I-295	Mercer	Hamilton Twp.	04:55 PM	04:55 PM	0:00	7514 - TD17788	N	South
03-06	Wed	I-295	Burlington	Florence Twp..	05:24 PM	05:26 PM	0:02	7510 - TD17109	N	South
03-06	Wed	I-295	Camden	Cherry Hill	05:24 PM	05:27 PM	0:03	7522 - TD17787	N	South
03-06	Wed	I-287	Morris	Harding	05:29 PM	05:35 PM	0:06	1725 - TD17789	N	North
03-07	Thu	I-295	Mercer	Hamilton Twp.	01:34 PM	01:36 PM	0:02	7512 - TD17114	N	South
03-07	Thu	I-295	Mercer	Hamilton Twp.	04:08 PM	04:12 PM	0:04	7533 - TD17129	N	South
03-07	Thu	I-195	Mercer	Robbinsville	04:32 PM	04:45 PM	0:13	7515 - TD17128	N	South
03-08	Fri	I-287	Morris	Harding	12:35 PM	-	-	1725 - TD17789	N	North
03-08	Fri	I-80	Morris	Montville	12:58 PM	01:04 PM	0:06	1719 - TD17110	N	North
03-08	Fri	NJ-3	Bergen	Lyndhurst	01:18 PM	-	-	1713 - TD17113	N	North
03-08	Fri	NJ-3	Bergen	Lyndhurst	01:39 PM	-	-	1714 - TD17127	N	North
03-08	Fri	I-287	Morris	Parsippany	01:22 PM	01:29 PM	0:07	1718 - TD17116	N	North
03-08	Fri	I-295	Camden	Bellmawr	10:52 AM	10:53 AM	0:01	7514 - TD17788	N	South

Test Date	Day	Location	County	City	iCone Notification Time	Waze Notification Time	Delay (min)	Device Name	Device inactive	SSP Jurisdiction
03-08	Fri	I-287	Morris	Cedar Knolls	10:03 AM	-	-	1725 - TD17789	N	North
03-08	Fri	I-295	Mercer	Hamilton Twp.	11:20 AM	-	-	7521 - TD17112	N	South
03-08	Fri	I-295	Gloucester	Paulsboro	11:33 AM	11:35 AM	0:02	7510 - TD17109	N	South
03-08	Fri	I-80	Essex	Fairfield	01:01 PM	01:04 PM	0:03	1719 - TD17110	N	North
03-09	Sat	I-287	Morris	Harding	10:58 AM	-	-	1720 - TD17133	N	North
03-09	Sat	I-287	Morris	Harding	11:01 AM	11:01 AM	0:00	1722 - TD17122	N	North
03-09	Sat	I-80	Union	Totowa	03:23 PM	-	-	1712 - TD17135	N	North
03-09	Sat	I-78	Union	Watchung	03:36 PM	03:39 PM	0:03	1709 - TD17783	N	North
03-11	Mon	I-195	Monmouth	Allentown	10:37 AM	10:46 AM	0:09	7515 - TD17128	N	South
03-11	Mon	I-287	Morris	Morristown	11:14 AM	-	-	1725 - TD17789	N	North
03-11	Mon	NJ-55	Gloucester	Sewell	11:28 AM	-	-	7512 - TD17114	N	South
03-12	Tue	I-287	Morris	Harding	06:32 PM	06:34 PM	0:02	1716 - TD17138	N	North
03-18	Mon	I-280	Essex	Newark	07:19 AM	-	-	1725 - TD17789	N	North
03-18	Mon	I-676	Camden	Camden	11:20 AM	11:21 AM	0:01	7530 - TD17132	N	South
03-18	Mon	I-295	Camden	Bellmawr	11:32 AM	11:33 AM	0:01	7515 - TD17128	N	South
03-18	Mon	I-295	Camden	Bellmawr	11:30 AM	-	-	7517 - TD17134	N	South
03-18	Mon	NJ-55	Gloucester	Franklin	05:55 AM	-	-	7518 - TD17786	N	South
04-18	Thu	I-287	Morris	Harding	12:39 PM	12:41 PM	0:02	1716 - TD17138	N	North
04-18	Thu	I-287	Morris	Harding	12:44 PM	12:48 PM	0:04	1719 - TD17110	N	North
04-18	Thu	I-80	Essex	Lodi	12:49 PM	12:50 PM	0:01	1725 - TD17789	N	North

