

The National Connected Vehicle SPaT Deployment Challenge

SPaT Procurement Resource

1. Introduction

The goal of the SPaT Challenge is to encourage state or local agencies throughout the United States to deploy Signal Phase and Timing (SPaT) message broadcasts at approximately 20 intersection locations, typically in a corridor or network setting. The intent of this document is to assist agencies understand the various components for developing procurement documents and provide examples from agencies that have already deployed SPaT broadcasts.

2. Summary of Procurement Documents

Agencies may issue one or more solicitations to procure various components that are needed to support SPaT broadcasts, which may include upgrading intersection and signal control infrastructure, backhaul communications, and software. Table 1 provides a high-level summary of procurement documents available within this resource, including the procuring agency and date the solicitation was issued, a description of the components procured, a gauge of success from the procuring agency, and lessons learned. The subsequent sections of this resource provide the specific procurement documents, with an introduction that includes comments from the procuring agency on potential modifications to the document that might be made for a different type or future procurement. Note that these documents reflect the most recent version at the time they were compiled, but it is expected that these procurement documents would be updated by the agencies for subsequent deployments based on their needs and lessons learned.

Agencies are encouraged to review procurement documentation in this resource as a general reference prior to developing their own customized procurement document. Each agency is expected to have unique regional and local goals, infrastructure readiness, and funding resources that should be kept in mind while developing a procurement document. Agencies may also contact practitioners at other agencies that have already issued similar procurements to better understand considerations and potential applications. As an example, the Macomb County, Michigan Department of Roads Special Provision for Roadside Units (RSUs) is based on the Michigan Department of Transportation (DOT) Special Provision for RSUs, but also incorporates additional elements based on local needs and best practices from other agencies based on conversations with practitioners and review of other existing procurement documentation.

Table 1: Description of Available Procurement Documentation included in this Resource

Agency, Date	Components Procured	Success Overview	Lessons Learned
Utah DOT , 12/30/2016	<ul style="list-style-type: none"> • DSRC-based RSUs • DSRC-based OBUs • Technical Support <p>Note: overall integration support was procured through a different contracting method than this RSU/OBU device procurement.</p>	30 intersections successfully broadcast SPaT and MAP messages for transit priority and testing RSU and OBU interoperability.	This deployment included deploying the Multi-modal Intelligent Traffic Signal System (MMITSS), and therefore included additional components and complexities beyond a basic SPaT deployment.
Florida DOT , 4/2017	<ul style="list-style-type: none"> • DSRC-based RSUs • DSRC-based OBUs • DSRC Multi-Channel Test Tool • Technical Support 	21 intersections successfully broadcast SPaT and MAP messages	
Michigan DOT , Current as of 7/2018	<ul style="list-style-type: none"> • Special Provision for DSRC RSUs 	RSUs are now required as part of Michigan DOT signalized intersection upgrades	
Macomb County (Michigan) Department of Roads Current as of 7/2018	<ul style="list-style-type: none"> • Special Provision for DSRC RSUs 		Based on Michigan DOT Special Provision, but modified to ensure deployments meet local goals.
USDOT, 4/28/2017	<ul style="list-style-type: none"> • DSRC RSU Specifications v4.1 (not a procurement) 	Requirements for RSUs for 5.9GHz DSRC infrastructure that integrates IEEE 802.11, 1609.x, SAE J2735, and SAE J2945 standards.	USDOT supports both DSRC and non-DSRC technologies for SPaT broadcasts, however DSRC is the only currently available technology tested and known to meet low-latency requirements and have high reliability for transmitting safety-critical information.

3. Utah DOT Procurement Documentation

The following document was issued by the Utah DOT (UDOT) in 2016 for a procurement of RSUs to support DSRC-based SPaT broadcasts with Multi-Modal Intelligent Traffic Signal Systems (MMITSS). A few comments on this include the following:

- [General Comment](#): UDOT's deployment of SPaT broadcasts was done in conjunction with deployment of the Multi-Modal Intelligent Traffic Signal System (MMITSS), developed by the Connected Vehicle Pooled Fund Study. The deployment of MMITSS accomplishes additional functions (e.g. transit signal priority requests and responses through DSRC exchanges) but also adds additional requirements beyond those needed solely for a SPaT broadcast.
- [Section 2, Requirement E](#): UDOT notes this may need to be modified. The RSU 4.0 specification requires these messages to be broadcast, but there is no OBU specification. As such, this is intended to reiterate the RSU requirement and also cover the OBU device. Additionally, MMITSS requires sending and manipulating the SRM and SSM message, which should be added here as UDOT found most vendors do not meet a requirement to handle the SRM and SSM messages.
- [Section 2, Requirement G](#): UDOT notes that some applications like MMITSS require two channels be used simultaneously. UDOT had some OBUs with only one radio for a time, and had to institute some channel switching routines. Not all agencies will need this requirement, but the UDOT application did.
- [Section 2, Requirement H](#): UDOT runs MMITSS on a Linux board outside of the DSRC units, so data must be passed to those devices. At least one OBU manufacturer will not allow their GPS signal to be passed out of the OBU to the Linux board, which presents a difficult challenge to UDOT.
- [Section 2, Requirement J](#): UDOT notes that this language could be improved today. Additionally, this requirement is a place where applications that should be on the DSRC units could be defined, if any.
- [Section 3](#): An additional part C might be added here to give the vendor an opportunity to describe any other products (e.g. handheld DSRC units) they might offer.

