

TECHNICAL SPECIAL PROVISION

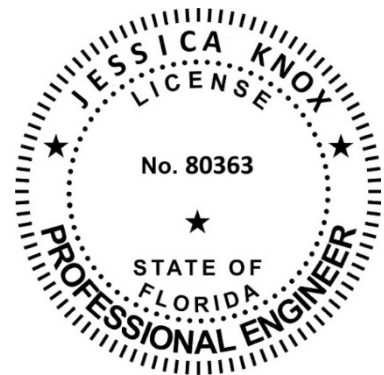
FOR

T681 - CONNECTED VEHICLE ROADSIDE UNIT

FINANCIAL PROJECT NO.: 445362-2-52-01; 440712-1-52-01

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T681 – CONNECTED VEHICLE ROADSIDE UNIT

T681-1 Description.

The Contractor is responsible for fulfilling all elements of this TSP (T681) except where specifically stated otherwise.

Install connected Vehicle (CV) equipment in accordance with the Contract Documents. The CV Roadside Unit (RSU) is a component of the CV equipment.

T681-2 Materials.

The Department will procure CV equipment meeting this section (T681-2) and all subsections with the exception of CV cabling and attachment hardware. The CV cabling and attachment hardware shall be procured by the Contractor. The CV equipment procured by the Department shall be installed by the Contractor. The Connected Vehicle (CV) equipment must be compatible with United States Department of Transportation (USDOT) approved Security Credential Management System (SCMS) message security solution for vehicle-to-infrastructure (V2I) communications and meet the applicable industry standards listed in Table T681-2.1.

Table T681-2.1 CV Equipment Requirements and Standards	
Document Identifier	Description
CTI 4001 v01.00	Roadside Unit Standard Version 1.0 https://www.ite.org/pub/?id=764FB228-0F6C-BA02-6D7B-16A86B1F8108
CTI 4501 v01.00	Connected Intersections (CI) Implementation Guidance Version 1.0 CTI 4501 v01.00, Connected Intersections (CI) Implementation Guide (ite.org)
ISS SCMS Specification v1.5 (17 AUG 2020)	Integrity Security Services PSID/SSP Profile Specification for Statewide SCMS document version 1.5
FHWA-JPO-17-589 (April 28, 2017)	Dedicated Short-Range Communications Roadside Unit Specifications https://rosap.ntl.bts.gov/view/dot/3600
3GPP Release 14	https://www.3gpp.org/ftp/Specs/latest/Rel-14/
NTCIP 1218	This standard defines the protocols and Simple Network Management Protocol (SNMP) objects for configuring, operating, and maintaining the RSU
Society of Automotive Engineers (SAE) J2735 v5	The J2735 v5 Standard specifies a message set, its data frames and data elements for the use by applications intended to utilize the 5.9 GHz Dedicated Short-Range Communications (DSRC) for Wireless Access in Vehicular Environments (WAVE) communications systems.
Society of Automotive Engineers (SAE) J2945/X 201712	The J2945_201712 Standard specifies DSRC interface requirements (and enables interoperability) for V2V Safety Awareness applications
IEEE 802.11-2012 (or later)	Institute of Electrical and Electronics Engineers (IEEE) Standard for Information technology--Telecommunications and information exchange between systems local and metropolitan area networks--Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications

IEEE 1609.0-2013 (or later)	IEEE Guide for WAVE - Architecture
IEEE 1609.2-2016 (or later)	IEEE Standard for WAVE -- Security Services for Applications and Management Messages
IEEE 1609.3-2016 (or later)	IEEE Standard for WAVE -- Networking Services
IEEE 1609.4-2016 (or later)	IEEE Standard for WAVE -- Multi-Channel Operation
IEEE 1609.12-2016 (or later)	IEEE Standard for WAVE -- Identifier Allocations
IEEE 802.3at-2009	Standard for Power over Ethernet
FCC Title 47, Parts 0, 1, 2, 15, and 90	Federal Communications Commission (FCC) Code of Federal Regulations (CFR)
FDOT CM-995-2.7-01 (12/22/2020)	FDOT Traffic Engineering Research Laboratory (TERL) Wrong Way Vehicle Detection System (WWVDS) Compliance Matrix

The CV equipment includes hardware, software, ancillary devices, and all material necessary to enable wireless V2I and V2X communications. Ensure that all assembly hardware, including nuts, bolts, external screws and locking washers less than 5/8 inch in diameter, are Type 304 or 316 passivated stainless steel. Use stainless steel bolts, screws and studs meeting the requirements of ASTM F593. Use nuts meeting the requirements of ASTM F594. Ensure all assembly hardware greater than or equal to 5/8 inch in diameter is galvanized. Use bolts, studs, and threaded rod meeting the requirements of ASTM A307. Use structural bolts meeting the requirements of ASTM F3125, Grade A325.