Test Date	Day	Location	County	City	iCone Notification Time	Waze Notification Time	Delay (min)	Device Name	Device inactive	SSP Jurisdiction
04-18	Thu	I-78	Morris	Madison	12:56 PM	12:57 PM	0:01	1722 - TD17122	N	North
04-18	Thu	I-287	Morris	Harding	04:01 PM	-	-	1714 - TD17127	N	North
04-18	Thu	I-287	Morris	Harding	04:09 PM	-	-	1712 - TD17135	N	North
04-18	Thu	I-287	Morris	Harding	04:16 PM	-	-	1720 - TD17133	N	North
04-18	Thu	I-287	Morris	Harding	04:21 PM	-	-	1709 - TD17783	N	North
04-18	Thu	NJ-3	Bergen	Rutherford	04:26 PM	-	-	1713 - TD17113	N	North
04-30	Tue	NJ-55	Gloucester	Harrison Twp.	04:53 PM	04:58 PM	0:05	7521 - TD17112	N	South
04-30	Tue	I-295	Burlington	Mt Laurel Twp.	05:25 PM	05:27 PM	0:02	7510 - TD17109	N	South
04-30	Tue	NJ-55	Burlington	Mt Laurel Twp.	05:26 PM	05:27 PM	0:01	7521 - TD17109	N	South
05-01	Wed	I-295	Camden	Cherry Hill	10:09 AM	10:12 AM	0:03	7510 - TD17109	N	South
05-01	Wed	I-287	Morris	Harding	10:27 AM	10:29 AM	0:02	1722 - TD17122	N	North
05-01	Wed	NJ-42	Camden	Bellmawr	10:30 AM	10:32 AM	0:02	7530 - TD17132	N	South
05-01	Wed	NJ-55	Gloucester	Deptford Twp.	10:32 AM	10:34 AM	0:02	7515 - TD17128	N	South
05-01	Wed	NJ-55	Gloucester	Deptford Twp.	10:51 AM	10:54 AM	0:03	7515 - TD17128	N	South
05-01	Wed	I-287	Morris	Harding	11:32 AM	11:33 AM	0:01	1706 - TD17138	N	North
05-01	Wed	NJ-55	Gloucester	Mantua Twp.	11:33 AM	11:44 AM	0:11	7515 - TD17128	N	South
05-01	Wed	NJ-55	Gloucester	Richwood	11:33 AM	11:43 AM	0:10	7515 - TD17128	N	South
05-01	Wed	NJ-55	Gloucester	Sewell	12:48 PM	12:48 PM	0:00	7510 - TD17109	N	South
05-01	Wed	I-280	Essex	Orange	12:56 PM	12:48 PM	0:08	1725 - TD17789	N	North
05-01	Wed	I-676	Camden	Camden	02:12 PM	02:12 PM	0:00	7521 - TD17112	N	South