5.9 GHz DSRC Communication Devices for Connected Vehicle Applications

SOLICITATION REQUIREMENTS / SCOPE OF WORK

Dec 30, 2016

Summary

It is the intent of this procurement to purchase the connected vehicle devices described in this Specification for field deployments, evaluation and/or testing of standards, and interoperability with other vendor equipment.

Technical Requirements

Section 1: General Requirements

- 1.1 The devices described in this document are deployment grade electronic instruments that must be capable of both transmitting and receiving using 5.9GHz band dedicated short range communication (DSRC) for the purpose of facilitating connected vehicle applications. Each unit shall include all components necessary for complete functionality of the unit. Types of devices shall include roadside units (RSU) and on-board units (OBU).
- 1.2 In the event that Vendors have multiple generations of hardware available, they shall offer only the latest version of their equipment for this procurement.
- 1.3 Vendors shall have been producing DSRC units for open purchase for at least three years, and shall briefly identify and describe two recent installations of their hardware at test beds or deployments. Each installation shall include at least three RSU and one OBU.

Section 2: Minimum Technical Requirements

This section identifies the minimum equipment requirements that must be met in order for a proposal to be considered responsive. All of the items described in this section are non-negotiable. All offerors express their willingness, capability, and ability to satisfy these requirements by submitting a proposal for consideration. If it is determined that a proposal does not meet all of the following requirements, at any time during the solicitation process, the proposal will be deemed non-responsive and disqualified from further consideration.

- A. All devices offered shall be new and available for purchase from the awarded contractor.
- B. DSRC Roadside Units (RSUs) shall be carrier grade fourth-generation or later.
- C. RSU must comply with USDOT RSE Device Design Specification v4.0, and be capable of a firmware upgrade to v4.1 (including the Hardware Security Module) at no additional cost.
- D. DSRC two-way communication protocol shall employ and integrate the IEEE 802.11p, 1609.1-1609.4 standards and the SAE J2735 message set dictionary.
- E. RSU and OBU devices shall be capable of transmitting and/or receiving the Basic Safety Message (BSM) as defined by SAE J2735, and the Signal Phase and Timing (SPaT), Traveler Information Message (TIM), and intersection geometry (MAP) messages.
- F. The RSU and OBU shall be capable of supporting both 10 and 20 MHz channel widths in the 5.9GHz band.
- G. The RSU and OBU shall each have two (2) DSRC radios on board, capable of transmitting simultaneous messages over two channels.
- H. The RSU and OBU shall support Global Positioning System (GPS) through internal or external antennas with an accuracy to less than one meter, and shall have a minimum of two external 5.9GHz Omni-directional antennas.
- I. The RSU devices shall be capable of being integrated with traffic signal controllers and connected to an existing, fiber optic, back-haul communications network.
- J. The RSU devices shall have software applications installed which will accept information from signal controllers and broadcast SPaT messages.
- K. OBU devices shall be of the "carry-in" type; a portable device intended for use in the vehicle but not integrated into the vehicle system. The OBU shall be capable of being powered by in-vehicle systems.
- L. The RSU hardware shall be able to use Power over Ethernet (at least PoE 802.3af).
- M. The RSU enclosure shall be NEMA TS2 rated with surge protection.
- N. All equipment purchased from an awarded contract shall be warranted for a minimum of one (1) year from the date of shipment. All warranties shall include repair or replacement of defective components.

3. Utah DOT Procurement Documentation

For repairs under warranty, the Vendor shall bear all costs including labor, parts, handling and shipping charges.

Section 3: Product Descriptions / Support / Ancillary Services Offered

Vendors shall provide the following:

- A. Technical support (phone, firmware upgrades) for six months. Describe the support being offered.
- B. Technical specification sheet(s) of the RSU and OBU.

Section 4: Product Features

Vendors shall identify and describe the features, services and/or secondary products that define and make their products unique and special. This section should be used to differentiate products which meet the minimum requirements from competitor's products, and shall include a discussion to address the following topics:

- A. Vendor's DSRC background and DSRC business model / growth
- B. Product durability & robustness
- C. Proven interoperability
- D. Ease of use (hardware and software)
- E. Security readiness (SCMS)
- F. Firmware / hardware upgrade solutions

4. Florida DOT Procurement Documentation

The following language was issued by the Florida DOT (FDOT) in 2017 for a procurement of RSUs and OBUs to support DSRC-based SPaT broadcasts along the US 90 corridor in Tallahassee. The following sections are most relevant to SPaT and were part of the larger request for proposal (RFP) document that contained additional, standard contract language.