The CV equipment must be FCC certified. The System Manager will ensure that the FCC identification number is displayed on an external label and that all devices operate within their FCC frequency allocation of 5.9 GHz Dedicated Short-Range Communication (DSRC) and Cellular V2X (C-V2X). Both the antennas and the base units must be FCC certified if they are approved separately.

The System Manager will ensure the CV equipment is capable of remote firmware updates to include SCMS updates and other related firmware updates. Device manufacturers must make firmware updates available to the Department and maintaining agency at no cost. DSRC and C-V2X capabilities that function concurrently are required.

T681-2.1 Roadside Unit (RSU): The RSU will be a commercially available production grade device that provides information and supports public safety operations in a V2I/V2X communication environment. The System Manager will ensure that the RSUs are delivered by the manufacturer to account for specific site conditions, preconfigured for SCMS, and are ready for the installation and operation at the sites shown on the plans. The Systems Manager will configure the following CV applications as well as the identified TIM for broadcasting to the OBUs as part of the project:

- MAP Message
- Signal Phase and Timing
- Traveler Information Message (TIM) to include:
 - TM08 – Traffic Incident Management System
 - TM12 – Dynamic Roadway Warning

- TM17 – Speed Warning and Enforcement
- TM25 – Wrong Way Vehicle Detection and Warning
- TI03 – Dynamic Route Guidance
- VS07 – Road Weather Motorist Alert and Warning
- VS08 – Queue Warning
- VS09 – Reduced Speed Zone Warning/Lane-Closure
- MC06 – Work Zone Management
- PS07 – Incident Scene Safety Monitoring
- TM04 – Connected Vehicle Traffic Signal System
- TM14 – Advanced Railroad Grade Crossing
- PT09 – Transit Signal Priority
- PS03 – Emergency Vehicle Preemption
- VS12 – Pedestrian and Cyclist Safety
- VS13 – Intersection Warning and Collision Avoidance
- CVO06 – Freight Signal Priority

The System Manager will ensure the RSUs are interoperable with all FDOT APL approved ATC traffic signal controllers and that the RSU is permanently marked with manufacturer name or trademark as well as part number and serial number. Ensure that the markings are visible after installation.

T681-2.1.1 Wired Interfaces: The RSU will include a wired Ethernet interface.

T681-2.1.2 Wireless Interface: The RSU will include a commercial grade radio that transmits and receives C-V2X and/or dual mode, dual active (with DSRC) messages within the 5.9GHz band. Supports Single Channel Continuous and dual Channel Alternating DSRC Channel Modes simultaneously. RSU will be dual mode with DSRC and C-V2X capabilities that function concurrently.

T681-2.1.3 Cellular Interface: Supports LTE V2X PC5 mode 4, defined by 3GPP Rel-14.

T681-2.1.4 Antennas: The System Manager will ensure that antennas are provided for all radio frequency (RF) connectors on the RSU. Only those antennas tested with the device to obtain the FCC Grant of Equipment Authorization (or similar antennas with equal or lesser gain) will be used and must not be co-located or operated with any other antenna or transmitter, except in accordance with the FCC multi-transmitter policy. Antennas must be removable to allow for the antennas to be installed at a distance from the RSU unit or replaced as needed. Antennas will contain an integrated Global Positioning System (GPS) receiver for positioning and timing.

The cabling for the RSUs shall be sized appropriately to ensure full functionality of the unit based on the separation of the antenna from the RSU. This cabling shall be the responsibility of the contractor.

T681-2.2 Configuration and Management: RSU will be provided by the system manager with all hardware, software, configuration tools and software licenses required for local and remote configuration, operation, and management including access to all user-programmable features as well as health and status monitoring, event logging, and diagnostic utilities. Configuration and management functions will be password protected. Access to all user-programmable features, alarm monitoring, configuration parameters, event logging and

diagnostic utilities must be through a vendor provided Graphical User Interface (GUI). The RSU will be provided with an open application programming interface (API) and software development kit available to the Department at no additional cost. The RSU will automatically recover from a power failure once power is restored. The System Manager will ensure that all programmable settings are restored to their previous configurations and that the system resumes proper operation. RSU will be interoperable with SunGuide® and other connected vehicle devices

T681-2.3 System Communication: The RSU will be assigned an IPv4 address by the System Manager as provided by the Department. The RSU will be IPv6 compatible.

T681-2.4 Electrical Specifications: The System Manager will ensure the RSU is provided with a power over Ethernet (PoE) injector as detailed in the plans. Powered ports on the PoE injector will meet the requirements set forth in IEEE 802.3at. The System Manager will ensure the PoE injector operates using a nominal input voltage of 120VAC. The Contractor shall ensure no interference from nearby cables by providing shielded cables for all installations.

T681-2.5 Environmental Requirements: Ensure equipment performs all required functions during and after being subjected to the transients, temperature, voltage, humidity, vibration, and shock tests described in NEMA TS2, 2.2.7, 2.2.8, and 2.2.9.