Test Date	Day	Location	County	City	iCone Notification Time	Waze Notification Time	Delay (min)	Device Name	Device inactive	SSP Jurisdiction
05-01	Wed	I-295	Mercer	Lawrenceville	02:54 PM	03:10 PM	0:16	7522 - TD17787	N	South
05-01	Wed	I-76	Gloucester	Gloucester	03:30 PM	03:33 PM	0:03	7521 - TD17112	N	South
05-01	Wed	I-295	Camden	Cherry Hill	05:17 PM	05:20 PM	0:03	7522 - TD17787	N	South
05-01	Wed	NJ-55	Gloucester	Harrison Twp.	06:06 PM	06:07 PM	0:01	7510 - TD17109	N	South
05-01	Wed	NJ-42	Gloucester	Deptford Twp.	06:18 PM	06:18 PM	0:00	7521 - TD17112	N	South
05-16	Thu	I-295	Burlington	Burlington	11:43 AM	11:43 AM	0:00	7530 - TD17132	N	South
05-20	Mon	I-295	Burlington	Mt Laurel Twp.	10:27 AM	10:28 AM	0:01	7530 - TD17132	N	South
05-20	Mon	I-80	Passaic	Totowa	10:17 AM	10:32 AM	0:15	1718 - TD17116	N	North
05-20	Mon	I-295	Burlington	Moorestown	11:16 AM	11:16 AM	0:00	7522 - TD17787	N	South
05-20	Mon	I-295	Mercer	Bordentown	11:37 AM	-	-	7510 - TD17109	N	South
05-22	Wed	I-295	Burlington	Mt Laurel Twp.	11:54 AM	-	-	7522 - TD17787	N	South
05-22	Wed	I-295	Burlington	Burlington	12:25 PM	-	-	7510 - TD17109	N	South
05-22	Wed	I-287	Morris	Harding	12:26 PM	-	-	1718 - TD17116	N	North
05-22	Wed	I-287	Morris	Harding	11:28 AM	-	-	1725 - TD17789	N	North
05-22	Wed	I-295	Mercer	Mercerville	02:12 PM	-	-	7521 - TD17112	N	South
05-22	Wed	I-295	Burlington	Mt Laurel Twp.	02:25 PM	-	-	7522 - TD17787	N	South
05-22	Wed	I-295	Camden	Bellmawr	03:16 PM	-	-	7518 - TD17786	N	South
05-22	Wed	I-195	Mercer	Robbinsville	03:46 PM	-	-	7522 - TD17787	N	South
05-22	Wed	I-295	Camden	Mt Ephraim	03:16 PM	-	-	7518 - TD17786	N	South
05-22	Wed	I-280	Essex	West Orange	05:16 PM	-	-	1725 - TD17789	N	North

Test Date	Day	Location	County	City	iCone Notification Time	Waze Notification Time	Delay (min)	Device Name	Device inactive	SSP Jurisdiction
05-28	Tue	I-195	Mercer	Hamilton Twp.	10:03 AM	-	-	7521 - TD17112	N	South
05-28	Tue	I-195	Mercer	Hamilton Twp.	10:07 AM	-	-	7521 - TD17112	N	South
05-28	Tue	I-76	Gloucester	Gloucester	05:21 PM	-	-	7530 - TD17132	N	South
05-29	Wed	I-295	Camden	Cherry Hill	12:14 PM	-	-	7530 - TD17132	N	South
05-29	Wed	NJ-29	Mercer	Trenton	04:45 PM	-	-	7510 - TD17109	N	South
05-29	Wed	I-295	Camden	Haddon Heights	06:25 PM	-	-	7530 - TD17132	N	South
05-30	Thu	I-280	Essex	West Orange	10:19 AM	09:46 AM	- 0:15	1718 - TD17116	N	North

Appendix E: iCone Inactive Device List

Table 14. iCone Inactive Device List

Device Name	Inactive Date
7510 - TD17109	12/19/18
7510 - TD17109	12/21/18
7510 - TD17109	12/22/18
7510 - TD17109	12/25/18
7510 - TD17109	12/26/18
7510 - TD17109	12/27/18
7510 - TD17109	01/01/19
7510 - TD17109	01/02/19
7510 - TD17109	01/04/19
7510 - TD17109	01/10/19
7510 - TD17109	01/14/19
7510 - TD17109	01/15/19
7510 - TD17109	01/16/19
7510 - TD17109	01/17/19
7510 - TD17109	01/18/19
7510 - TD17109	01/19/19
7510 - TD17109	01/20/19
7510 - TD17109	01/21/19
7510 - TD17109	01/22/19
7510 - TD17109	01/27/19
7510 - TD17109	02/03/19
7510 - TD17109	02/10/19
7510 - TD17109	02/14/19
7510 - TD17109	02/15/19
7510 - TD17109	02/16/19
7510 - TD17109	02/17/19

