PREPARED BY: Metric Engineering, Inc.

FDOT

I-75 FLORIDA'S REGIONAL ADVANCED MOBILITY ELEMENTS (F.R.A.M.E.)

Roadside & Onboard Units Testing

July 31, 2018

TSM&O
Transportation Systems Management & Operations
Managing and Operating for an Efficient Transportation System

METRIC ENGINEERING

PREPARED FOR:
Florida Department of Transportation - District 5
710 South Woodland Boulevard
DeLand, Florida 32720

525 Technology Park, Suite 153
Lake Mary, Florida 32746

Contents

List of Acronyms

The following is a list of acronyms and their meanings used throughout this document:

APL = Approved Products List

BIU = Bus Interface Unit

BSM = Basic Safety Messages

CLI = Command Line Interface

CV = Connected Vehicle

DSRC = Dedicated Short-Range Communication

EVP = Emergency Vehicle Pre-emption

FDOT = Florida Department of Transportation

FRAME = Florida's Regional Advanced Mobility Elements

GPS = Global Positioning Satellite

GUI = Graphical User Interface

J2735 = Dedicated Short-Range Communications (DSRC) Set Dictionary

MAP = Map Messages

NTCIP = National Transportation Communications for Intelligent Transportation System Protocol

OBU = Onboard Unit

RSU = Roadside Unit

SDK = Software Development Kit

SDLC = Synchronous Data Link Control

SPaT = Signal Phasing and Timing

SRM = Signal Request Messages

SSH = Secure Shell Terminal

THEA = Tampa Hillsborough Expressway Authority

TIM = Traveler Information Messages

TSP = Transit Signal Priority

V2I = Vehicle-to-Infrastructure

V2V = Vehicle-to-Vehicle

Introduction

The Florida's Regional Advanced Mobility Elements (FRAME) Evaluation Team was tasked with performing interoperability testing of various connected vehicle Roadside Units (RSUs) and Onboard Units (OBUs) received from various vendors against FDOT APL approved controllers. Testing would involve connecting to multiple controllers in both the Seminole County Traffic Engineering lab and field "live" test environments located at the University of Central Florida and surrounding areas. At the lab, multiple controllers were set up to include the following:

- Trafficware ATC/Naztec
- Intelight X3
- Siemens M60
- Econolite ASC/3
- Econolite Cobalt

Field validation was conducted at two (2) different test locations. The first location was in Seminole County at the intersection of McColloch Road and Lockwood Boulevard. This site was equipped with a Trafficware ATC controller. The second location was in Orange County, at the Gemini Boulevard and Greek Park drive intersection and was equipped with an Intelight X3 controller.

A total of ten (10) vendors participated in the FRAME CV equipment testing. Of these ten, six (6) provided on-site support and four (4) vendors provided support remotely. The table below identifies the vendors and the level of support provided. Both an RSU and an OBU were provided by the vendors for testing except Siemens who provided an RSU.

Vendors	On-site Lab and/or Field Testing	Remote Support Provided
Applied Info (AI)	✓	✓
Cohda		✓
Commsignia	✓	
Lear		✓
MioVision	✓	
Rhythm Engineering	✓	
Savari	✓	
Siemens	✓	
TrafficCast	✓	
Wavemobile		✓

The testing strategy consisted of the vendors first meeting at the Seminole County test lab. The vendors then were asked to perform various tests by configuring their units and hooking up to the controllers to ensure the successful transmitting and receiving of various messages (BSMs, MAP, TIM, SPaT, EVP, and TSP). Interoperability testing with OBUs and RSUs from other vendors was also completed. On the subsequent days, field visits were done and/or additional testing at the lab was performed where needed.

Prior to the scheduled vendor visits, the Evaluation Team conducted their independent lab interoperability testing which included webinars with vendors. All video webinars and initial lab

interoperability testing notes were recorded, documented and placed on the FDOT District 5 FRAME SharePoint site.

Similarly, all field visits and additional testing with the vendors were documented, photographed and recorded. All documents and recordings were placed on FDOT District 5 FRAME SharePoint in appropriate and organized folders.

This document serves as a summarization of the findings and experiences of the Evaluation Team and can be used as a supplement to all notes placed on the FDOT District 5 FRAME SharePoint site.

