

# Tennessee Department of Transportation (TDOT) Global Navigation Satellite System Specifications

## 1 Bid Specifications

1.1 These bid specifications, by and between the State of Tennessee, Department of Transportation ("State" or "TDOT"), and [bidding entity] ("Contractor"), are for the provision of global navigation satellite system receivers ("GNSS"), as further defined below. This specification establishes the technical requirements for the purchase of new survey-grade GNSS field hardware and includes training, warranty, and delivery of all hardware. The State operates a statewide continuously operating reference station ("CORS") network, which utilizes antennas and receivers. Therefore, the hardware procured under this bid specification shall communicate and work seamlessly with the CORS network and experience no loss of function with the data collectors and GNSS receivers listed in Section 1.2.

### 1.2 Existing Hardware

#### 1.2.1 Data Collectors

- a. Spectra (Nomads, Rangers)
- b. Trimble T7
- c. Carlson RT4
- d. Sokkia SHC5000
- e. Sonarmite/HydroLite echo sounders

1.3 Definitions – For purposes of this bid specification, definitions shall be as follows and as stated elsewhere in the bid specification:

1.3.1 "ARP" shall mean antenna reference point.

1.3.2 "CORS" shall mean a Continuously Operating Reference Station. A station comprises various hardware and typically includes at least one mark containing one geometric reference point, a GNSS antenna, receiver, power, and communications hardware. The purpose of a CORS network is to continuously collect GNSS data to monitor the coordinates of the geometric reference point.

1.3.3 "EFI" shall mean an interface between an operating system and platform firmware.

1.3.4 "FCC" shall mean Federal Communications Commission, an independent agency of the United States government that regulates communications by radio, television, wire, satellite, and cable across the United States.

1.3.5 "Galileo" shall mean a global navigation satellite system (GNSS) operated by the European Union Agency for the Space Program (EUSPA), headquartered in Prague, Czech Republic.

1.3.6 "GNSS" shall mean global navigation satellite system, a general term

- describing any satellite constellation that provides positioning, navigation, and timing services worldwide or on a regional basis.
- 1.3.7 “GPS” shall mean Global Positioning System, which refers to a constellation of satellites developed by the United States.
- 1.3.8 “GLONASS” shall mean a Russian satellite navigation system operating as part of a radionavigation-satellite service. It provides an alternative to Global Positioning System (GPS) and is the second navigational system in operation with global coverage and of comparable precision.
- 1.3.9 “hybrid operation” shall mean solutions in a hybrid environment; a software vendor can offer multiple software deployment methods. It can be used on-premises, hosted on the vendor’s cloud, or another firm’s cloud.
- 1.3.10 “IRNSS” shall mean an independent regional navigation satellite system designed to provide accurate position information service to users in its primary service area, India, and the region extending up to 1500 km from its boundary.
- 1.3.11 “MIL-STD-810G environmental standard” shall mean a U.S. military standard that, through iterations and decades, has certified military equipment as field-ready with a system of tests that simulate various environmental conditions, including shock and vibration.
- 1.3.12 “NTRIP” shall mean Network Transport of RTCM data over IP.
- 1.3.13 “Off-the-shelf” shall mean not designed or made to order but taken from existing stock or supplies.
- 1.3.14 “PNT” shall mean positioning, navigation, and timing services on a global or regional basis.
- 1.3.15 “PDH” shall mean professional development hour and is defined as one contact hour of instruction, presentation, or study.
- 1.3.16 “QZSS” shall mean a Quasi-zenith satellite system designed so that at least one satellite out of three exists near the zenith over Japan.
- 1.3.17 “RTCM” shall mean real-time configuration manager. RTCM is an EFI application that allows using software SRAM technology on non-virtualized systems.
- 1.3.18 “RTK” shall mean Real-time kinematic positioning; surveying is used to correct common errors in current satellite navigation (GNSS) systems.
- 1.3.19 “SBAS” shall mean a Satellite-based accuracy system. It improves the accuracy and reliability of GNSS information by correcting signal measurement errors and providing information about its signals' accuracy, integrity, continuity, and availability.
- 1.3.20 “SRAM” shall mean Static random-access memory, a random-access memory that uses latching circuitry (flip-flop) to store each bit.
- 1.3.21 “SIM” shall mean subscriber identity module or subscriber identification module, an integrated circuit running a card operating system.
- 1.3.22 “TCP/IP” shall mean Transmission Control Protocol/Internet Protocol. TCP/IP is a set of standardized rules allowing computers to communicate on a network like an internet.
- 1.3.23 “TDOT” shall mean the Tennessee Department of Transportation.
- 1.3.24 “UHF” shall mean Ultra high frequency, a designation for radio

frequencies.