Device Name	Inactive Date
7510 - TD17109	02/18/19
7510 - TD17109	02/24/19
7510 - TD17109	02/25/19
7510 - TD17109	03/08/19
7510 - TD17109	03/09/19
7510 - TD17109	03/10/19
7510 - TD17109	03/11/19
7510 - TD17109	03/12/19
7510 - TD17109	03/13/19
7510 - TD17109	03/14/19
7510 - TD17109	03/15/19
7510 - TD17109	03/16/19
7510 - TD17109	03/17/19
7510 - TD17109	03/18/19
7510 - TD17109	03/19/19
7510 - TD17109	03/20/19
7510 - TD17109	03/23/19
7510 - TD17109	03/24/19
7510 - TD17109	03/25/19
7510 - TD17109	03/26/19
7510 - TD17109	03/31/19
7510 - TD17109	04/01/19
7510 - TD17109	04/04/19
7510 - TD17109	04/08/19
7510 - TD17109	04/09/19
7510 - TD17109	04/12/19

Device Name	Inactive Date
7510 - TD17109	04/13/19
7510 - TD17109	04/14/19
7510 - TD17109	04/15/19
7511 - TD11958	12/19/18
7511 - TD11958	12/20/18
7511 - TD11958	12/21/18
7511 - TD11958	12/22/18
7511 - TD11958	12/23/18
7511 - TD11958	12/24/18
7511 - TD11958	12/25/18
7511 - TD11958	12/26/18
7511 - TD11958	12/27/18
7511 - TD11958	12/28/18
7511 - TD11958	12/29/18
7511 - TD11958	12/30/18
7511 - TD11958	12/31/18
7511 - TD11958	01/01/19
7511 - TD11958	01/02/19
7511 - TD11958	01/03/19
7511 - TD11958	01/04/19
7511 - TD11958	01/05/19
7511 - TD11958	01/06/19
7511 - TD11958	01/10/19
7511 - TD11958	01/11/19
7511 - TD11958	01/12/19
7511 - TD11958	01/13/19
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Device Name	Inactive Date
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Device Name	Inactive Date
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7511 - TD11958	03/11/19
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7511 - TD11958	03/21/19

Device Name	Inactive Date
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7512 - TD17114	12/22/18

Device Name	Inactive Date
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7512 - TD17114	02/17/19

Device Name	Inactive Date
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7512 - TD17114	04/03/19
7512 - TD17114	04/04/19
7512 - TD17114	04/05/19

Device Name	Inactive Date
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7512 - TD17114	04/07/19
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7513 - TD17784	01/27/19

Device Name	Inactive Date
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7513 - TD17784	02/25/19

Device Name	Inactive Date
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7513 - TD17784	03/26/19

Device Name	Inactive Date
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7514 - TD17788	01/02/19

Device Name	Inactive Date
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7514 - TD17788	01/19/19
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7514 - TD17788	01/22/19
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7514 - TD17788	03/16/19
7514 - TD17788	03/17/19
7514 - TD17788	03/23/19
7514 - TD17788	03/25/19

Device Name	Inactive Date
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7514 - TD17788	03/27/19
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7515 - TD17128	12/25/18
7515 - TD17128	12/29/18
7515 - TD17128	12/30/18
7515 - TD17128	01/01/19

Device Name	Inactive Date
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7515 - TD17128	01/06/19
7515 - TD17128	01/12/19
7515 - TD17128	01/16/19
7515 - TD17128	01/21/19
7515 - TD17128	01/27/19
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7515 - TD17128	02/06/19
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7515 - TD17128	02/15/19
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7515 - TD17128	02/17/19
7515 - TD17128	02/18/19
7515 - TD17128	02/19/19
7515 - TD17128	02/20/19
7515 - TD17128	02/23/19
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7515 - TD17128	03/08/19
7515 - TD17128	03/09/19
7515 - TD17128	03/10/19
7515 - TD17128	03/11/19
7515 - TD17128	03/13/19

Device Name	Inactive Date
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7515 - TD17128	03/29/19
7515 - TD17128	03/30/19
7515 - TD17128	04/06/19
7515 - TD17128	04/07/19
7515 - TD17128	04/12/19
7515 - TD17128	04/13/19
7515 - TD17128	04/14/19
7515 - TD17128	04/15/19
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7517 - TD17134	01/07/19
7517 - TD17134	01/09/19
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7517 - TD17134	02/24/19
7517 - TD17134	02/25/19
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7517 - TD17134	02/27/19