Wavemobile

The Evaluation Team scheduled several webinars with Wavemobile. All related documentation can be found on the FDOT District 5 FRAME SharePoint Site. Wavemobile assisted in the programming of the RSU and OBU. Both units are the same and can be programmed as either an RSU or OBU. Basic programing of both units was done with their graphical user Interface (GUI) and more technical programming was performed using Linux syntax.

Once both units were configured properly by Wavemobile and the RSU was communicating with the OBU, the Evaluation Team began testing the RSU with the different signal controllers. The Evaluation Team was not able to verify SPaT or MAP with any of the controllers. We were also unsuccessful in verifying communication between their RSU and any other OBU's as well as their OBU's with other vendor OBU's and RSU's.

The Evaluation Team contacted Wavemobile on several accounts via electronic mail. The vendor informed the Evaluation Team that we would need to develop an application similar to Lear and Cohda to translate the vendor controller SPaT messages. We believed this application would be embedded within their RSU. We were successful in testing and transmitting BSMs only between their RSU and OBU.

Representatives from Intelight came to the lab on April 26th with their new controller, which had the Maxtime-CV Application installed on it. Maxtime-CV is an application which runs independently of the controller software and provides SPaT, MAP, and TIM messages to the RSU. Intelight configured the Maxtime-CV Application with a MAP, TIM and timings and then "pointed" the CV Application to the Wavemobile RSU. We were able to confirm BSM, MAP, SPaT, and TIM messages being broadcast by the RSU from the Wavemobile OBU. We were not able to confirm these messages with the other vendors OBU's. At this time, we could not test interoperability with other RSU's and OBU's as well as could not confirm compatibility with other controllers, with the exception of Intelight. It should be noted that the Intelight Controller, running the Maxtime-CV Application, supports SPaT, MAP and TIM messages and the RSU's only requirement is to forward these message types.

Cohda

The Evaluation Team scheduled several webinars with the Cohda representative, all of which were recorded and can be found on the FDOT District 5 FRAME SharePoint site. At first, Cohda was very reluctant to assist the Evaluation Team with the FDOT testing project. The representative sent emails to Joe Perri (VHB) stating that they would not provide us with a lot of support. The webinars provided to the Evaluation Team were short, and when the scheduled hour was finished Cohda promptly ended the call. At the beginning stages of the testing phase, the Evaluation Team would email the Cohda representative and the responses would be slow, sometimes requiring additional follow-up to remind their engineer the Evaluation team required assistance. Towards the end of our testing, however, Cohda became more responsive.

Their RSU's and OBU's do not use a Graphical User Interface (GUI) and rely solely on a Linux syntax. The Evaluation Team found it difficult to work with their devices due to the amount of programming required to operate both the RSU and OBU. The OBU needed the security settings applied every time the unit was powered on. Once programmed correctly, Linux was used to navigate throughout the menus which became very difficult if you were not proficient in the language.

Like Lear, their RSU's were sent with a "Store and Repeat Message" for SPaT and MAP messages. This means a SPaT/MAP message that was downloaded to the RSU and the unit would broadcast messages based on a predetermined time that was configured in the message. This message consisted of a generic signal and phasing times along with the MAP message. While using this message, the evaluation team verified the interoperability with Lear, Wavemobile, Commsignia and Denso. The evaluation team had success with verifying the J2735 messages consisting of the SPaT, MAP, TIM, and BSM messages with the Lear and Commsignia OBU. We were not able to test for EVP and TSP as Cohda did not visit for field testing.

When we programmed the RSU for "Forward Message", as with the Lear RSU, we could not detect SPaT messages from any of the controllers. Cohda claims they have interoperability with the Siemens controller as well as the Naztec, however, we could not prove that. They also requested that our team contact the signal controller vendors to resolve the issue.

Cohda provided the Evaluation Team with an extension for the Wireshark application so that the packets could be captured from their RSU and OBU and then viewed. We found this tool extremely helpful as each packet/message that was being transmitted and received by both RSU and OBU could be dissected and viewed. With Wireshark, we could see the J2735 message sets. The Evaluation Team uses the Cohda OBU for interoperability testing because of this feature.

Lear

Both the RSU and OBU used the CLI (Command Line Interface) for configuration purposes. CLI is the syntax used to program the units at the administration (admin) level and the Linux program had a requirement for a Privileged mode. Most of the "Basic" programming was performed in "Admin" mode using CLI. CLI being an easier syntax to use then Linux, we programmed the RSU to broadcast SPaT, BSM, and TIM messages.