- [Section 9](#): This section presents qualifications for device requirements, preferred staffing experience, and relevant standards.
- [Section 30](#): This section presents a requirement for the top-scored vendors to test their devices in the presence of FDOT staff to verify functionality as described. FDOT noted this was very useful in the selection process.
- [Scope of Services](#): This exhibit describes the project objective, support services and equipment to be provided, the project location, deliverables and schedule, and also describes what aspects will be conducted by Florida DOT.
- [Bid Sheet](#): This table appeared at the beginning of the FDOT RFP.
- [5.9 GHz DSRC Device Technical Specifications](#): This attachment provides a background on DSRC, and technical specifications for RSUs and OBUs used in the project.

Request for Proposal Connected Vehicle Signal Phase and Timing Deployment Project

Section 9. Qualifications

9.5. Device Requirements

9.5.1. General Requirements

This section identifies the DSRC RSU general requirements:

- The devices described in this document are deployment grade electronic instruments that must be capable of both transmitting and receiving 5.9 GHz DSRC for facilitating connected vehicle applications. Each unit shall include all components necessary for complete functionality of the unit. Types of proposed devices include Road Side Equipment (RSE), OBUs, Traffic Controller, and handheld units or referred to as MCTT.
- If Vendors have multiple generations of hardware available, they shall offer only the latest version of their equipment for this bid.

9.5.2. Minimum Technical Requirements

This section identifies the minimum equipment requirements that shall be met in order for a proposal to be considered responsive. All Vendors express their willingness, capability, and ability to satisfy these requirements by submitting a proposal for consideration. If it is determined that a proposal does not meet all of the following requirements, at any time during the solicitation process, the proposal will be deemed non-responsive and disqualified from further consideration.

1. All devices offered shall be new and available for purchase from the awarded Vendor.
2. DSRC RSUs shall be carrier grade fourth-generation or later.
3. RSU must comply with USDOT RSE Device Design Specification v4.0, and be capable of a firmware upgrade to v4.1 (including the Hardware Security Module) at no additional cost.
4. DSRC two-way communication protocol shall employ and integrate the Institute of Electrical and Electronics Engineers (IEEE) 802.11p, 1609.0-1609.12 standards and the Society of Automotive Engineers (SAE) J2735_201603 message set dictionary.
5. RSUs shall support the remote antenna hook up at least 60 ft.

4. Florida DOT Procurement Documentation

6. RSUs shall support an Internet Protocol (IP) Ipv4 connection to the USDOT Proof of Concept Security Credential Management System (SCMS).
7. RSUs shall transmit the SPaT, Traveler Information Messages (TIMs), and intersection geometry (or MAP) messages as defined in SAE J2735_201603.
8. RSUs shall forward Basic Safety Messages (BSMs) received from passing vehicles to a configurable remote network host
9. OBUs shall transmit the BSM as defined by SAE J2945/1
10. OBUs shall process BSM, SPaT, MAP and TIMs and provide applicable information to driver
11. The RSU and OBU shall support both 10 and 20 MHz channels in the 5.9 GHz DSRC band.
12. The RSU shall support Global Positioning System (GPS) as specified in USDOT RSU Specification 4.0/4.1.
13. The OBU shall support Global Positioning System (GPS) as specified in SAE J2945/1.
14. The RSU devices shall integrate with the supplied traffic signal controllers and shall connect to an existing IP network via Ethernet.
15. The RSU devices shall have software applications installed which will accept information from FDOT supplied signal controllers and broadcast SPaT messages.
16. OBU devices shall be of the "carry-in" type; a portable device intended for use in the vehicle but not integrated into the vehicle system.
17. The OBU shall be capable of being powered by in-vehicle systems.
18. The RSU hardware shall be able to use Power over Ethernet (PoE) at least PoE 802.3af. (Note one or more intersection may require PoE over 300 ft.)
19. Any additional enclosures required to accommodate supporting equipment shall be National Electrical Manufacturers Association (NEMA) rated with surge protection.

9.6. Preferred Qualifications

1. Experience providing equipment for, and working on similar vehicle to infrastructure (V2I) tests or projects.
2. Experience working with USDOT's Affiliated Connected Vehicle Test Beds and Pilots.
3. Staff availability and resumes showing experience in similar V2I installation projects.
4. Experience working with Basic Safety Message standard SAE J2735_201603 and SAE J2945/1 latest version.
5. Equipment is an approved Federal DSRC broadcasting equipment and are tested and approved USDOT projects per RSU specifications described in this document.
6. Ability to provide RSE system and other materials as shown in the BID SHEET within thirty (30) days of the Notice to Proceed (NTP).
7. Ability to perform training and oversight for the installers and other staff.