Device Name	Inactive Date
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7517 - TD17134	03/02/19
7517 - TD17134	03/03/19
7517 - TD17134	03/04/19
7517 - TD17134	03/05/19
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7517 - TD17134	03/08/19
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7517 - TD17134	03/11/19
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7517 - TD17134	03/13/19
7517 - TD17134	03/14/19
7517 - TD17134	03/23/19
7517 - TD17134	04/01/19
7517 - TD17134	04/02/19
7517 - TD17134	04/08/19
7517 - TD17134	04/09/19
7517 - TD17134	04/10/19
7517 - TD17134	04/12/19
7517 - TD17134	04/13/19
7517 - TD17134	04/14/19
7517 - TD17134	04/15/19
7518 - TD17786	12/19/18
7518 - TD17786	12/20/18
7518 - TD17786	12/23/18
7518 - TD17786	12/24/18

Device Name	Inactive Date
7518 - TD17786	12/25/18
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7518 - TD17786	12/27/18
7518 - TD17786	12/28/18
7518 - TD17786	12/29/18
7518 - TD17786	12/31/18
7518 - TD17786	01/01/19
7518 - TD17786	01/03/19
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7518 - TD17786	01/06/19
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7518 - TD17786	01/16/19
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7518 - TD17786	01/31/19
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7518 - TD17786	02/03/19
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7518 - TD17786	02/05/19
7518 - TD17786	02/06/19
7518 - TD17786	02/07/19
7518 - TD17786	02/08/19

Device Name	Inactive Date
7518 - TD17786	02/09/19
7518 - TD17786	02/10/19
7518 - TD17786	02/13/19
7518 - TD17786	02/14/19
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7518 - TD17786	02/25/19
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7518 - TD17786	03/24/19
7518 - TD17786	03/29/19
7518 - TD17786	03/30/19
7518 - TD17786	04/04/19

Device Name	Inactive Date
7518 - TD17786	04/05/19
7518 - TD17786	04/06/19
7518 - TD17786	04/07/19
7518 - TD17786	04/08/19
7518 - TD17786	04/09/19
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7518 - TD17786	04/15/19
7519 - TD17136	12/19/18
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7519 - TD17136	12/31/18
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7519 - TD17136	01/16/19
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7519 - TD17136	01/19/19

Device Name	Inactive Date
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7519 - TD17136	01/22/19
7519 - TD17136	01/23/19
7519 - TD17136	01/24/19
7519 - TD17136	01/27/19
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7519 - TD17136	03/13/19
7519 - TD17136	03/14/19
7519 - TD17136	03/15/19
7519 - TD17136	03/16/19

Device Name	Inactive Date
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7519 - TD17136	03/18/19
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7519 - TD17136	03/20/19
7519 - TD17136	03/21/19
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7519 - TD17136	03/24/19
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7519 - TD17136	04/02/19
7519 - TD17136	04/03/19
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7519 - TD17136	04/07/19
7519 - TD17136	04/08/19
7519 - TD17136	04/09/19
7519 - TD17136	04/10/19
7519 - TD17136	04/11/19
7519 - TD17136	04/12/19
7519 - TD17136	04/13/19
7519 - TD17136	04/14/19

Device Name	Inactive Date
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7520 - TD17120	12/19/18
7520 - TD17120	12/21/18
7520 - TD17120	12/25/18
7520 - TD17120	12/26/18
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7520 - TD17120	12/28/18
7520 - TD17120	12/30/18
7520 - TD17120	01/01/19
7520 - TD17120	01/02/19
7520 - TD17120	01/03/19
7520 - TD17120	01/04/19
7520 - TD17120	01/09/19
7520 - TD17120	01/10/19
7520 - TD17120	01/11/19
7520 - TD17120	01/13/19
7520 - TD17120	01/16/19
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7520 - TD17120	01/27/19
7520 - TD17120	02/03/19
7520 - TD17120	02/10/19
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7520 - TD17120	03/02/19
7520 - TD17120	03/03/19
7520 - TD17120	03/04/19
7520 - TD17120	03/05/19

