MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
TRAFFIC SIGNAL MANAGED FIELD ETHERNET SWITCH, COPPER ONLY

SIG:HJK 1 of 4 APPR:BA:HLO:10-28-24
FHWA:APPR:10-29-24

a. Description. This work consists of completing one or more of the following work types at locations shown on the plans:

1. Furnishing and installing an environmentally hardened managed field Ethernet switch (MFES) and all required power supplies, cables, patch cords, and jumpers.

2. Removing and disposing of an existing MFES.

3. Removing, storing, and reinstalling an existing MFES.

b. Materials. Ensure the MFES is fully compatible and interoperable with MDOT's signal controller and communications network.

1. Furnish a MFES that is suitable for a signal controller cabinet without the need for special environmental conditioning. The MFES must have no fan or other moving parts.

2. Ensure the MFES supports full-duplex Ethernet communication.

3. Furnish a MFES that complies with the *IEEE networking standards IEEE-802.1* and *IEEE-802.3*. Specifically, the MFES must comply with the following *IEEE 802.1 standards*:

A. *IEEE 802.1D Media Access Control (MAC) Bridges, including Rapid Spanning Tree Protocol (RSTP)*;

B. *IEEE 802.1ad – Q-in-Q/Provider Bridging Support or Stacked Virtual Local Area Networks (VLANs)*;

C. *IEEE 802.1Q VLAN tagging and Multiple Spanning Tree Protocol (MSTP)*;

D. *IEEE 802.1X (Port Based Network Access Protocol)*.

E. Dynamic Host Configuration Protocol (DHCP) Snooping. Ability to filter DHCP packets to ensure clients only use addresses assigned to them by authorized DHCP servers.

F. Dynamic Address Resolution Protocol (ARP) Inspection/Protection. Ability to verify and filter ARP packets to prevent ARP spoofing.

G. Internet Engineering Task Force (RFC 7039) Internet Protocol (IP) Source Guard. Ability to block IP source addresses that are not assigned to clients to prevent IP spoofing.

H. Port Security. Ability to limit the MAC addresses that are allowed on a switch port.

4. Furnish a MFES that can be managed using simple network management protocol (SNMP) version 3.

5. Port Configuration. Furnish a minimum of eight copper ports with Type Registered Jacks (RJ)-45 connectors that are capable of 10/100Base-TX communications. Furnish MFES with an adequate number of ports to accommodate Ethernet communications at each site as shown on the plans, with at least one spare 10/100Base-TX copper port at each site.

6. Electrical Specifications.

A. Unless detector rack mounted, provide a power supply that interfaces the MFES to 120 volts alternating current (VAC), 60 hertz (Hz) single-phase power. If the device requires operating voltages of less than 120 VAC, ensure the appropriate voltage converter is supplied at no additional cost.

B. The MFES must consume no more than 20 watts (W) of power.

C. Furnish a MFES resistant to electromagnetic interference (EMI).

7. Environmental Specifications.

A. Ensure MFES and its power supply has an operating temperature range of at least -40 °F to 165 °F.

B. Ensure MFES and its power supply has an operating humidity range of at least 10 percent to 95 percent relative humidity (RH).

8. Furnish a MFES that is shelf mounted unless otherwise specified on the plans.

A. If specified on the plans, furnish a MFES capable of mounting on a *Deutsches Institut für Normung* (DIN) rail and furnish all DIN rail hardware necessary to mount the MFES.

B. If specified on the plans, furnish a MFES with a grid-type shelf that allows proper air flow.

9. Furnish a MFES with diagnostic LEDs. These indicators must include link, activity, speed, and power LEDs.

10. Ensure the MFES uses secure file transfer protocol (SFTP) to transfer configuration files to and from a central server.

11. Ensure the MFES performs multicast filtering using internet group management protocol (IGMP) snooping.

12. Furnish power cables and Category 5e (CAT-5e) or Category 6 (CAT-6) patch cords as required.

13. Furnish a MFES that has American Standard Code for Information Interchange (ASCII) based configuration files for offline editing and bulk configuration.

14. Ensure the MFES is configurable using a web browser or graphical user interface (GUI), in addition to the terminal emulation.

15. Ensure the MFES can backup and restore the complete software configuration, in the field by, without the use of a personal computer (PC), powered by the console port, and only use a 1 button handheld data backup unit (DBU), capable of being used by technician with no IP knowledge.

c. Construction. Complete this work in accordance with sections 818 and 820 of the Standard Specifications for Construction, as shown on the plans and as directed by the Engineer.

1. Installation.

A. Connect the MFES to the communications network and ensure connections are made to each Ethernet/IP appliance within the cabinet. Use CAT-5e or CAT-6 patch cords for twisted pair connections to the MFES.

B. Verify MFES maintained a minimum actual measured data throughput of 10 Megabits per second (Mbps) for 10 minutes duration during the testing process performed by the MDOT electrician. Ensure these data rates are validated and documented during acceptance testing, and any exceptions approved by the Engineer.

2. Local Device Assembly Testing.

A. Verify physical connections are performed as specified in contract.

B. Verify all LED indicators for link, activity, and power are functioning.

C. Verify these configuration settings: system name, location, IP address, subnet mask, and default gateway.

D. Verify all active ports have been configured properly. Check the speed, duplex, and VLAN settings.

3. Warranty. Furnish MFES with a standard manufacturer's warranty, transferable to the MDOT. The MFES must carry a warranty (parts, software, and labor) of 5 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.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay items:

Pay Item	**Pay Unit**
TS, Managed Field Ethernet Switch, Layer 2, Copper	Each
TS, Managed Field Ethernet Switch, Rem	Each
TS, Managed Field Ethernet Switch, Salv	Each

1. **TS, Managed Field Ethernet Switch, Layer 2, Copper** includes procuring, installing, and verify testing of a MFES.

2. **TS, Managed Field Ethernet Switch, Rem** includes removing and storing or disposing of an existing managed field Ethernet switch at the location(s) shown on the plans.

3. **TS, Managed Field Ethernet Switch, Salv** includes reinstalling a removed managed field Ethernet switch at the location(s) shown on the plans.