1.3.25 "USB" shall mean Universal Serial Bus, an industry standard that establishes specifications for cables, connectors, and protocols for connection, communication, and power supply (interfacing) between computers, peripherals, and other computers.

1.4 TDOT may purchase the following items that meet the minimum specifications below. The contractor shall not impose minimum purchases to process orders.

1.4.1 Eighty-five (85) GNSS receivers with a case.

1.4.2 A minimum three (3) year manufacturer warranty for GNSS receiver from the time of delivery.

1.4.3 Twenty (20) GNSS base accessory kits.

1.4.4 Sixty-five (65) GNSS rover accessory kits.

1.4.5 Four (4) cloud-based NTRIP correction services.

1.4.6 Training: use of the hardware, software, and GNSS surveying techniques.

## **2 General Requirements**

2.1 All data collected by the hardware and all related documentation are the property of the State and shall not be used without prior approval from the State. All data collected shall be made available to the State.

2.2 The Contractor shall provide one (1) point of contact to resolve any issues that arise from the contents of this Bid Specification (e.g., hardware, software, functionality), etc. Contractor shall be the only point of contact for the State to resolve issues, problems, etc., and not a third-party hardware manufacturer. It is the sole responsibility of the Contractor to resolve all issues concerning the hardware solutions for the State.

2.3 The Contractor shall provide the specific technical information requested in each requirement detailed in section 3 and may not substitute technical brochures or product manuals. The Contractor may not refer the State to pages or items in product brochures, manuals, or similar materials in lieu of specific technical information requirements.

2.4 If the Contractor or manufacturer has newer or updated hardware products that are publicly released and commercially available within One-hundred-eighty (180) calendar days from the effective date of the bid specification, the State has the option to obtain, at no additional cost, the most recent hardware/software/firmware upgrade(s) or new product lines that upgrade the functionality or usability of requested products to any portion of this package.

2.5 The Contractor shall provide replacement hardware product(s) that meet or exceed the original hardware specifications for any discontinued hardware for

the term of the manufacturer warranty.

- 2.6 The State reserves the right to purchase hardware upgrades or new product lines that upgrade the functionality or usability of requested products to any portion of this package, whether from the Contractor or any other vendor not party to this bid specification for the term of the warranty.
- 2.7 The Contractor shall provide all modem accessories required for proper functionality as a part of this bid specification. The cost for any modem hardware shall be included in the overall price for the unit. In addition, the State shall provide wireless service for the modem connection. The wireless carrier shall be made known to the Contractor at the time of purchase so that modem receiver configuration can be completed.
- 2.8 GNSS receiver connections to the State CORS network and data collectors shall be tested and deemed fully functional before acceptance.
- 2.9 Communications between all hardware obtained in this bid specification and the data collectors currently utilized by the State are required via Bluetooth technology, cable, or equivalent.
- 2.10 The Contractor shall properly install, configure, interface, maintain, and operate per the manufacturer's specifications. In addition, the Contractor shall provide an accurate and valid serial number for each GNSS Receiver and accessory.
- 2.11 The Contractor shall provide expert knowledge to assist in troubleshooting for hybrid operation between the GNSS Receiver and any new data collectors and data collector software.
- 2.12 The Contractor shall provide support for GNSS Receiver purchased during the Contract Term, including support for any hardware or software upgrades or updates made to existing software or hardware currently owned by the State during the Contract Term. Support shall also include ensuring that in the event software communication failure occurs Contractor will provide resolution to ensure that the equipment performs to outlined specifications.
- 2.13 If necessary, all applications for the broadcast radio Federal Communications Commission (FCC) licenses shall be completed by the Contractor and forwarded to the State for signatures. Completed applications shall be included with the delivery of the applicable hardware.

### **3 Receiver and Accessory Requirements**

#### **3.1 Software Requirements**

- 3.1.1 Fully compatible with field surveying hardware currently deployed by the State is listed in Section 1.2.

- 3.1.2 Carlson field and office software are currently used to interface with this hardware and process the field data in MicroStation V8i, GEOPAK, and Bentley OpenRoads software. Therefore, the hardware provided under this bid specification shall function appropriately with all software currently deployed by the State.
- 3.1.3 Contractor shall be responsible for meeting and maintaining application compliance with current and ongoing State communication and security requirements with patching and updates at no cost to the State for the term of the warranty.