9.7. Qualitative Standards and Criteria

The Vendor shall ensure the following standards and criteria are followed:

1. DSRC RSU specifications document – preferable version 4.1, or 4.0 that is forward compatible with 4.1. Version 4.0: <http://docplayer.net/11087167-Dsrc-roadside-unit-rsu-specifications-document.html>
Version 4.1: http://www.fdot.gov/traffic/Doc_Library/PDF/USDOT%20RSU%20Specification%204%201_Final_R1.pdf
2. 5.9 GHz DSRC Technical Specifications (See Exhibit A, Attachment A).
3. DSRC Message Set Directory – the SAE J2735_201603 Library for BSM, SPaT, MAP, and TIM: <https://www.sae.org/standardsdev/dsrc/>

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4. Best Practices for Surveying and Mapping Roadway and Intersections for Connected Vehicles; Connected Vehicle Pooled Fund Study; May 15, 2016; <http://escholarship.org/uc/item/4f88m75k#page-1>
5. USDOT SPaT Documentation. Obtain from www.itsforge.net
6. FDOT TERL Product Certification Handbook http://www.dot.state.fl.us/trafficoperations/Traf_Sys/Terl-pch.shtm
7. FDOT Approved Products List <https://fdotwp1.dot.state.fl.us/ApprovedProductList/Specifications>
8. 2017 FDOT standard specifications <http://www.dot.state.fl.us/programmanagement/Implemented/SpecBooks/January2017/Files/117eBook.pdf>
9. 2017 FDOT design standards <http://www.dot.state.fl.us/rddesign/DesignStandards/Standards.shtm>
10. USDOT SCMS http://www.its.dot.gov/pilots/pdf/SCMS_POC_EE_Requirements.pdf or later
11. USDOT Intersection MAP and SPaT Tool <https://webapp2.connectedvcs.com/>

Section 30. Proposal Evaluation

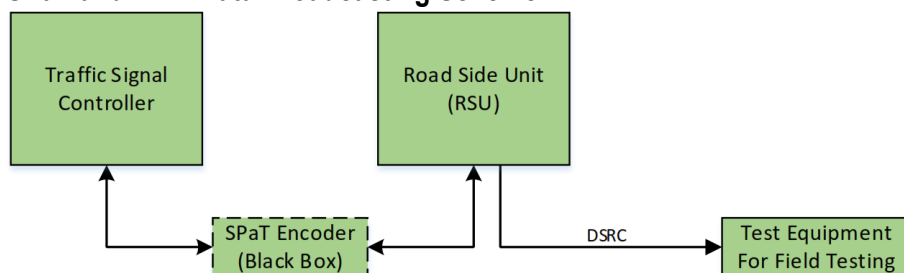
30.2 TERL Testing

The Department will hold a public meeting to summarize the technical evaluations and identify the Proposers that attained an average score of seventy (70) points or higher on their Technical Proposal and are thus considered responsive. The responsive Proposers will continue in this procurement process and be participating in TERL testing on the date(s) scheduled in the Timeline (See Introduction Section 2 Timeline). TERL testing will be done by the top three (3) proposers at TERL campus in presence of the TERL staff. The committee members will independently evaluate TERL test results. TERL testing demonstration is not open to the public. The three shortlisted Vendors shall bring three (3) RSUs, one (1) OBU, and one (1) multi-channel test tool (MCTT). Vendors will be provided with two Intelight 2070LDX controller at TERL during testing. One intersection at TERL will be tested with two RSUs on separate mast arms and the other with just one RSU. All RSU antennas shall be separated from the base by at least 50 ft. and tested for that configuration at each signal. The base to attach to the upright and antenna on the mast arm. A bucket truck will be provided for the vendor to install RSU equipment. The Vendors will be provided with the MAP data created using the USDOT Intersection MAP and SPaT Message Creator Tool to use during testing. The Vendor shall connect and test their system using OBU and MCTT in the presence of the TERL staff and document their findings. These tests will be conducted at two traffic signals located inside the TERL campus. The Vendor shall make their qualified and experienced staff available during testing and provide hands on demonstration to the TERL staff on configuring, installing, and testing the system. The goal of the testing is to ensure:

- SPaT, and MAP, and TIM data comply with SAE J2735_201603
- SPaT message status matches the Signal Head status
- BSMs comply with SAE J2735_201603 using OBUs and MCTT.

It is anticipated that the testing and demonstration can be completed in two (2) days, but additional days can be provided upon request. TERL is located at the following address: 2612 Springhill Road, Tallahassee, FL 32305.

SPaT and MAP Data Broadcasting Scheme



If the RSU does not encode SPaT data directly from the signal controller, the Vendor may need to install a SPaT encoder/processing unit between the RSU and traffic signal controller to broadcast SPaT and MAP data as part of TERL testing.

EXHIBIT "A" Scope of Services

I. OBJECTIVE

The Florida Department of Transportation (hereinafter referred to as Department) intends to deploy Connected Vehicle (CV) Signal Phase and Timing (SPaT) and MAP data broadcasting equipment at twenty-two (22) signalized intersection along US 90 Mahan Drive in Tallahassee, and at the two (2) intersections in the Traffic Engineering Research Laboratory (TERL) campus. The project purpose is to solicit a Roadside Unit (RSU) Vendor (hereinafter referred to as Vendor) to furnish a total of thirty-five (35) Roadside Equipment (RSE) systems including four (4) On Board Units (OBUs), and two (2) MCTT to provide services included in this document.

