Georgia Department of Transportation
Transportation Products
Qualified Products List (QPL)

By signing this form, the applicant declares that he/she has read and understood the provisions of Section 926 of the GDOT Minimum Specifications for Wireless Communication Equipment and all implemented modifications. The requirements listed on this matrix are derived from Section 926, which in all cases will be the basis for determining a product's compliance and its acceptability for use on Georgia's roads.

Date: _____

Applicant's: _____
Name (print)

Manufacturer: _____

Signature: _____

Item, Model No: _____

GDOT Wireless Communication Equipment Specification Compliance Matrix (926.2.01 B)

Requirement	Item Comply? (Yes/No)	Comments	Evaluation Method[1]
A. General			
1. Comply with ISO 9001 or Sigma Six quality manufacturing requirements.	N/A		N/A
2. Provide only equipment and materials that are of new and of like kind and function provided by one manufacturer, using the same model, part number, and revision.	N/A		N/A
B. Overall System			
1. Provide wireless system that supports the following site configuration types: PtP, PtMP (access point / subscriber unit) and repeater as shown in the Contract documents.	N/A		N/A
2. Provide a single-band or dual-band radio that is either integrated with an antenna unit or as an alternative a single radio with an external antenna.	N/A		N/A
3. Provide capability for the user to select transmit power output level in incremental steps up to the maximum transmit output power.	N/A		N/A
4. Provide maximum transmit power, antenna gain that provides an EIRP as permitted by FCC Part 15 for unlicensed frequencies. Select final transmit power and antenna gain based on manufacturer's recommendation and distance and signal strength.	N/A		N/A
5. Provide a wireless link with path availability of 99.99% in worst-case weather conditions for the area where it is installed.	N/A		N/A
6. Provide wireless system with a minimum MTBF of 200,000 hours using Telcordia SR-332, latest version, or MIL-HDBK-217F standards.	N/A		N/A

Requirement	Item Comply? (Yes/No)	Comments	Evaluation Method[1]
7. Provide wireless system with dynamic frequency and channel selection capability based on interference detection, with a manual override option.	N/A		N/A
8. Provide wireless system with adaptive or automated modulation and space diversity capability for maximum throughput.	N/A		N/A
9. Provide wireless system with receive sensitivity that is adaptive.	N/A		N/A
10. Provide wireless system with a VSWR value not exceeding 2.0:1 for the specified radio frequency.	N/A		N/A
11. Design equipment for ease of maintenance. Ensure that all component parts are readily accessible for inspection and maintenance using hand tools. Provide test points for checking essential voltages, waveforms, signals, and similar data.	N/A		N/A
12. Provide support for the following minimum network and security requirements:			
☐ IEEE 802.3 ☐ IEEE 802.1D ☐ IEEE 802.1p ☐ IEEE 802q ☐ IEEE 802.1d ☐ IEEE 802.1w ☐ IEEE 802.3x	N/A		N/A
☐ Provide at a minimum AES-128 bit (AES-128) encryption capability, FIPS197, keys set through password-protected browser interface for PtP backhaul network. Minimum security for communications with WiFi units is WPA2.			
☐ Provide support for internal MAC address control list and RADIUS networking protocol for authentication, authorization, and accounting.			
13. Provide wireless system that meets the following minimum radio configuration and management software requirements:			
a. Provide programming and software to make operational and support the wireless system with the following minimum features: radio and network configuration, diagnostic routines (i.e., bandwidth test, spectrum scan, and ping test), and alarm management.	N/A		N/A
b. Provide capability to display or provide status information of indicators that include data port link activity, data port speed, and link status.	N/A		N/A
c. Provide capability to display the following alarm features:	N/A		N/A
☐ Provide 24 hour monitoring capability for user-selected alarms. ☐ Provide optional alarm notifications via email or text messages.	N/A		N/A
14. Provide wireless system with bi-directional communications.	N/A		N/A
15. Provide wireless system including connectors that are IP67 weathertight rated and UV stabilized.	N/A		N/A
16. Provide wireless system with alignment tool for aligning the antenna system. Provide alignment tool that consists of audible indicators, or as recommended by the manufacturer.	N/A		N/A