T681-2.6 Ports and Connectors: The RSU will include all necessary ports and connectors for a complete assembly. Type N weatherproof RF ports are used for the antennas. All ports must be legibly and permanently marked, by the Contractor, designating their intended use. All labels must be weather resistant.

T681-2.7 FCC License: The System Manager will compile all information required to register RSU devices and locations with the FCC and provide this information to the Engineer for review in accordance with Section 7-2. Support the permitting effort until complete.

T681-3 Installation.

The Contractor will install all equipment in accordance with the Contract Documents, manufacturer's recommendations, and as directed by the Engineer. Contractor to furnish all equipment with the appropriate power and shielded communication cables, any electronics (i.e. PoE), mounting brackets, and mounting hardware according to the manufacturer's recommendations and per the plans. Ensure that cables comply with NEC sizing requirements and meet all other applicable standards, specifications, and local code requirements.

Cut all wires to their proper length before assembly. Do not double back any wire to take up slack. Neatly lace wires into cables with nylon lacing or plastic straps. Secure cables with clamps and provide service loops at all connections. Ensure that all shielded twisted pair Ethernet network cables are compliant with the EIA/TIA-568 standards and UL type CM/CMX/GMG outdoor. Secure drip loops and outdoor cables with self-locking outdoor rated cable ties of UV stabilized black plastic having a minimum tensile strength of 100 pounds. Ensure that all device cabling is free from defects. Provide slack coils within cabinets and pull boxes to facilitate future re-terminations. Neatly bundle, coil, and band all slack within storage areas using heavy duty cable ties. Provide drip and service loops for RSU and antenna cabling. Provide weatherproof cable tags at all storage points and at cable termination ends. Verify that all field wiring meets applicable National Electric Code (NEC) requirements.

T681-3.1 Connectorized Ends: Securely and properly perform all field terminations in accordance with the manufacturer's recommendations.

T681-3.2 Surge Protection: Contractor will provide surge protection devices at locations

as shown on the plans and in accordance with Section 620. Provide surge protection at the ends of cabling prior to its final destination. Ensure that all cables are protected against surges and induced voltage when entering cabinets. Ensure that all grounding clips or cables are provided and properly grounded. All grounding wires for surge protection within the cabinet shall be connected to the cabinet's grounding busbar.

T681-3.3 RSU Installation: Contractor shall install RSUs on existing poles, signal poles/structures, or on new poles, as shown in the Plans. Ensure that the devices are not directly obstructed which may impact or reduce communication functionality. Ensure that status indicators (LEDs) remain unobstructed and visible. The System Manager will submit electronic configuration file backups to the Engineer following field testing. Backup files must include MAP files, communication settings, firmware, and all other files and settings required to program a new replacement RSU.

The mounting hardware, and any other related material that is exposed to the environment must be designed for 150 mph wind speeds and meet the requirements of the Department's Structures Manual.

T681-3.4 Industrial Computer Installation: The Contractor shall install the industrial computer (IVP Hub), interoperable with the RSUs and installed sensors for local CV applications inside a field site cabinet, where noted in the plans. Ensure that the industrial computer is mounted securely and is fully accessible by field technicians.

The System Manager will submit electronic configuration file backups to the Engineer following field testing. Backup files must include communication settings, firmware, and all other files and settings required to restore current operation and program a new replacement industrial computer for local CV applications.

T681-3.5 OBU Installation: Contractor shall install the interoperable OBU in accordance with the Contract Documents, manufacturer's recommendations, and as directed by the Engineer. Submit electronic configuration file backups to the Engineer following field testing. Backup files must include communication settings, firmware, and all other files and settings required to restore current operation and program a new replacement OBU.

T681-3.6 TESTING:

T681-3.6.1 General: The Contractor shall conduct device testing after the Contractor has installed the CV equipment. Contractor shall test the equipment per the testing requirements provided in the T612 Specifications.

Submit/completed test documents to the Engineer for consideration and approval. The Engineer reserves the right to witness all field acceptance tests.

T681-4 Warranty.

The Department will be responsible for any warranties related to CV equipment they procure. The Contractor shall not do anything to void the warranty while the device is under their control, including mishandling and improper connections to power and surge suppression devices. The Contractor shall be responsible for any additional costs.

T681-5 Method of Measurement.

The Contract unit price for each RSU, will include installation, placement, and testing of all materials and equipment, and for all tools, labor, equipment, hardware, operational software packages and firmware, supplies, support, personnel training, shop drawings, documentation, and incidentals necessary to complete the work.

T681-6 Basis of Payment.

Price and payment will be full compensation for furnishing all materials and completing all work to install the Department furnished RSU and IVP Hubs, as specified in this section or shown in the Plans.

Payment will be made under:

Item No. 920-681-X Connected Vehicle Roadside Unit – each.

Item No. 920-681-X Connected Vehicle Roadside Unit – Industrial Computer -
each.