II. SERVICES TO BE PROVIDED

A. Furnish RSE System

The Vendor shall furnish Dedicated Short Range Communications (DSRC) Roadside Units (RSU) and other ancillary equipment (hereinafter referred to as RSE system, as defined below) for installation at twenty-two (22) signalized intersections along US 90 Mahan Drive from Duval Street to I-10 and at two (2) intersections at the TERL campus. The Vendor shall ensure that the RSE system works with Intelight 2070LDX controllers to broadcast SPaT and MAP data using the 5.9 GHz DSRC. The Vendor shall use identical and completely interchangeable units at each field location. The Vendor shall provide a test plan to the Department to ensure each unit is operational prior to the delivery of the RSE system. The Vendor shall provide the test results to the Department upon delivery.

The RSE system includes antennas, mounting accessories, power and communication connectors, repeater antennas, and Software Development Kit (SDK) for a fully functional unit. The RSE system will also include the SPaT encoder/processing unit, communications and all necessary power cables (including PoE), cables for remote antennas, any inside cabinet equipment, and surge protection for the RSU connection (if needed) and all necessary materials required to make installation fully functional and operational.

B. Field Installation Support

The Vendor shall provide, upon request, the telephone or on-site installation oversight using a qualified staff to ensure that the RSE system is installed per manufacturer's recommendation. The Vendor shall also provide field integration and testing support as requested via telephone or on-site. The hours requested for

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telephone and field support are listed in the BID SHEET. If on-site support is requested, the Vendor will be provided with a 48-hour advance notification.

C. Staff Training

The Vendor shall provide classroom training(s) and related materials (handouts, slides, booklets, etc.) on equipment installation, configuration, integration, and commissioning of the RSU equipment assemblies, and other related components as specified in this scope. At least 160 contact hours (as specified in the BID SHEET) of on-site direction of implementation shall be provided. In addition, 16-hour classroom training session on the equipment shall be provided to the Department to, at a minimum of, twenty (20) individuals. All handouts, slides and training booklets/material shall be provided by the Vendor. The Department will provide the training facility. The Vendor shall include all costs related to the training in the BID SHEET. The Vendor shall provide a Certificate of Completion to all individuals who successfully complete this training.

III. PROJECT SCHEDULE

The Vendor shall furnish RSE system and other devices within thirty (30) days of Notice to Proceed (NTP).

IV. PROJECT LOCATION

The project is located along US 90 Mahan Drive from Duval Road to West of I-10 in Tallahassee, Florida. There are twenty-two (22) signalized intersections along this segment are shown below. In addition, there are two (2) signals located at the TERL campus that will be used during TERL testing.

V. SERVICES/MATERIALS PROVIDED BY THE DEPARTMENT

As part of this project, the Department will develop MAP data, apply for the Federal Communications Commission (FCC) DSRC site licensing, perform equipment installation, configure and test the RSE system components in the field, and perform project management.

VI. SUBMITTALS/DELIVERABLES

The following deliverables are associated with this project:

- The Vendor shall make all RSE systems available within thirty (30) days of NTP.
- The Vendor shall provide troubleshooting guides, customer service plan, and warranty documentations. See RFP Section 10 Warranty/Substitutions for warranty requirements. The Vendor shall ensure all warranties are transferred to the Department. Manufacturer's Warranty shall include all software and hardware upgrades required to be complied with the latest version of the standards. The on-site service includes the hardware and software technical support, software upgrades, licenses, product upgrade, and hardware repair and support with guaranteed response times.
- The Vendor shall provide SDK license to the Department for the RSU.

BID SHEET

BID TITLE: Connected Vehicle Signal Phasing and Timing Deployment Project

BID AS SPECIFIED

<u>WORK SITE LOCATIONS</u>	<u>UNIT</u>	<u>PRICE</u>
Road Side Equipment (RSE) Systems with Signal Phase and Timing (SPaT) encoder/processing unit	35 Assembly	\$ _____
Attachment Cable for Remote Road Side Unit (RSU) Antennas	2,100 Linear Feet	\$ _____
RSU Power and Communications Cable per Vendor Specifications	14,000 Linear Feet	\$ _____
On Board Units (OBUs) including all necessary hardware (cabling, mounting brackets, Global Positioning System (GPS) antenna, Dedicated Short Range Communications (DSRC) antenna, Driver Display Unit, communication and power connectors, etc.	4 Each	\$ _____
RSU Cable Connectors, including: <ul style="list-style-type: none"> • Communication (data) Cable • Antenna • Power 	100 Each	\$ _____
Any specialized tool(s) required to install the RSU Cable Connectors	1 Each	\$ _____
DSRC Multi-Channel Test Tool (MCTT) with Diagnostic Software and Five-Year License Renewal Fee	2 Each	\$ _____
Telephone Support	25 Hours	\$ _____
Training Support	16 Hours	\$ _____
On-Site and Configuration Support	160 Hours	\$ _____
GRAND TOTAL (For all sites)		

ATTACHMENT "A" 5.9 GHz DSRC Device Technical Specifications

1. Description

Dedicated Short Range Communications (DSRC) devices (Roadside Unit [RSU] and On-board Unit [OBU]) are short range communications devices that provide information and support Public Safety operations in Vehicle to Infrastructure (V2I) and Vehicle to Vehicle (V2V) communication environments. DSRC devices are commercial grade electronic devices that transmit and receive DSRC Messages defined in the Society of Automotive Engineers (SAE) Standards J2735_201603 and J2945 suite over the 5.9 Gigahertz (GHz) band approved by the Federal Communications Commission (FCC) for Intelligent Transportation System applications. Furthermore, DSRC devices use Institute of Electrical and Electronics Engineers (IEEE) 1609 standards suite to transmit and receive SAE messages.