Requirement	Item Comply? (Yes/No)	Comments	Evaluation Method[1]
17. Equip wireless system with a minimum of one shielded Ethernet-port, using an IP67 rated RJ-45 weathertight connector or other Ethernet-compatible locking shielded and weathertight connector.	N/A		N/A
18. Comply with FCC Part 15.247 (ISM) requirements.	N/A		N/A
C. Type 1 Wireless System			
Meet the following system requirements, in addition to the requirements specified in Section 926.2.01.B:			
1. Provide a system that operates in the FCC unlicensed (license-exempt) ISM band of 900 MHz, 2.4 GHz, or 5 GHz.	N/A		N/A
2. Provide aggregate system throughput of up to 10 Mbps in a LOS environment.	N/A		N/A
3. Provide a flat panel type, single (H or V) or dual polarized (H+V), narrow beam-width antenna, Yagi, or omnidirectional or as recommended by the wireless radio manufacturer.	N/A		N/A
4. Provide wireless system with minimum channel bandwidths of 5 MHz, 10 MHz, and 20 MHz.	N/A		N/A
5. Provide wireless system with OFDM or DSSS modulation technology.	N/A		N/A
D. Type 2 Wireless System			
Meet the following system requirements, in addition to the requirements specified in Section 926.2.01.B:			
1. Provide a system that operates in the FCC unlicensed (license-exempt) ISM band of 2.4 GHz or 5 GHz.	N/A		N/A
2. Provide aggregate system throughput of up to 50 Mbps in a LOS environment.	N/A		N/A
3. Comply with IEEE 802.11a/n standard.	N/A		N/A
4. Provide a 2x2:2 MIMO flat panel type, dual polarized (H+V), narrow beam-width antenna or alternative parabolic or as recommended by the radio manufacturer.	N/A		N/A
5. Provide wireless system with minimum channel bandwidths of 5 MHz, 10 MHz, 20 MHz, and 40 MHz.	N/A		N/A
6. Provide wireless system with OFDM modulation with BPSK, QPSK, QAM16, and QAM64.	N/A		N/A
7. Provide wireless system that supports MCS with dynamic data rate selection.	N/A		N/A
8. Provide wireless system with full support of SSL technology.	N/A		N/A
9. Provide wireless system that supports the following network requirements:			
☐ Provide forward error correction capabilities with automatic retransmission. ☐ Provide dynamic allocation of uplink and downlink bandwidth. ☐ Provide capability for jitter correction to avoid delay fluctuation in video streams.	N/A		N/A

Requirement			Item Comply? (Yes/No)	Comments	Evaluation Method[1]
☐ Provide data burst transmission capability so that fragmented packets are transmitted together.	☐ Provide the capability to use a polling protocol to reduce packet loss due to RF collisions.	☐ Provide support for Layer 2 features including QoS and IGMP snooping to reduce un-needed multicast traffic.	N/A		N/A
10. Provide local and remote management capabilities through HTTP, Telnet, SSH, and SNMP.			N/A		N/A
E. Type 3 Wireless System					
Meet the following system requirements, in addition to the requirements specified in Section 926.2.01.B:					
1. Provide a system that operates in the FCC unlicensed (license-exempt) ISM band of 2.4 GHz or 5 GHz.			N/A		N/A
2. Provide aggregate system throughput of up to 100 Mbps in a LOS environment.			N/A		N/A
3. Comply with IEEE 802.11a/n standard.			N/A		N/A
4. Provide a 2x2:2 MIMO flat panel type, dual polarized (H+V), narrow beam-width antenna or alternative parabolic or as recommended by the radio manufacturer.			N/A		N/A
5. Provide wireless system with minimum channel bandwidths of 5 MHz, 10 MHz, 20 MHz, and 40 MHz.			N/A		N/A
6. Provide wireless system with OFDM modulation with BPSK, QPSK, QAM16, and QAM64.			N/A		N/A
7. Provide wireless system that supports MCS with dynamic data rate selection.			N/A		N/A
8. Provide wireless system with full support of SSL technology.			N/A		N/A
9. Provide wireless system that supports the following network requirements:					
☐ Provide forward error correction capabilities with automatic retransmission.	☐ Provide dynamic allocation of uplink and downlink bandwidth.	☐ Provide capability for jitter correction to avoid delay fluctuation in video streams.	N/A		N/A
☐ Provide data burst transmission capability so that fragmented packets are transmitted together.	☐ Provide the capability to use a polling protocol to reduce packet loss due to RF collisions.	☐ Provide support for Layer 2 features including QoS and IGMP snooping to reduce un-needed multicast traffic.			
10. Provide local and remote management capabilities through HTTP, Telnet, SSH, and SNMP.			N/A		N/A
F. Type 4 Wireless System					
1. Provide an integrated broadband cellular wireless router only as listed on the GDOT QPL and as approved by the Department's current cellular telecommunications service provider. No other devices are permitted.			N/A		N/A