The Evaluation Team had several webinars and email correspondence with Lear. The webinars consisted of ensuring that the RSU and OBU were set-up correctly.

Testing began with confirming GPS Lock on both units. Once verified we configured each controller to "point" the IP to the Lear RSU. Through the CLI we could watch the counters increase on the transmittal of SPaT, MAP, TIM, and BSM. The evaluation team then logged into the OBU and through the "Egoprocess" command we could see the RX of the SPaT, BSM, TIM, and MAP counters climb. The "Egoprocess" command was used to verify transmittal and receiving of SPaT, MAP, TIM, and BSM messages from RSU's and other OBU's.

After further testing, confirmed by an additional webinar, the team quickly realized the RSU was set in "Store and Repeat Mode". This feature entails a fixed message to be stored on the RSU and broadcasted at a programmed time. The Evaluation Team contacted Lear and asked if they could set the RSU for Immediate Forward. This option allows the RSU to broadcast any J2735 messages coming from the controller(s). Immediate Forward is the mode needed for the RSU to broadcast true SPaT messages. Lear remotely set the RSU to the appropriate mode, but we could not broadcast SPaT messages from any of the controllers.

Lear indicated that the Evaluation Team would have to build an application through their SDK that would translate the SPaT message for each controller so the RSU could Broadcast it. Each Controller company packages SPaT in a different matter due to the lack of a true specification, so therefore a new build for the controller or some application work on the RSU would be needed.

TrafficCast

The TrafficCast Team brought with them an RSU, an OBU, and a tablet with their application on it for viewing information being broadcasted by the RSU in a graphical format. They also brought with them a "Black Box" or translator box used to decode the SPaT Message coming from the controller and converting it into a message that can be broadcast by the RSU.

This translator box would reside between the controller and the RSU and listen for SPaT via NTCIP. TrafficCast had to use the translator box on the Naztec Controller, however, they were successful without the translator box on the Siemens m60 and Econolite ASC/3 Controller. At this time, they could not receive SPaT from the Intelight Controller nor the Econolite Cobalt Controller.

Interoperability was tested with their RSU against the other OBU's for BSM, TIM, MAP, and all were successful in receiving the messages with the exception of the Commsignia OBU. TrafficCast's RSU was successful in receiving BSM's from all other OBU's.

Field testing was performed at McColloch and Lockwood Avenue in Seminole County with the Trafficware ATC controller. TrafficCast set up their translator box, configured the RSU and their Denso OBU. The Evaluation Team configured the Lear and Commsignia OBU for receiving the J2735 messages from the TrafficCast RSU.

The TrafficCast team was successful in broadcasting SPaT, MAP, and TIM messages from their RSU to their OBU. SPaT was developed via the translator box and sent to their RSU for broadcasting. The Lear OBU was the only OBU able to receive the SPaT, MAP, and TIM messages. Currently TrafficCast is unable to perform EVP and TSP.

The Evaluation Team was able to view the SPaT, MAP, and TIM messages via the application on the tablet they provided while driving through the intersection as shown in the videos and photographs located on the FDOT District 5 FRAME SharePoint. We utilized their application provided for a graphical view of the messages in addition to viewing the individual packets as shown by other vendors.

The TrafficCast team claimed at the end of the field evaluation that they were working on EVP and TSP and will have a solution soon. Their RSU and OBU worked successfully and the vendor provided software for viewing the J2735 Messages. Due to the Trafficware controller not being NTCIP a Translator box was needed, however, its small enough that it would not take up much space within a cabinet.

UPDATE AS OF 9/17/18 TO 9/18/18

The TrafficCast team revisited and was able to demonstrate EVP on the Trafficware ATC. The team mentioned that they were working to obtain a test Intelight Controller. The team visited the SR 417 / SR 434 and conducted MAP, SPaT, mounting of the RSUs for vertical and spacing testing.

Siemens

Siemens brought to the lab for testing their RSU and a 3M DSRC Sniffer. Siemens did not have an OBU for testing. Instead they used another one of their RSU's to emulate an OBU. The Evaluation Team tested for interoperability between RSU's, OBU's and different signal controllers. Before Siemens visited to the lab, we were not able to have any webinars nor support due to Siemens working on the THEA CV Pilot Program.

