

TECHNICAL SPECIAL PROVISION

FOR

Master Hub Ethernet Switch (MHES)

FINANCIAL PROJECT NO.: 437501-1-52-01

LAKE COUNTY

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T684-7
MASTER HUB ETHERNET SWITCH

T684-7-1 Description.

Furnish and install a Master Hub Ethernet switch (MHES) for intelligent transportation system (ITS) projects. Ensure that the MHES provides wire-speed fast Ethernet connectivity at transmission rates of 10 gigabits per second to and from adjacent MHES within the ITS network. Use only equipment and components that meet the requirements of these minimum specifications.

T684-7-2 Materials.

T684-7-2.1 General: Ensure that the FDOT ITS network administrator will be able to manage each MHES individually and as a group for switch configuration, performance monitoring, and troubleshooting.

Ensure that the MHES includes Layer 2+ capabilities, including, QoS, IGMP, rate limiting, security filtering, and general management. Ensure that the furnished MHES is fully compatible and interoperable with the ITS trunk Ethernet network interface, and that the MHES supports half and full duplex Ethernet communications.

Ensure that the MHES includes Layer 3+ capabilities, including, Open Shortest Path First (OSPF) routing protocol, Routing Information Protocol (RIP), Generic Routing Encapsulation (GRE), and Virtual Router Redundancy Protocol (VRRP) , Protocol Independent Multicast (PIM), Protocol Independent Multicast Sparse Mode (PIM-SM), Protocol Independent Multicast Dense Mode (PIM-DM), and Protocol Independent Multicast Source Specific Multicast (PIM-SSM)), Multiprotocol Label Switching (MPLS) and Virtual Private LAN Service (VPLS).

Ensure the MHES includes any license(s) required to utilize all layer 3 features. Ensure all routing protocols are performed by way of hardware to ensure maximum line rates speed. Ensure the MHES includes any license(s) required to utilize all layer 3 features.

Furnish all hot-swappable Gigabit Interface Converter (GBIC) fiber optical transceivers listed in Table 1 below for each MHES.

Table 1
Required Optical Transceivers

GBIC QUANTITY	PHYSICAL LAYER STANDARD	DATA TRANSFER RATE	MINIMUM TRANSCEIVER DISTANCE
4	10GBASE-ZR	10 Gbps	80 kilometers
4	1GBASE-EX	1 Gbps	40 kilometers
8	1GBASE-LX10	1 Gbps	10 kilometers

Furnish an MHES that provides 99.999% error-free operation, and that complies with the Electronic Industries Alliance (EIA) Ethernet data communication requirements

using single-mode fiber optic transmission medium and Category 5E copper transmission medium. Provide a switched Ethernet connection for each remote ITS field device.

Ensure that the MHES has a minimum mean time between failures (MTBF) of 10 years, or 87,600 hours, as calculated using the Bellcore/Telcordia SR-332 standard for reliability prediction.

T684-7-2.2 Networking Standards. Ensure that the MHES complies with all applicable IEEE networking standards for Ethernet communications, including but not limited to:

- IEEE 802.1AH Provider Backbone Bridges
- IEEE 802.1D MAC Bridges;
- IEEE 802.1AB Link Layer Discovery Protocol
- IEEE 802.1AG Connectivity Fault Management (CFM)
- IEEE 802.1P Quality of Service (QoS);
- IEEE 802.1Q Virtual Bridged LANs (VLAN Tagging);
- IEEE 802.1S Multiple Spanning Tree Protocol (MSTP);
- IEEE 802.1X Port-Based Network Access Control;
- IEEE 802.1W Rapid Spanning Tree (RST);
- IEEE 802.3X Flow Control;
- IEEE 802.3Z Standards Compliant 1000 Base-SX and 1000 Base-LX optics;
- IEEE 802.3ab 1000Base-T
- IEEE 802.3ad Link Aggregation;
- IEEE 802.3ae 10-Gigabit Ethernet;
- IEEE 802.3af Power over Ethernet (PoE);
- IEEE 802.3 CSMA/CD Access Method and Physical Layer Specification
- RFC 2236 – IGMP v1, v2, v3 Snooping;
- RFC 2362 – Protocol Independent Multicast (PIM-SM/DM);
- RFC 2328 – OSPF v2;
- RFC 3768 – Virtual Router Redundancy Protocol (VRRP);
- RFC 3031 – Multiprotocol Label Switching (MPLS);
- RFC 4762 – Virtual Private LAN Service (VPLS);
- RFC 2030 – Simple Network Time Protocol (SNTP); and
- RFC 2267 – Denial of Service (DoS).

T684-7-2.3 Optical Ports. Ensure that all fiber optic link ports operate at 1,310 or 1,550 nanometers in single mode. Ensure that the optical ports are Type ST, SC, LC, or FC only, as specified in the plans or by the Engineer. Do not use mechanical transfer registered jack(MTRJ) type connectors.

Provide a MHES having a minimum of four optical 10 Gigabit Ethernet ports capable of transmitting data at 10 gigabits per second. Provide an MHES having a minimum of four optical 1 Gigabit Ethernet ports capable of transmitting data at 1 gigabits per second. Ensure the MHES is configured with the number and type of ports detailed in the Contract Documents. Provide optical ports designed for use with a pair of fibers; one fiber to transmit (TX) data and one fiber to receive (RX) data.