Requirement	Item Comply? (Yes/No)	Comments	Evaluation Method[1]
2. Provide wireless system meeting the following general requirements:			
a. Provide 4G LTE or greater throughput as specified in the Contract documents or directed by the Department.	N/A		N/A
b. Provide a broadband cellular wireless router that meets the following minimum network standards and protocols:	N/A		N/A
☐ Comply with IEEE 802.3 standards for 10/100/1000 Mbps Ethernet. ☐ Provide full support for SSL. ☐ Provide full support for IPsec and VPN functionality. ☐ Provide at a minimum AES-128 encryption capability. ☐ Support MAC address filtering and ACL.	N/A		N/A
c. Provide capability for network traffic to be accessible via a public or private IP connection, via VPN tunnel with SSL, IPsec, and IP pass-through.	N/A		N/A
d. Equip wireless system with a minimum of one 10/100/1000 Base-T/TX, shielded Ethernet-port, outdoor-rated RJ-45 connector or other Ethernet-compatible weathertight connector.	N/A		N/A
e. Provide wireless system with visual status indicators that include Power, Signal, Ethernet Link, and Activity.	N/A		N/A
3. Provide wireless system meeting the following antenna requirements:			
a. Provide an external ruggedized antenna for broadband wireless operations meeting the following minimum requirements:	N/A		N/A
☐ A minimum gain of 4 dBi, vertical polarized. ☐ Omnidirectional pattern. ☐ Up to 100W power. ☐ Multiband support including the 698 to 960 MHz and 1,700 to 2,700 MHz bands.	N/A		N/A
b. Provide mounting hardware as recommended by the manufacturer.	N/A		N/A
c. Provide RF coaxial cable as specified in Section 926.2.01.J.3 between the wireless router and the antenna.	N/A		N/A
G. Mechanical			
1. For non-integrated types provide a wireless radio that is capable of being rack- or shelf-mounted in a secure manner.	N/A		N/A
2. Provide wireless equipment that is modular in design such that it can be easily replaced in the field.	N/A		N/A
3. For Types 1 to 3 only, unit dimensions and weights shall be as follows:			
☐ Maximum dimensions shall be 16 in (0.4 m) by 16 in (0.4 m) by 12 in (0.3 m) for integrated units, not including the antenna. ☐ Maximum weight shall not exceed 35 lb (16.9 kg).	N/A		N/A

Requirement	Item Comply? (Yes/No)	Comments	Evaluation Method[1]
4. Use external screws, nuts, and locking washers that are stainless steel. Do not use self-tapping screws unless specifically approved by the Department.	N/A		N/A
5. Use mounting hardware and parts made of stainless steel.	N/A		N/A
6. Use materials in construction that are protected from fungus growth and moisture deterioration.	N/A		N/A
7. Separate any dissimilar metals by an inert dielectric material.	N/A		N/A
H. Electrical			
1. Provide wireless radios and routers that meet all specified requirements when the input power is 120 VAC ±20%, 60 Hz ±3 Hz.	N/A		N/A
2. Provide appropriate voltage conversion, PoE injectors, or other power supply hardware if the radio equipment or any radio-related ancillary devices require operating voltages other than 120 VAC or rely on PoE or PoE+.	N/A		N/A
3. Provide voltage converters or PoE injectors that accept an input voltage of 120 VAC as noted above.	N/A		N/A
4. Provide any required PoE or PoE+ devices that are 802.3af or 802.3at compliant, meeting the power requirements of the radio equipment.	N/A		N/A
5. Provide PoE injector that can be either wall/panel mounted or DIN-rail mounted within the field cabinet.	N/A		N/A
6. Provide devices that meet the requirements in Section 2.1.4, "Power Interruption," of NEMA Standard TS 2.	N/A		N/A
7. Provide devices that meet the requirements of Section 2.1.6, "Transients, Power Service," of NEMA Standard TS 2.	N/A		N/A
I. Mounting and Support Structure			
1. Provide wireless equipment mounting hardware that is designed to mount to the support structure as shown in the Contract documents.	N/A		N/A
2. Provide pole mounting attachment hardware that meets the requirements of the wireless system survey and the wireless manufacturer.	N/A		N/A
J. Cabling and Surge Protection			
1. Provide antenna coaxial cables as specified herein for external antenna (non-integrated radio and antenna) sites or outdoor-rated Category-6 cables for integrated radio/antenna sites.	N/A		N/A
2. Provide outdoor-rated, shielded Category-6 cabling from the PoE injector to the wireless radio meeting the following minimum requirements:	N/A		N/A