2. RSU

- RSUs shall comply with USDOT RSU Specification 4.1, or 4.0 and be firmware upgradable to 4.1 within 2 months of purchase.
- RSUs shall comply with the USDOT Proof-of-Concept Security Credential Management System (SCMS) with a firmware update when the SCMS is available.
- RSU shall broadcast WAVE Service Announcement (WSA) to advertise the SCMS services including IP address.
- The Vendor shall supply an RSU Software Development Kit (SDK).

3. OBU

- OBUs shall broadcast Basic Safety Messages as defined in SAE J2945/1.
- OBUs shall support DSRC applications based on SAE J2735_201603 defined messages including at a minimum, Signal Phase and Timing (SPaT), MAP, and Traveler Information Messages (TIMs).
- OBUs shall be compliant with the following IEEE standards: 1609.0-2016 or later; 1609.2-2016 or later; 1609.3-2016 or later; 1609.4-2016 or later; 1609.12-2016 or later
- OBUs shall comply with the USDOT Proof-of-Concept SCMS with a firmware update when the SCMS is available.
- OBUs shall receive and process WSAs
- OBUs shall be compatible with RSUs described in Section 2.
- The Vendor shall supply an OBU SDK.

5. Michigan DOT RSU Provision Document

MICHIGAN DEPARTMENT OF TRANSPORTATION SPECIAL PROVISION FOR 5.9 GIGAHERTZ DEDICATED SHORT RANGE COMMUNICATION ROADSIDE UNIT

- a. Description.** This work consists of furnishing installing, testing, and warranting a Roadside Unit (RSU). This work must be completed in accordance with the standard specifications, except as modified herein.
1. General.
 - A. Furnish, install, test, and provide manufacturer warranty for all equipment and components necessary to provide complete functionality without additional expense to the Department.
 - B. Use identical and completely interchangeable units at each field location.
 - C. Ensure final equipment selection, procurement, and installation is approved and coordinated with the Engineer.
- b. Materials.**
1. RSU must be in compliance with the FHWA Dedicated Short-Range Communications Roadside Unit Specification 4.1.
 2. Functional and Performance Requirements.
 - A. RSU must minimally support SAE J2735 compliant message sets, including: Basic Safety Message (BSM), Signal Phase and Timing (SPaT), Map or Geometric Intersection Description (GID) and Traveler Information Message (TIM).
 - B. RSU must support the full range of Provider Service Identifiers (PSIDs) as specified in IEEE 1609.12.
 3. Electrical Requirements.
 - A. Ensure RSU is capable of being powered by IEEE 802.3at power over Ethernet (PoE).
 - B. Provide PoE injector that interfaces with 120 volts alternating current (V AC), 60 hertz single-phase power. If the device requires operating voltages of less than 120 V AC, the appropriate voltage converter will be supplied at no additional cost.
 - C. Ensure RSU design protects personnel from exposure to high voltage during installation and maintenance.
 4. Ensure RSU can withstand exposure to direct solar heating.
 5. RSU must support use of global navigation satellite systems (GNSS) to an accuracy of less than 1 meter. External antennas, if necessary, are to be provided at no additional cost.
 6. Minimum of two external antennae mounting ports for DSRC broadcast. External antennas, if necessary, are to be provided at no additional cost
- c. Construction.** All elements included in this special provision, including power and communications, must comply with all standard specifications, and any applicable state and local regulations.
1. Furnish all available software/firmware upgrades through final acceptance at no additional cost to the Department.
 2. Installation.
 - A. Ensure all installation is done in a neat and professional manner. Ensure installed RSU can withstand a three second gust wind speed of 120 miles per hour (mph) from any direction as required by ASCE 7.
 - B. Ensure installation of RSU is in conformance with the manufacturer's specifications.
 - C. Ensure all cabling from RSU to switch is labeled on both ends, bundled, and stressed.
 - D. Ensure the installation meets local and state electrical requirements, including grounding. Grounding will be paid for under 12SP-826B - Grounding, Bonding, Lightning Protection and Surge Protection for ITS Equipment.

- E. Do not damage any part or equipment during installation. Ensure damaged parts or equipment are replaced at no additional cost to the project or the Department. Repair is not an acceptable means of replacement. Ensure all equipment is replaced with new parts.
 - F. Ensure the appropriate surge protector protects the power and components of the RSU. Surge protection is to be paid for under the Special Provision for Grounding, Bonding, Lightning Protection and Surge Protection for ITS Equipment.
 - G. Mount the RSU as shown on the plans. The RSU must be mounted at a height recommended by the Manufacturer and in compliance with the Federal Communications Commission regulations.
3. **Manufacturer Warranty.** Ensure any defect in design, materials, or workmanship which may occur during proper and normal use through final system acceptance is corrected by and/or replacement by the Contractor without cost to the Department.