Siemens set up and configured their equipment in the lab. They used a sniffer box to sniff the DSRC Channels to verify the J2735 messages. The team was successful in verifying SPaT messages with the Trafficware ATC, Siemens M60, Econolite ASC/3, and the Intelight Controller. Siemens did not have an OBU, so the Evaluation Team used their Lear, Commsignia, and Cohda OBU and were successful in obtaining SPaT, MAP, BSM, and TIM messages.

The FDOT Evaluation team conducted field evaluations at two (2) Intersections in Seminole and Orange County. The first intersection was at McColloch and Lockwood Boulevard in Seminole County. Siemens configured their RSU with the sniffer box while the Evaluation Team set up their OBU's. Siemens was successful in demonstrating SPaT, BSM, MAP, and TIM messages at the live intersection. The SPaT, BSM, MAP, and TIM messages were verified by our OBU's as well as the packets being displayed by the sniffer box.

Siemens did not have an OBU but brought with them a spare RSU which they configured to emulate an OBU so it could broadcast SRM's (Signal Request Messages) for EVP to the RSU. We were able to verify the SRM's with the sniffer as well as see the controller go into a PR4 Preemption call. Photos and videos are available on the FDOT District 5 FRAME SharePoint site. Siemens was plugged into the RSU/OBU and manually requested the call through the unit, in turn sent the SRM to the RSU causing the pre-emption. The exact set-up was used for the intersection at Gemini Blvd and Greek Park Drive in Orange County.

Siemens was able to verify SPaT with their software, which was all GUI based and easy to configure. Their software was able to take the signal, phasing, timing, and produce the SPaT message which could be broadcasted by the RSU.

Rhythm Engineering

Prior to coming down for the Field Evaluation, Rhythm Engineering shipped approximately five (5) boxes of equipment for testing in the lab and out in the field. They used the Cohda RSU and OBU for DSRC communications. Upon arrival to the lab, they unboxed their proprietary equipment and began setting up and configuring for lab testing.

Within the lab environment there were many pieces of equipment which needed to perform and verify the J2735 messages. Documentation, photos, and videos are available for reference on the FDOT District 5 FRAME SharePoint site. Their external systems, when set up, receives the signals as outputs from either BIUs or the ABC plugs. Their system is tied to the SDLC connector to essentially sniff the outputs. Outputs from the cabinet are sent to their processing unit, which then creates the SPaT message and sends it to the RSU for broadcasting on DSRC. The processing unit handles the MAP and TIM messages as well.

With this type of configuration, Rhythm Engineering is independent of any type of controller due to the system creating all the SPaT data from the outputs of the cabinets. They essentially can potentially work with any cabinet type or controller.

With all of their equipment installed in the lab, the Evaluation Team was able to verify SPaT, BSM, MAP, TIM, EVP and TSP messages. All of these messages were created by their equipment, bypassing the controller and pushed to the RSU for broadcasting. With the Evaluation Teams OBU's consisting of a Lear, Cohda, and Commsignia, we were able to verify SPaT, BSM, MAP, and TIM messages.

The Evaluation Team conducted a field evaluation at two (2) live intersections in Seminole County and Orange County. We first went to the intersection of McColloch and Lockwood Blvd in Seminole County. Rhythm Engineering set up and configured all their equipment as they did in the lab, using the outputs of the cabinet only and not the controller. We verified SPaT, BSM, MAP, TIM, EVP, and TSP through '.pcap' files using Wireshark. The same results were also verified at the intersection of Gemini Boulevard and Greek Park Drive in Orange County. EVP was visually verified by the Evaluation Team at both locations.

It should be noted this type of CV installation requires additional available space within the signal cabinet to house all the Siemens equipment needed to perform the CV functions.

Commsignia

Prior to CV testing, Commsignia sent an RSU, OBU and a Tablet to the Evaluation Team for testing interoperability between RSU's, OBU's and the different Signal Controllers. Several webinars were performed to help configure both units and confirm the updated firmware was loaded. All recorded webinars can be viewed on the FDOT District 5 FRAME SharePoint Site

The Evaluation Team spent several weeks working with their RSU and OBU and learning how to configure the RSU to produce and broadcast the J2735 messages. Commsignia provided a GUI which is where most settings could be applied. However, for more advanced settings, the Linux syntax was still needed. The GUI is also where counters and verification of the various BSM, SPaT, TIM and MAP messages would be viewed. The Evaluation Team was able to use Commsignia's tablet and their pre-loaded application which gave a graphical view of the intersection and displayed the signal heads which would turn colors consistent with the SPaT data. The Evaluation Team, prior to Commsignia's visit, was successful in communicating with the Trafficware Controller and verifying SPaT messages from the Unit. We were also able to verify BSM and MAP messages from the Commsignia RSU to Lear and Cohda OBU. The team could not verify interoperability with the Wavemobile OBU.