### 3.2 Hardware Requirements GNSS Receiver and Accessories

#### 3.2.1 GNSS receivers

##### a. Physical

- Minimum 4 GB internal memory.
- SD and SIM card slot.
- Serial port, USB port, TCP/IP, NTRIP, and Bluetooth capable.
- Tilt compensator with automatic level correction for a survey pole tilted up to 30° from the zenith axis.
- The antenna/receiver shall mount on a standard surveying tripod having a five-eighths (5/8) inch by eleven (11) threads per inch instrument fastener.
- Carrying case.
- Meets IP67 or greater dust and water protection.
- Meets MIL-STD-810G environmental standards.
- Minimum 10-hour hot-swappable battery life.
- Positional accuracy (1 RMS): RTK (8 mm + 1 ppm), static (2.5 mm + 1 ppm).
- Field configurable as an RTK base or rover.
- Must weigh less than 3 pounds with a battery

##### b. Communication

- Minimum of four hundred-fifty-two (452) channels
- Multi-Frequency GNSS tracking
- Web user interface.
- Ability to connect to Wi-Fi networks.
- Internal antenna.
- Internal UHF radio for transmitting and receiving data.
- RTCM 3.2 and CMR+ support
- Ability to track and fully utilize GPS, GLONASS, BeiDou, Galileo, QZSS, SBAS, and IRNSS signals
- Ability to function as a network rover and connect to the State CORS network
- Ability to broadcast and receive corrections and function as an NTRIP server utilizing a cellular modem internet connection.
- Non-proprietary connectivity with the ability to communicate via Bluetooth and cable with the existing State data collectors listed in section 1.2.
- Able to communicate with and be controlled by the most current version of the Carlson SurvPC software.
- Ability to utilize SureFix, verified fix, or double fix technology to ensure

fixed GNSS solutions with a minimum two (2)-sigma ninety-five percent (95%) confidence level.

### 3.2.2 Rover Accessory Kit

- a. Receiver battery charger cradle (2 battery capacity)
- b. One (1)-piece carbon fiber three (3) position Snap-Lock two (2) meter rover rod
- c. Receiver to Carlson RT4 Data Collector/ PC Serial Cable
- d. Receiver to Carlson RT4 Data Collector/PC USB Cable
- e. Carbon fiber thumb release bipod
- f. Two (2) receiver batteries

### 3.2.3 Base Accessory Kit

- a. Telescoping Tripod, 2m Fixed Height with Bag
- b. Receiver to external battery cable, ten foot (10') minimum length

### 3.2.4 Accessory Requirements

- a. The Contractor shall provide a means of measuring from a survey ground point to the antenna phase center and the antenna reference point (ARP). Fixed height tripods/bipods and standard antenna calibrations are accurate methods of measurement.
- b. Receivers shall be housed in a carrying case which shall not be used as a shipping container. Shipping containers shall be provided in addition to the carrying case.
- c. The receiver case shall have a rigid exterior that is water and dust resistant. The interior shall be form-fitted to the GNSS receiver to secure all contents during transport.

## 4 **Warranty and Support Specifications**

- 4.1 The warranty period shall begin upon the State's final acceptance of the delivery. It shall be for a minimum duration of three (3) years, or the manufacturer's standard warranty period, whichever is greater, from the final acceptance of the delivery.
- 4.2 The Contractor shall be responsible for oversight of all repairs and be authorized by the manufacturer to perform all repairs.
- 4.3 All respondents shall be required to submit a letter at the time of bid from the manufacturer indicating they are an authorized reseller for the hardware and are authorized to perform warranty repairs.
- 4.4 The Contractor shall include a warranty against all defects in materials and quality for all hardware and software provided under this bid specification. The warranty shall apply to all hardware and peripherals, such as radios, tripods,

modems, etc.