All RSUs and associated PoE injector devices must carry a standard manufacturer's warranty (equipment and parts) of 2 years from the date of shipment with at least 1 year remaining at the start of burn-in. Furnish warranty and other applicable documents from the manufacturer, and a copy of the invoice showing the date of shipment, to the Engineer prior to final written acceptance. Ensure all warranties are transferred to MDOT upon written final acceptance.

4. **Intersection Installation.** If Intersection type installation is specified in the contract the following procedures apply:
- A. Verify physical connections are performed as specified in contract.
 - B. Verify the RSU is operational and settings for Internet Protocol address, subnet mask, and default gateway, unless otherwise directed by the MDOT Engineer.
5. **Non-intersection Installation.** If Non-Intersection type installation is specified in the contract the following procedures apply:
- A. Perform local testing after installation as detailed in the Special Provision for Local Device Testing.
- d. Measurement and Payment.** The completed work, as described, will be measured and paid for at the contract unit price using the following pay item.

Pay Item	Pay Unit
Roadside Unit, (type)	Each

Roadside Unit, Intersection includes the processing unit, antennas, power over Ethernet injector, surge protection, cabling, mounting accessories, and power and communication connections for a fully functional unit at an Intersection installation

Roadside Unit, Non-intersection includes the processing unit, antennas, power over Ethernet injector, surge protection, cabling, mounting accessories, and power and communication connections for a fully functional unit and a non-intersection installation.

6. Macomb County (Michigan) Department of Roads RSU Provision Document

Several general comments related to this special provision include the following:

- This special provision document is based on the Michigan DOT Special Provision for RSUs, but also incorporates elements from the UDOT specification.
- Including a specification for the levels of support (based on the UDOT specification) helps to address a common issue of working with vendors that shy away from support.
- A Special Provision provides leverage in encouraging vendors to comply to agency goals.
- Agencies should familiarize themselves with applications they are interested in by reaching out to other agencies to learn about various implementations.
- Make a conscious effort to understand the limits of your existing infrastructure and make necessary upgrades that reflect your goals

MACOMB COUNTY DEPARTMENT OF ROADS SPECIAL PROVISION FOR ROADSIDE UNIT PROCUREMENT AND INSTALLATION HAA: 06-21-2018

Description

This work consists of furnishing installing, and warranting a Roadside Unit (RSU).

1. General.
 - A. Furnish, install, and provide manufacturer warranty for all RSUs and PoE injectors and any component necessary for complete functionality without additional cost to MCDR.
 - B. Use identical and completely interchangeable units at each field location.
 - C. Ensure final material selection, procurement, and installation is approved and coordinated with the MCDR Project Engineer.

Materials

1. RSU must meet/exceed all requirements included in the USDOT "DSRC Roadside Unit (RSU) Specifications Document, v4.1" or later. Additionally, the RSU unit must meet the following:
 - A. RSU must minimally support SAE J2735 compliant message sets, including but not limited to: Basic Safety Message (BSM), Signal Phase and Timing (SPaT), MAP or Geometric Intersection Description (GID) and Traveler Information Message (TIM), Signal Request Message (SRM), Signal Status Message (SSM), Radio Technical Commission For Maritime Services (RTCM) Messages, and Personal Safety Message (PSM).
 - B. RSU must support the full range of Provider Service Identifiers (PSIDs) as specified in IEEE 1609.12.
 - C. RSU shall include necessary software application capable of accepting traffic controller information from a source IP address (from existing 2070 controllers and D4 controller software) and converting it into SAE J2735 SPaT message for broadcast over 5.9 GHz DSRC Radio without the need for a separate translation hardware "black box".
 - D. RSU must include applications supporting the correct and efficient processing of received SRM, while properly interfacing with existing 2070 controller and D4 controller software to activate relevant priority and preemption requests.
 - E. RSU must be able to interface with 2070 controller and D4 controller software to acquire preemption/priority signal status, and translate it into J2735 standard SSM for broadcast over 5.9 GHz DSRC Radio.
2. RSU must support use of global navigation satellite systems (GNSS) to an accuracy of less than 1 meter. Necessary external antennas, are to be provided at no additional cost.

3. All necessary mounting equipment and cabling (including cabling ends) for RSU installation is to be provided at no additional cost to MCDR.
4. Minimum of two external antennae mounting ports for DSRC broadcast. External antennas and cabling, if necessary, are to be provided at no additional cost
5. RSU must enable local Wi-Fi hotspot communication.
6. Product Support: Vendors must provide technical support for a period of at least 1 year from date of shipment. Technical support includes, but is not limited to :
 - Assist and aid in troubleshooting arising product related issues
 - Provide ongoing no-cost firmware upgrades (to meet/adhere the most recent published SAE, IEEE and USDOT standards/specifications)
 - Provide RSU installation how-to/documentation
 - RSU Configuration how-to/documentation
 - RSU Firmware Release Notes
7. RSU must be certified through the OMNIAIR V2X connected vehicle certification program, with Test Performance Results provided as proof of certification
8. The RSU base unit SHALL support device network monitoring and management via all SNMP v3 (“DSRC Roadside Unit (RSU) Specifications Document v4.1” (or later) – Appendix B) parameters at a minimum from the RSU to one or more SNMP central IPv4/IPv6 destination addresses.
9. The RSU base unit management software must be free from software defects in both running/operational states and in configuration of the unit (base unit and radio units or it must otherwise be repaired/fixed upon discovery at the Suppliers cost.)