Device Name	Inactive Date
7520 - TD17120	03/06/19
7520 - TD17120	03/07/19
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7520 - TD17120	03/26/19
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7520 - TD17120	03/31/19
7520 - TD17120	04/01/19
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7520 - TD17120	04/03/19

Device Name	Inactive Date
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7520 - TD17120	04/05/19
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7520 - TD17120	04/08/19
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7521 - TD17112	01/02/19
7521 - TD17112	01/05/19
7521 - TD17112	01/06/19
7521 - TD17112	01/07/19

Device Name	Inactive Date
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7521 - TD17112	02/09/19

Device Name	Inactive Date
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7521 - TD17112	02/16/19
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7521 - TD17112	02/18/19
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7521 - TD17112	03/16/19
7521 - TD17112	03/17/19
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7521 - TD17112	04/06/19
7521 - TD17112	04/07/19
7521 - TD17112	04/12/19
7521 - TD17112	04/13/19

Device Name	Inactive Date
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7521 - TD17112	04/15/19
7522 - TD17787	12/19/18
7522 - TD17787	12/25/18
7522 - TD17787	12/31/18
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7522 - TD17787	03/11/19
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7522 - TD17787	03/16/19
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7522 - TD17787	03/23/19
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7522 - TD17787	04/11/19
7522 - TD17787	04/12/19
7522 - TD17787	04/13/19
7522 - TD17787	04/14/19

Device Name	Inactive Date
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7524 - TD17130	12/27/18
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7524 - TD17130	12/31/18
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7524 - TD17130	01/07/19
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7524 - TD17130	01/10/19
7524 - TD17130	01/12/19
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7524 - TD17130	01/14/19
7524 - TD17130	01/15/19
7524 - TD17130	01/17/19
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7524 - TD17130	01/29/19

Device Name	Inactive Date
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7524 - TD17130	01/31/19
7524 - TD17130	02/01/19
7524 - TD17130	02/02/19
7524 - TD17130	02/03/19
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7524 - TD17130	02/08/19
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7524 - TD17130	03/05/19
7524 - TD17130	03/06/19
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7524 - TD17130	03/08/19

Device Name	Inactive Date
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7524 - TD17130	03/10/19
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7524 - TD17130	04/11/19
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7524 - TD17130	04/13/19

Device Name	Inactive Date
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7524 - TD17130	04/15/19
7525 - TD17123	12/25/18
7525 - TD17123	12/29/18
7525 - TD17123	12/30/18
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7525 - TD17123	01/13/19
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7525 - TD17123	01/29/19
7525 - TD17123	01/30/19
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7525 - TD17123	02/02/19

Device Name	Inactive Date
7525 - TD17123	02/03/19
7525 - TD17123	02/04/19
7525 - TD17123	02/05/19
7525 - TD17123	02/13/19
7525 - TD17123	02/14/19
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7525 - TD17123	02/17/19
7525 - TD17123	02/18/19
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7525 - TD17123	02/23/19
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7525 - TD17123	03/07/19
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7525 - TD17123	03/10/19

Device Name	Inactive Date
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7525 - TD17123	03/12/19
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7525 - TD17123	03/15/19
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7525 - TD17123	04/05/19
7525 - TD17123	04/06/19
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7525 - TD17123	04/08/19

Device Name	Inactive Date
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7525 - TD17123	04/13/19
7525 - TD17123	04/14/19
7525 - TD17123	04/15/19
7527 - TD17118	12/22/18
7527 - TD17118	12/23/18
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7527 - TD17118	02/08/19
7527 - TD17118	02/09/19
7527 - TD17118	02/10/19

Device Name	Inactive Date
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7527 - TD17118	02/12/19
7527 - TD17118	02/13/19
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7527 - TD17118	02/15/19
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7527 - TD17118	03/11/19

Device Name	Inactive Date
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7527 - TD17118	03/13/19
7527 - TD17118	03/14/19
7527 - TD17118	03/15/19
7527 - TD17118	03/16/19
7527 - TD17118	03/17/19
7527 - TD17118	03/18/19
7527 - TD17118	03/19/19
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7527 - TD17118	03/22/19
7527 - TD17118	03/23/19
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7527 - TD17118	04/03/19
7527 - TD17118	04/04/19
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7527 - TD17118	04/06/19
7527 - TD17118	04/07/19
7527 - TD17118	04/08/19
7527 - TD17118	04/09/19