#### 4.5 Repair and Replacement

- 4.5.1 When repair/replacement is necessary, hardware is shipped by a one (1) day express delivery service. The Contractor shall pay all costs of shipping and shipping insurance. The insurance rate shall be determined by the value of the hardware established through this bid specification.
- 4.5.2 The Contractor shall repair the hardware. The mode of shipping will be agreed upon by both parties, either by shipping direct or picked up by the State. Repair shall occur within ten (10) working days of the Contractor's receipt of the hardware. If the problem involves a change to the software, the Contractor shall, where possible, provide a workaround to the problem until the problem is resolved and shall provide a permanent fix for the issue as soon as possible.
- 4.5.3 While the Contractor is repairing or diagnosing a repair, the Contractor shall provide loaner hardware of equal or better specifications during the repair period at no additional cost to the State. Loaner hardware shall be shipped to the State no later than the day after the Contractor receives the damaged unit, whether shipped or by hand delivery.

#### 4.6 Technical Support

- 4.6.1 The Contractor shall provide technical support for all hardware and any Contractor-provided software required for hardware functionality from 6:00 a.m. - 10:00 p.m. Monday through Friday, excluding State holidays. State holidays are listed on the following webpage:  
<https://www.tn.gov/about-tn/state-holidays.html>
- 4.6.2 Technical support shall be provided, at no cost to the State, via in-person (field), phone, email, or website during the warranty period.
- 4.6.3 Technical and user manuals covering all the items bid in this specification shall be included with the delivery. These manuals shall consist of, at a minimum, the following topics: system operation, user operation of the system, and user maintenance of the system. In addition, one (1) set of field (electronic or physical) manuals shall be supplied by the Contractor with each receiver. Contractor shall provide the latest revisions to reference manuals as software updates become available. The State may be notified of reference manual updates via electronic mail (email). Such updates may be delivered electronically or sent as physical USB to the State-designated point of contact.

#### 4.7 Purchase Order and Delivery Requirements

- 4.7.1 Purchase Orders – Upon award of this bid specification, the State shall submit a purchase order(s) for the hardware. The Contractor shall not impose minimum purchases to process orders.
- 4.7.2 Equipment Delivery – The Contractor shall deliver the equipment at an agreed-upon time to the loading dock of the location(s) listed on each purchase order submitted. Delivery locations are defined in Section 4.7.5. Elevators and loading docks are present at each location. The State shall not provide the supplies necessary to deliver the equipment. The Contractor shall provide the necessary supplies to deliver the equipment before the scheduled delivery time.
- 4.7.3 Delivery Hours – The Contractor shall deliver the equipment at an agreed-upon time during the hours of 7:00 a.m. to 3:30 p.m., local time (Eastern Time or Central Time), Monday through Friday, excluding legal State holidays. State holidays are listed on the following webpage: <https://www.tn.gov/about-tn/state-holidays.html>.
- 4.7.4 Delivery Clearance – The State shall provide the Contractor with a point of contact for each location defined in Section 4.7.5; the Contractor shall contact the point of contact for delivery clearance at least 48 hours prior to the scheduled delivery time. The point of contact will check the availability of the loading dock and provide instructions for which loading dock or entrance to utilize.
- 4.7.5 Delivery Locations – Delivery locations include:
- |  |  |
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| <p>a. TDOT – Region 1<br/> Site Contract: Kent Fox<br/> Email: Christopher.Fox@tn.gov<br/> Address: Survey Office Building<br/> 7366 Region Lane,<br/> Knoxville, TN 37914</p> | <p>Twenty-nine (29) GNSS receivers,<br/> Twenty-five (25) rover kits<br/> Four (4) base kits</p> |
| <p>b. TDOT – Region 2<br/> Site Contact: Doug Ford<br/> Email: Douglas.Ford@tn.gov<br/> Address: Survey Office<br/> 7512 Volkswagen Drive,<br/> Chattanooga, TN 37421</p>      | <p>Twenty-one (21) GNSS receivers<br/> Seventeen (17) rover kits,<br/> Four (4) base kits</p>    |

- c. TDOT – Region 3  
 Site Contact: Melissa Portell  
 Email: Melissa.Portell@Tn.gov  
 Address: Survey Office  
 6636 Centennial Boulevard,  
 Nashville, TN 37243  
 Nineteen (19) GNSS receivers,  
 Fourteen (14) rover kits  
 Five (5) base kits
  
- d. TDOT – Region 4  
 Site Contact: Glen Blankenship  
 Email: Glen.Blankenship@tn.gov  
 Address: Project Development Office  
 Administration Bld, 1<sup>st</sup> Floor  
 300 Benchmark Place,  
 Jackson, TN 38301  
 Fifteen (15) GNSS receivers  
 Eleven (11) rover kits  
 Four (4) base kits

4.7.6 Delivery shall not be considered complete until all hardware and software purchased under this bid specification are received, fully operational, tested, and approved by the State.