Delivery

Specified materials shall be delivered to a contractor designated temperature controlled facility within 45 miles of the Macomb County Department of Roads (MCDR) Administrative Building as measured along a straight line, excluding Canada. The MCDR Administrative Building facility is located at 117 South Groesbeck Highway, Mount Clemens, MI 48043. The contractor must inform the MCDR Project Engineer 2 weeks prior to any material shipment to the contractor designated facility.

Construction

All elements included in this special provision, including power and communications, must comply with all standard specifications, and any applicable state and local regulations.

1. Installation.
 - A. Ensure all installation is done in a neat and professional manner. Ensure installed RSU can withstand a three second gust wind speed of 120 miles per hour (mph) from any direction as required by ASCE 7.
 - B. Ensure installation of RSU is in conformance with the manufacturer’s specifications.
 - C. Ensure all cabling from RSU to switch is labeled on both ends, bundled, and stressed.
 - D. Ensure that the mounted RSU cabling is plugged into the correct PoE port according to the Manufacturer installation documentation.
 - E. Ensure that the installation of patch cables (for the mounted RSU) is in the correct PoE port according to the Manufacturer installation documentation.
 - F. Grounding and Surge Protection must be provided for each RSU installed.
 - G. Do not damage any part or equipment during installation. Ensure damaged parts or equipment are replaced at no additional cost to the project or the Department. Repair is not an acceptable means of replacement. Ensure all equipment is replaced with new parts.

- H. As directed by the MCDR Project Engineer, mount the RSU as shown on the plans. The RSU must be mounted at a height recommended by the Manufacturer and in compliance with the Federal Communications Commission regulations.
- I. Ensure Completing the FCC 601 Schedule M form for each location at no cost to the Department. This collected field data must be provided to the project engineer for FCC registration purposes. Some of the data elements that need to be recorded are shown in the following table:

	Data Field	Example	Comments
Location Information	Site Name (Alphanumeric Only)	I75BLMM0003	ITS site name with spaces and special characters removed (I75MM0046) OR Intersection (US12WDorset)
	Latitude (DD MM SS.S)	42 36'40.44" N	Latitude DMS NAD83
	Longitude (DD MM SS.S)	83 14'05.56" W	Longitude DMS NAD83
	Municipality	Bloomfield Township, MI	City, Village, Township
	Site Elevation (AMSL) (m)	278.9	Meters
Device Information	Hardware Make/Model	Cohda MK5	
	Serial #	04E54810154C	
	FCC ID #	2AEGPMK5RSU	
	Firmware Version	3.10.17-rt12	
Mounting Information	Structure Type	Steel Strain Pole	Mounting structure: Steel Strain Pole (RSU only), Steel Strain Pole (RSU only), Spun Concrete Pole, DMS Structure, Etc.
	Structure Height (Above Road) (m)	12.2	
	... with Appurtenances (Above Road) (m)	12.9	Including air terminals and other antennas
	Mounting Height (Above Road) (m)	7.62	
	Elevation Angle (Degrees)	0	Elevation angle of the transmitting antenna (rounded to the nearest degree), measured from the horizontal up to the center line of the main beam of the antenna. If the antenna tilts down (depression angle), indicate with a minus sign. See FCC Form 601 Sched M
Broadcast Information	Service Channel	184	
	Antenna Make	Mobile Mark	Make of actual antenna
	Antenna Model	EN-60000	Make of actual antenna
	Antenna Gain (dBi)	5 dBi	
	Beamwidth (degrees)	21 degrees	
	Azimuth beamwidth (degrees)	360 degrees	
	Max Power Output (dBm)	24 dBm	
	Max EIRP Power Output (dBm)	29 dBm	

2. **Manufacturer Warranty.** Ensure any defect in design, materials, or workmanship which may occur during proper and normal use through final system acceptance is corrected by and/or replacement by the Contractor without cost to the Department.

All RSUs and associated PoE injector devices must carry a standard manufacturer’s warranty (equipment and parts) of 2 years from the date of shipment. Furnish warranty and other applicable documents from the manufacturer, and a copy of the invoice showing the date of shipment, to the Engineer prior to final written acceptance. Ensure all warranties are transferred to MCDR upon written final acceptance.

Measurement and Payment

The completed work, as described, will be measured and paid for at the contract unit price using the following pay item.

Pay Item	Pay Unit
RSU, Deliver	Each
RSU, Install.....	Each

RSU, Deliver: Payment includes the delivery of the Roadside units, antennas, and power over Ethernet injector.

RSU, Install: Payment includes:

- Completion of work defined under the Construction section herein.
- Installation of all RSUs, CAT6 cables and cable ends, CAT6 patch cables, mounting accessories and brackets, power and communication connections, and/or any other items necessary for a fully functional unit at an intersection.
- Completing the FCC 601 Schedule M form for each location.