Commsignia arrived at the lab and brought with them their own RSU, OBU, and Tablet. We immediately hooked up to the Trafficware controller and started to configure. At this time, Commsignia needed a cable which came from the RSU, other than the Ethernet cable, that would land on the pre-emption board of the signal cabinet, so they could gather the outputs. The Evaluation Team was successful in testing all SPaT, BSM, MAP, TIM, and EVP through the application on the tablet as well as seeing the packets using the Wireshark program. We did not see TSP. The team was successful in testing with the Intelight Controller. This verification was performed at the lab only and not the field as Intelight had to send us a new firmware build which was not ready at the time of Commsignia's visit. We could not verify SPaT messages from the Siemens M60, due to the controller not being NTCIP Compatible (as of 6/20/18 we now have an NTCIP compatible M60 to test with).

Testing at the Orange County location was not done due to Intelight not getting us a new build until later that day. We did successfully test back in the lab SPaT, EVP, BSM, MAP, and TIM messages. While out at the Seminole County location, Commsignia wired up to the pre-emption panel of the controller and configured their RSU and OBU. The Evaluation Team verified BSM's from all the OBU's including Lear, TrafficCast's Denso, our Commsignia and the Cohda OBU. We also verified SPaT, MAP, TIM with the Lear, Commsignia, and Cohda OBU's. EVP was verified with their OBU and application, as shown on the videos and photographs on FDOT District 5 FRAME SharePoint. The test team drove through the intersection with Commsignia's tablet and verified communication with the OBU, verified EVP by pushing a button on the application and watching for the signal change while in that phase. We also verified the SRM's being broadcasted by the OBU. The application also represented certain warnings such as when the current signal light was illuminated, what lane we were in, collision warnings, blind spot warnings, and red-light violations to name a few.

The team came back to the lab and performed some V2V functionality with their new application. Photos and videos are available on FDOT District 5 FRAME SharePoint. The application demonstrated all V2V warnings including braking, blind spot, and head-on collision warnings.

Commsignia has informed the Evaluation Team that they are currently working on being able to perform EVP and TSP without wiring into the pre-emption board and that all EVP and TSP calls would be made from the RSU directly over Ethernet. The Evaluation Team found their equipment to be the easiest to configure and work with. Commsignia has helped us along the way without hesitation. Their application on the tablet, is by far the best graphical interface with which we have worked with and tested. It allows the user to see the intersection, the countdown (proven with MioVision) of the lights, all the V2V and V2I warnings as well as the ability to manually send EVP calls.

MioVision

MioVision's equipment consisted of utilizing the Commsignia RSU, the Commsignia OBU and their MioVision Smartlink box which is capable of handling processes and applications. The Smartlink unit is currently used for their other product applications such as for cameras and other I/O's. The Smartlink device will reside between the Controller and the RSU and will receive SPaT via NTCIP.

MioVision's set up and configured their equipment and began testing with the Trafficware controller. The collective team was successful in viewing SPaT, MAP (message is stored on their Smartlink Box) BSM's and TIM messages via the Commsignia application on a tablet. We were also able to verify the messages using our Lear, Cohda, and Commsignia OBU's, thus proving interoperability. Videos and photographs can be found on the FDOT District 5 FRAME SharePoint site. Their Smartlink box uses NTCIP and listens to the output port from the controller to deliver the SPaT message to the RSU.

MioVision, with the Smartlink configuration, established successful SPaT with Trafficware, Econolite ASC/3, Intelight and the Siemens M60 Controller. We could not establish SPaT with the Econolite Cobalt controller although communication was established. In all cases, the Smartlink box would be needed to communicate with the Signal Controllers.

After setting up the RSU, OBU and Smartlink Box at the field test sites, we started verifying SPaT, MAP, and BSM's with the Commsignia application on their tablet as well as witnessing the messages come across our Lear, Cohda, Commsignia, and Denso OBU's, proving interoperability.