T684-7-2.4 Copper Ports. Provide a MHES that includes a minimum of 20 copper ports unless otherwise shown in the plans. Ensure all copper ports are Type RJ-45

and auto-negotiate speed (i.e., 10/100/1000 Base) and duplex (i.e., full or half). Ensure all 10/100/1000 Base TX ports meet the specifications detailed in this section and are compliant with the IEEE 802.3 standard pinouts.

T684-7-2.5 Management Capability. Ensure that the MHES supports all Layer 2 management features and certain Layer 3 features as defined by these specifications. Ensure at minimum the Layer 2 features include:

1. A MHES that is a port-based VLAN and supports VLAN tagging that meets or exceeds specifications as published in the IEEE 802.1Q standard, and has a minimum 4-kilobit VLAN address table.

2. A forwarding/filtering rate that is a minimum of 14,880 packets per second for 10 megabits per second, 148,800 packets per second for 100 megabits per second, and 1,488,000 packets per second for 1000 megabits per second.

3. A minimum 4 kilobit MAC address table.

4. Support of, at a minimum, Version 2 of the Internet Group Management Protocol (IGMP).

5. Support of remote and local setup and management via telnet and secure Web-based GUI.

6. Support of the Simple Network Management Protocol (SNMP). Ensure that the MHES can be accessed using the resident EIA-232 management port, a telecommunication network, or the Trivial File Transfer Protocol (TFTP).

7. Port security through controlling access by the users. Ensure that the MHES has the capability to generate an alarm and shut down ports when an unauthorized user accesses the network.

8. Support of remote monitoring (RMON) of the Ethernet agent and the ability to be upgraded to switch monitoring (SMON), if necessary.

9. Support of TFTP and either Network Time Protocol (NTP) or the Simple Network Time Protocol (SNTP). Ensure that the MHES supports port mirroring for troubleshooting purposes when combined with a network analyzer.

10. Sampled Flow Network Monitoring export protocol capable of being turned on or off on individual Ethernet ports without affecting traffic.

11. Support port monitoring on copper ports and optical ports.

Ensure at minimum the Layer 3 features include:

1. Open Shortest Path First (OSPF) routing protocol.

2. Routing Information Protocol (RIP)

3. Generic Routing Encapsulation (GRE)

4. Virtual Router Redundancy Protocol (VRRP)

5. Protocol Independent Multicast (PIM)

6. Protocol Independent Multicast Sparse Mode (PIM-SM)

7. Protocol Independent Multicast Dense Mode (PIM-DM)

8. Protocol Independent Multicast Source Specific Multicast (PIM-SSM)

9. Virtual Private LAN Service (VPLS)

10. Multiprotocol Label Switching (MPLS)

T684-7-2.6 Mechanical Specifications. Ensure equipment is permanently marked with manufacturer name or trademark, part number, and serial number.

Ensure that every conductive contact surface or pin is gold-plated or made of a noncorrosive, nonrusting, conductive metal.

Do not use self-tapping screws on the exterior of the assembly. All parts will be made of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal.

T684-7-2.7 Electrical Specifications. MHES must be capable of operating on a nominal voltage of 120 volts alternating current (V_{AC}) when installed in an ITS Master Hub building and Negative 48 volts direct current (V_{DC}) for MHES installed in existing microwave towers. Supply an appropriate voltage supply for each device.

Ensure that the MHES has diagnostic light emitting diodes (LEDs), including link, TX, RX, and power LEDs.

T684-7-2.8 Environmental Specifications. Ensure that the MHES has a minimum operating temperature range of 0° Celsius to 40° Celsius. Ensure that the MHES has a minimum storage temperature range of -25° Celsius to 70° Celsius. Ensure that the MHES has a non-condensing relative humidity range of 5% to 90% at 40° Celsius.

T684-7-3 Installation Requirements.

T684-7-3.1 General.

Mount the MHES inside a master hub rack as shown in plans. Ensure that the MHES is resistant to all electromagnetic interference (EMI). Ensure that the MHES is mounted securely and is fully accessible by field technicians. Ensure that all unshielded twisted pair/shielded twisted pair Ethernet network cables are compliant with the EIA/TIA-568-B standard.

T684-7-3.2 Testing.

Subject the MHES to all tests as required by the FDOT specifications and the project Testing and Integration technical special provisions.

T684-7-4 Warranty.

Ensure that the manufacturer will furnish replacements for any part or equipment found to be defective during the warranty period at no cost to the Department or the maintaining agency within 10 calendar days of notification.

The manufacturer will warranty all components against defects in materials and workmanship for five years from the date of final acceptance by the Engineer. The warranty will cover all parts and onsite labor required for troubleshooting and repair.

Contractor hereby assigns to the Department any and all manufacturers' or other sellers' warranties that come with any products, material or supplies which are incorporated into or are consumed in the project in any way. To the extent that any such warranties do not extend to subsequent purchasers or owners or such warranties contain a limitation on assignment, Contractor agrees that Contractor purchased the products, materials and supplies on behalf of the Department with the intent that the Department be the intended recipient of any warranties. All documents associated with

or describing any such warranties will be delivered to the Department along with the other project final acceptance documents and will be deemed to be a part of the required final acceptance documentation. Contractor will not take any action or fail to act in any way which voids any such warranties. All subcontracts will contain a similar provision which requires subcontractors to assign any such warranties to the Department.

T684-7-5 Method of Measurement.

The quantity to be paid for will be the number of MHES furnished, installed, and accepted.

T684-7-6 Basis of Payment.

Price and payment will be full compensation for all work specified in this Technical Special Provision.

Payment will be made under:
Item No. 684-7- Master Hub Ethernet Switch-each.