Requirement			Item Comply? (Yes/No)	Comments	Evaluation Method[1]
☐ Comply with TIA-568-C.2 standard.	☐ Comply with ICEA S-56-434 standard or equivalent industry standard as approved by the Department for communications cables for outdoor use including weathertight, outdoor CMX UV-rated, abrasion-resistant jacket.	☐ Provide cable that is UL 444 sunlight resistant listed.	N/A		N/A
☐ Provide insulated No. 22 to 23 AWG, solid bare copper conductors with polyolefin insulation, arranged in four color-coded shielded twisted-pairs with drain wire incorporating a cross-web separator design.	☐ Provide modular IP67-rated shielded RJ-45 8P8C male push-pull connectors with eight-position non-keyed and eight gold anodized pins or other Ethernet-compatible locking weathertight connector.				
3. Provide an RF coaxial cable meeting the following minimum requirements:					
☐ Provide a cable that is flexible, low-loss, outdoor-rated and weathertight.	☐ Provide nominal impedance that is matched to the antenna's impedance to minimize the VSWR.	☐ Provide a cable with a black UV-resistant polyethylene jacket.	N/A		N/A
☐ Provide a cable with a dual shield consisting of 100% foil and 88% braided.	☐ Provide shielding effectiveness of >90 dB.	☐ Provide solid bare, copper center conductor.	N/A		N/A
☐ Provide a characteristic impedance of 50 ohms, nominal.	☐ Provide a cable with maximum frequency of 6 GHz.	☐ Provide an attenuation of 3.9 dB/100 ft (at 900 MHz) or better. If cable length is shorter than 20 ft (6.1 m), the cable can be smaller in diameter with a maximum attenuation of 9.9 dB/100 ft.	N/A		N/A
☐ Provide a capacitance (conductor to shield) of 23.9 pF/ft or better, nominal.	☐ Provide an inductance of 0.060 µH/ft or better, nominal.	☐ Provide Type N connectors or as recommended by the manufacturer that are weathertight and factory installed on both ends with a maximum insertion loss of 0.2 dB.	N/A		N/A
☐ Provide maximum cable length of 10 ft (3.05 m) from radio to antenna (if not integrated) when radio is mounted on an external structure. Provide 100 ft (30.5 m) maximum length from radio to antenna when radio is mounted in the field cabinet and antenna is mounted on the structure.			N/A		N/A
4. Provide wireless system with surge protection that meets the following minimum SPD requirements:					
a. Category-6 Ethernet PoE Surge Protection			N/A		N/A

Requirement			Item Comply? (Yes/No)	Comments	Evaluation Method[1]
☐ Provide SPD that is listed per UL 497B.	☐ Comply with TIA-568-B.	☐ Comply with IEEE 802.3af or IEEE 802.3at as required.	N/A		N/A
☐ Support 10Base-T, 100Base-T, and 1000Base-T transmission speeds.	☐ Provide a peak surge current rating (Imax) of a minimum of 10 kA (8/20 µs waveform).	☐ Provide a clamping voltage of up to 90V ±20% for L-G and 20V ±20% for L-L			
☐ Provide surge protection for all connector pins.	☐ Provide input and output connections with shielded RJ-45 connectors.	☐ Provide an in-line, series-connected configuration.			
☐ Provide system capable of being either wall/panel or DIN-rail mounted.	☐ Provide an SPD that is constructed of aluminum metal housing.				
b. RF Coaxial Surge Protection					
☐ Provide SPD that is listed per UL 497E.	☐ Provide a rated nominal surge current (In) per UL 497E of 10 kA (8/20 µs waveform).	☐ Provide a rated power/current (RF, DC) per UL 497E: VHF 375W, UHF (low) 250W, 800 MHz to 1 GHz 125W.	N/A		N/A
☐ Provide a protection level of <1000V for up to 375W SPD.	☐ Provide an insertion loss of ≤0.2 dB over wireless system frequency range.	☐ Provide SPD that supports a VSWR of 1.3:1.			
☐ Provide SPD with field replaceable gas discharge tube for maintenance.	☐ Provide SPD with minimum environmental protection rating of IP65.	☐ Provide SPD with mating connectors per antenna type.			
c. Provide hardware and materials to bond SPDs to the field cabinet ground buss bar.			N/A		N/A
K. Environmental					
1. Provide wireless equipment and components as specified herein that meet the following minimum operating ambient temperature range and humidity levels:					
☐ −4°F (−20°C) through 131°F (55°C)	☐ Up to 95% relative humidity (non-condensing)		N/A		N/A
2. Comply with NEMA 250, Type 4X corrosion requirements.			N/A		N/A
3. Comply with IEC EN 61000-4-5 surge immunity testing requirements.			N/A		N/A
4. Comply with NEMA TS 2 Sections 2.2.8 (vibration) and 2.2.9 (shock) test requirements.			N/A		N/A

Requirement	Item Comply? (Yes/No)	Comments	Evaluation Method[1]
5. Provide wireless system that is capable of withstanding wind speeds of 100 mph (161 kph) with a 20% gust factor.	N/A		N/A
6. Comply with FCC Part 15 emission standard and FCC Public Notice 2019-01.	N/A		N/A

Note 1:

Evaluation Method:

1. **Physical Inspection** – a vision inspection of the product
2. **Compliance Matrix Review** – a review of the matrix comments column itself to see if all required statements were made
3. **Document Review** – a review of all specs, lab test reports, etc.
    a. Independent 3rd Party Facility Test results
    b. 1st Party (Manufacturer) Test results
4. **Functional Review / Inspection –** GDOT Lab and/or Field Trial testing