We then began to test for EVP with the Trafficware controller. The process would consist of the team driving through the intersection and the MioVision representative, using an application on his laptop that would connect to the OBU. A manual call would be placed for EVP and the OBU and would send the SRM to the RSU causing a preemption call. The team could not successfully test this feature while driving through the intersection. This may be due to the pre-emption calls within the controller not matching the MAP. Additionally, we experienced significant loss of communication with their application on the Laptop during several test drives. The application on their laptop also connected to the Smartlink via LTE to help place the calls for EVP. We did, however, test and prove that high-priority EVP does work while parked in front of the signal cabinet. We were successful in placing an EVP call for PR6 (Pre-emption 6) on the controller from the OBU to the RSU, down to the Smartlink and finally to the controller. Photographs and videos can be referenced on the FDOT District 5 FRAME SharePoint site.

On the second field test day, the team went to the intersection in Orange County with an Intelight Controller. After setting up the RSU, OBU and Smartlink Box we started verifying SPaT, MAP, and BSM's with the Commsignia application on their tablet as well as witnessing the messages come across the Lear, Cohda, Commsignia, and Denso OBU's. The team then began testing for EVP in the same way as was tested at the intersection in Seminole County. On the Commsignia application/tablet, we verified transmittal of the Spat, MAP, BSM, TIM, and EVP messages.

We were successful in EVP testing for all phases of the intersection. The team was able to confirm the OBU was sending SRM's to the RSU and causing the preemption calls within the controller. We also witnessed on the Commsignia application a phase count-down to Green; we previously had not been able to verify this function with any of the other tests. Along with CTG (Countdown to Green) we were able to see with the application, all other V2V and V2I messages.

The test within Orange county was extremely successful. We verified all J2735 messages, with the exception of TSP. EVP was proven on all phases of the intersection and with Commsignia's application. The Evaluation Team was able to graphically visualize the messages being transmitted by the RSU from the Smartlink using Commsignia's application running on their tablet.

Savari

Savari arrived at the Seminole County Signal Shop with their RSU and OBU. A representative with Econolite was present to assist in the integration of the Savari RSU and the Econolite controllers. At the time of the visit to the Signal Shop Savari was unable to perform EVP and TSP, however their development team was currently addressing this issue and would get back to the team on a resolution.

Because Savari could not demonstrate EVP and TSP it was agreed upon both with the Vendor and the Evaluation Team that the lab and field testing would be performed in the Seminole County Signal Shop Lab. All SPaT, MAP, BSM, and TIM Messages can be tested in the lab. Since pre-emption could not be performed it was not necessary to test out at a "live" intersection.

Testing began with powering up the RSU and placing it outdoors to receive valid GPS Signal. At this time Savari needed to do some programming to the RSU via Linux. They do not have a GUI for the RSU and all configurations are made through an SSH Terminal.

The Evaluation Team with Savari tested the Econolite ASC/3, Cobalt, Intelight X3, Siemens M60, and the Trafficware ATC with the Savari RSU. We were successful in demonstrating SPaT and MAP messages with the Econolite ASC/3, Cobalt, Siemens M60, and the Trafficware ATC. The Evaluation Team could not verify the SPaT and MAP messages with the Intelight Controller. Although Savari could receive packets from the Intelight controller, they were unable to interpret them. They claim more time would be needed by their development team to produce a SPaT Message with the Intelight Controller. Messages being broadcasted by the Savari RSU were confirmed by inspecting the .pcap files.

While validating the SPaT Messages with the different Signal Controllers we also were testing concurrently interoperability with the OBU's in the lab. The Evaluation Team was successful in receiving SPaT, MAP, TIM, and BSM messages with the Savari, Lear, Cohda, and Commsignia OBU from the above controllers. Both Wavemobile and Denso could not receive the SPaT, MAP, and TIM messages. The Denso OBU was able to see BSM messages from the Savari OBU as well as the others.

The Evaluation Team configured the Commsignia RSU to broadcast SPaT and MAP messages and the Savari OBU was able to receive both messages. Verification was witnessed by inspecting the packets on the Savari OBU. We configured the Cohda RSU as well and unfortunately the Savari OBU was unable to receive SPaT or MAP messages, more high-level configuration would have been needed on the Cohda RSU. Due to inclement weather and time we were not able to proceed and only tested the Commsignia and Cohda RSU (RSU's need valid GPS Signal and need to be placed outdoors).