Device Name	Inactive Date
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7527 - TD17118	04/11/19
7527 - TD17118	04/12/19
7527 - TD17118	04/13/19
7527 - TD17118	04/14/19
7527 - TD17118	04/15/19
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7528 - TD17115	12/23/18
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7528 - TD17115	02/06/19
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7528 - TD17115	02/09/19

Device Name	Inactive Date
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7528 - TD17115	02/11/19
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7528 - TD17115	02/16/19
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7528 - TD17115	03/24/19

Device Name	Inactive Date
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7528 - TD17115	03/26/19
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7528 - TD17115	04/15/19
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7529 - TD11961	12/22/18
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7529 - TD11961	12/25/18

Device Name	Inactive Date
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7529 - TD11961	12/27/18
7529 - TD11961	12/28/18
7529 - TD11961	12/29/18
7529 - TD11961	12/30/18
7529 - TD11961	12/31/18
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7529 - TD11961	01/27/19
7529 - TD11961	01/28/19
7529 - TD11961	01/29/19
7529 - TD11961	01/30/19

Device Name	Inactive Date
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7529 - TD11961	02/01/19
7529 - TD11961	02/02/19
7529 - TD11961	02/03/19
7529 - TD11961	02/04/19
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7529 - TD11961	02/25/19
7529 - TD11961	02/26/19
7529 - TD11961	02/27/19
7529 - TD11961	02/28/19

Device Name	Inactive Date
7529 - TD11961	03/01/19
7529 - TD11961	03/02/19
7529 - TD11961	03/03/19
7529 - TD11961	03/04/19
7529 - TD11961	03/05/19
7529 - TD11961	03/06/19
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Device Name	Inactive Date
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7534 - TD17126	04/11/19
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7534 - TD17126	04/15/19

Appendix F: iCone® 12 Month Extended Warranty

iCone Products LLC warrants the iCone® against defects in materials and workmanship for the twelve (12) month period immediately following the twelve (12) month period covered by the iCone® Standard Warranty. This warranty applies to the iCone® electronics only. During the warranty period, iCone Products will either replace or repair, at its own option, covered items. In the event of a warranty claim, the claimant will ship at the claimant's own cost the defective product to a location iCone Products specifies. iCone Products will either repair or replace the iCone® at no cost to the claimant and ship, at no charge to the claimant, the repaired or replaced iCone® back to the claimant. iCone Products may also elect to send to the claimant replacement replacement parts for the claimant to install themselves.

This warranty does not apply to the following: Electronic equipment that have been accidentally or intentionally damaged, normal wear and tear, wear and tear on the battery, repairs (other than those authorized by iCone Products), damage caused by unauthorized repair or alteration, damage caused by failure to follow instructions in the iCone® users manual, placement (intentional or unintentional) of the equipment into an environment that the equipment is not specified to operate within, the availability of wireless communications services, (including geopositioning services), being struck by vehicles, being struck by construction equipment or any other moving objects, acts of God.

iCone Products will solely determine if the subject equipment is covered by warranty. iCone Products will notify the claimant that if the particular equipment is not covered by warranty, in which case, iCone Products shall be under no obligation to repair or replace the subject equipment under warranty.

iCone Products will not be responsible, under any circumstances, for consequential or punitive damages or bodily injury/death or property damage resulting from the use or misuse of the equipment, and any such claims are not covered

by this warranty. Consequential damage includes the loss or non-receipt of data, use of data and economic or service loss by the unavailability of data. The customer and any user, authorized or not, will specify and place into service the equipment in the manner that is specified in the iCone® user's manual and the user will comply by all applicable standards, particularly those involving Federal, State or local highway regulations, including the Manual of Uniform Traffic Control Devices (MUTCD), including any state or local modifications of it. Consequences caused by the user, authorized or not, to fail to follow all applicable standards, including the MUTCD, applicable state or local modifications of the MUTCD and any other applicable surface transportation regulation shall be the sole responsibility of the user for using equipment produced by iCone® Products LLC.