4.7.7 Delivery of all hardware shall be coordinated through a State-authorized point of contact and delivered to State-designated sites within the State as directed by the State.

4.7.8 Delivery of all hardware shall be made within thirty (30) days of the Contractor receiving the purchase order from the State.

#### 4.8 **Training**

4.8.1 The Contractor shall be responsible for providing a factory-certified trainer, or equivalent, to perform all training. Each attendee shall receive a completion certificate from the Contractor after successfully completing the class. The certificate shall include the course dates, the course name, trainer, student, Tennessee Survey Board class number, PDH's earned, and the certified trainer's signature. Training shall consist of courses covering the use of the hardware, software, and GNSS surveying techniques.

##### 4.8.2 Field System Training

- a. Number of people: Maximum of twenty-four (24) State training attendees
- b. Duration of training: Minimum of eight (8) working hours
- c. Number of Trainers Required: Minimum of two (2) per training class
- d. Subject Matter shall include but is not limited to:
  - i) Review of the System
  - ii) Overview of planning for a satellite survey
  - iii) Field procedures

- iv) Care and maintenance of the system
- v) Procedures for the use of GNSS hardware with State CORS network
- vi) Static data collection
- vii) RTK data collection
- viii) Hybrid survey operation

- 4.8.3 The Contractor shall submit all training classes to the State of Tennessee Board of Land Surveyors for continuing education official PDH credits. The Contractor shall contact by Board of Land Surveyors by submitting the form via the website:  
<https://www.tn.gov/commerce/regboards/surveyors/licensee-applicant-resources/approved-course-listing.html>
- 4.8.4 The Contractor shall provide all training materials, manuals, hardware supplies, and other necessary training materials. It shall be permissible to use the hardware and manuals delivered under these specifications for training. Contractor shall be responsible for all travel costs (lodging, meals, etc.) for all trainers required for each training class. The State shall not reimburse trainers for travel expenses. The State shall provide computers for training.
- 4.8.5 Training manuals shall be made available to State staff at least two (2) weeks before the date of the classes. All printing fees shall be included in the cost of the training classes. The Contractor shall provide enough copies of each training manual to satisfy the maximum number of students in each class, as designated by the State. The State may make as many copies of these training manuals for use by State employees as the State deems necessary, without any copyright restrictions from the Contractor. The State is permitted to copy and paste sections from the electronic versions of these manuals for the internal use of State staff. An electronic copy of each manual shall be provided to the State in \*.doc and \*.PDF, Adobe version 10x or better format. The State reserves the right to videotape each training session for future use.
- 4.8.6 Both the State and the Contractor may make changes to the agendas of any training session; however, the change shall be agreed upon by both parties. The minimum number of trainers, locations, students, etc., is defined in section 4.8. In addition, both parties may agree to additional topics for the class agenda.
- 4.8.7 Training shall be scheduled by the State and Contractor representatives as required. The date (s) of the training classes may be adjusted or rescheduled by either party as required, with 48 hours advance notice.
- 4.8.8 The State and Contractor shall determine if training shall be onsite or

virtual depending on State business needs. Onsite training classes shall be held at the four (4) State regional offices (Jackson, Nashville, Chattanooga, and Knoxville). Contractor shall coordinate with the State regional surveying manager or other State-authorized staff to finalize training dates.

- a. TDOT – Region 1 Survey Office  
Site Contract: Kent Fox  
Email: [Christopher.Fox@tn.gov](mailto:Christopher.Fox@tn.gov)  
Address: 7366 Region Lane,  
Knoxville, TN 37914
- b. TDOT – Region 2 Survey Office  
Site Contact: Doug Ford  
Email: [Douglas.Ford@tn.gov](mailto:Douglas.Ford@tn.gov)  
Address: 7512 Volkswagen Drive,  
Chattanooga, TN 37421
- c. TDOT – Region 3 Survey Office  
Site Contact: Melissa Portell  
Email: [Melissa.Portell@Tn.gov](mailto:Melissa.Portell@Tn.gov)  
Address: 6636 Centennial Boulevard,  
Nashville, TN 37243
- d. TDOT – Region 4 Project Development Office  
Site Contact: Glen Blankenship  
Email: [Glen.Blankenship@tn.gov](mailto:Glen.Blankenship@tn.gov)  
Address: Administration Bld, 1<sup>st</sup> Floor  
300 Benchmark Place,  
Jackson, TN 38301