At the time of testing, Savari could not perform EVP and TSP. In order for their RSU to receive and broadcast SPaT messages from the various controllers, they needed some time configuring for every controller. This time equated to approximately two (2) days of lab time, at which that was all the time they had. It should be noted that Savari was successful in receiving SPaT and MAP from all the Signal Controllers, with the exception of Intelight, while successful in broadcasting those messages to the various OBU's we had in the lab.

Applied Info (AI)

AI (Temple Incorporated) arrived at the Seminole County lab with their Cellular OBU and Cellular RSU, which is a 19" Rack Mounted 1U box. Their initial testing consisted of connecting to the Trafficware ATC Controller and programming their RSU to receive the SPaT and MAP messages. AI was successful in receiving and broadcasting SPaT and MAP messages via CELL only. AI uses Cell technology to push the data to the "cloud" were it is translated and re-broadcasted to a cell phone. The cell phone was running their Travel Safety Application and was displaying the MAP and SPaT Messages. The application also does V2V and Pedestrian messages/warnings, which was tested out in the field.

AI was not able to demonstrate transmittal of TIM messages.

In the lab environment, AI was successful with the Siemens M60 Controller as well as the Intelight Controller in receiving and broadcasting the SPaT and MAP messages. At the Orange County test site, it was found that the Intelight controller was not equipped with the updated firmware versus what was in the lab, therefore testing could not be done at the field.

AI claimed that they work with DSRC RSU's, however at the time of the visit, we could not successfully test that option.

TSP and EVP was demonstrated successfully by hard-wiring into the pre-emption board of the signal cabinet. Their OBU sends the SRM and TSP calls via cellular to the cloud which then sends back to the RSU via cellular.

A Pedestrian Alert warning test was conducted in the field. With the pedestrian application downloaded on the mobile device, the pedestrian should be able to receive a warning with an approaching vehicle. During this test, it was observed that the application did notify the pedestrian of the approaching vehicle, however there was noticeable latency in the message warning for BOTH the vehicle and the pedestrian. AI observed this as well and notified that the application would require tweaks to address this.

Interoperability testing could not be tested due to AI using cell technology and not DSRC.

Cisco

The Cisco team is currently working to get on the testing schedule.

Conclusion and Recommendations

The Evaluation Team was given a task by FDOT to determine the best possible equipment to be used for upcoming CV Projects consisting of RSUs and OBUs. These units would communicate with each other via V2V (Vehicle to Vehicle) and V2I (Vehicle to Infrastructure) as well as receive messages from signal controllers, thereby efficiently managing traffic during incidents and special/emergency events as well as to help improve safety and connectivity for all types of road users.

Along certain corridors of the project the RSUs would be required to interface with signal controllers, to be able to transmit SPaT messages they receive from the controllers as well as broadcast MAP and TIM messages. The idea would be that the RSU would "seamlessly" integrate with the controller via an ethernet cable coming from the layer 2/3 switch within the signal cabinet to the RSU located on the signal pole, and power would be provided by a POE injector also installed in the cabinet. As far as the deployment on the highway, the RSU would be receiving and broadcasting messages to the connected vehicles (V2V & V2I).

The OBUs would need to communicate with the RSUs (V2I) and other OBUs (V2V) regardless of make or model. With J2735 compliancy, transmittal and receipt of messages should be consistent according to standards, and therefore successful.

Out in the field environment, there was a Trafficware ATC controller in Seminole County and an Intelight controller in Orange County. Seven (7) of the ten (10) vendors participated in the CV lab and field testing. These vendors were:

- Commsignia
- Rhythm Engineering
- Siemens
- TrafficCast
- MioVision
- Savari
- Applied Info

The Evaluation Team's recommendation will be based on the following factors and results.

- Ability to transmit and receive all J2735 Messages
- Ability to follow RSU 4.1 Standards
- Ability to communicate with the various signal controllers
- Interoperability between other vendors RSUs and OBUs
- Amount of equipment needed for full CV deployment
- Vendor Support
- Configuration of units

The Evaluation Team has updated the Evaluations Test Sheet and Matrix supporting documentation which are available on the FDOT District 5 FRAME SharePoint.