# SECTION 16733
# MANAGED FIELD HARDENED ETHERNET SWITCH

**1.** Description. Furnish and install Managed Field Hardened Ethernet Switch (MFHES) at designated locations as shown on the plans, as detailed in accordance with these specifications, and as directed. Provide all MFHES from the same manufacturer.

**A.** Submittals. Provide to the Engineer all submittals identified in these specifications no later than two (2) weeks following award of the contract. These include but are not limited to Manufacturer's test results or third party test results, manufacturer's operation manual and documentation of experience.

**2.** Materials.

**A.** General Requirements. Provide all new equipment in strict accordance with the details shown on the plans and in the specifications.

Provide a high-performance, modular hardened Ethernet switch to support standard Ethernet, and Fast Ethernet connectivity. Ensure dedicated bandwidth to the desktop and guarantees that each end-user receives a full 10 or 100 Mbps connection, as configured, enabling applications to operate reliably, and with low latency.

They must provide highly reliable, Electronic Industries Association (EIA) compatible Ethernet data communications via single-mode fiber optic transmission medium and Category 5 or better copper transmission medium.

The role of the MFHES is to provide a switched Ethernet connection for each field device.

Include licenses for all equipment, where required, for any software or hardware in the system.

Ensure compatibility with existing field switches.

**B.** Adherence To Standards. Furnish, assemble, fabricate, or install MFHES under this item that is in compliance with the following:

1. IEEE 802.3, 802.3u, 10BASE-T, 100BASE-TX/100BASE-FX.
2. IEEE 802.3u,Auto-sensing for speed
3. IEEE 802.3x, Flow Control
4. IEEE 802.3Q, Port-Based VLAN
5. IEEE 802.3W, Rapid Spanning Tree Protocol
6. UL, cUL, FCC and CE.

**C.** Functional Requirements.

**(1).** Physical Design Requirements. Ensure MFHES physical design conforms to the following requirements:

**a.** Design to operate in abnormal temperature applications, and are suitable for use in harsh environments with inhospitable high /low temperatures.

**b.** Ease to install and use. Addresses of attached nodes are automatically learned and maintained, adapting the switching services to network changes and expansions.

**c.** Ensure plug-and play installation, and operation is transparent to software.

**d.** Ensure unit has high-strength 18-gauge steel enclosure to seal out insects, dirt, smoke, and other contaminants. Ensure steel enclosure operates as heat sinks, drawing heat away from internal components.

**e.** Identify clearly all modules and assemblies with name, model number, serial number, or any other pertinent information required to facilitate equipment maintenance.

**f.** All optics will operate at single-mode, 1310 nm or 1550 nm.

**g.** Optics will have the ability to transmit and receive Ethernet data at a minimum distance of 16km.

**h.** Unit will have at least four (4) optical 100FX ports (100Mbps).

**i.** Each optical port is part of a pair of fibers, one fiber for Transmit, one fiber for Receive.

**j.** Ports will be type SC or type ST if noted on the plans.

**k.** No type MTRJ or LC connectors allowed.

**(2).** Electrical and Mechanical Requirements. Provide the following functionality and features:

**a.** Ports Performance.

- Fiber, and when an auto-negotiating port is operating at 100 Mbps: Data Rate: 100 Mbps.
- RJ-45 auto-negotiating port is operating at 10 Mbps: Data Rate: 10 Mbps.
- CAT 5 UTP/STP will be EIA/TIA 568-A Compliant.
- Unit will have at least four (4) 10/100Base TX ports (100Mbps).
- CAT 5 ports will be standard EIA/TIA 568-A pin outs.

| PIN | Signal |
|---|---|
| 1 | RX+ |
| 2 | RX- |
| 3 | TX+ |
| 4 | na |
| 5 | na |
| 6 | TX- |

| | |
|---|---|
| 7 | na |
| 8 | na |

**b.** Switch will have the ability to support Layer 2 Management features commonly found in managed Ethernet switches.
Will meet or exceed IEEE 802.1Q Standard Minimum 4K VLAN address table required.

**c.** Rapid Spanning Tree Protocol.
STP healing rate will meet or exceed IEEE 802.1W Standard

**d.** MAC Address Table. Minimum 4K MAC address table.

**e.** SNMP Support.
- SNMP management electronics required.
- Access via resident RS-232 management port.
- Access via telnet or ftp.

**f.** RMON (Remote Monitoring) Support. Support RMON for Ethernet Agent.

**g.** Packet-Processing Between Domains.
- Filtering and forwarding rate from 100 Mbps ports: 148,800 pps max.
- Filtering and forwarding rate from 10 Mbps ports: 14,880 pps max.
- Processing type: store and forward.
- Auto-learning: 16K address table, shared for all traffic domains.
- Packet buffers: 1.0 Mb, dynamically shared on all domains.
- Latency (not include packet time): 100 to 10 Mbps and 10 to 100: < 15 microsecond.

**h.** Path Delay Value.
50 BT on all ports.

**i.** Network Cable Connectors.
- 100 Mbps: Category 5 UTP/STP;
- Fiber: Singlemode fiber with SC connectors.
- 10 Mbps: Category 3, 4, 5 UTP (Auto-sensing)

**j.** Full-duplex/ Half-duplex on copper (RJ-45) switched ports.
- All the RJ-45 ports support full/half duplex and 10/100 speed, each independently auto-negotiating.
- The switched fiber ports will be fixed at full-duplex only, 100 MB speed.

**k.** Mean Time Between Failure. > 5 years.

**l.** LED Indicators. One LED for power, TX, RX, speed (CAT 5 ports only), link/activity.

**m.** Power Requirements. Ensure Hardened Ethernet Switch furnished, assembled, fabricated, or installed under this Item meets all of its specified requirements when the input power is 115 VAC ± 10%, 60 ± 3 Hz.

- Power Supply (External) AC Power Supply.
  AC power connector: IEC-type, male recessed at rear of power supply chassis.
  Input Voltage: 85 to 260 VAC (auto-ranging)
  Input Frequency: 47 to 63 Hz (auto-ranging)
  Power Consumption: 15 watts typical, maximum 20 Watts.
  Power Supply Rating: 3 amps at 5 VDC.
  Input Fuse for overload and short protection: 3 AG type, 0.5 amp.
  Power Capacity: 15 watts output, 70% min efficiency.
  Surge Protection: Over 150 joules, with clamping at 800V 50A min.
  Operating Shock and Vibration: Meets Bellcore GR-63-CoreSections 4.4.1 and 4.4.3.

Provide equipment operations that are not affected by the transient voltages, surges and sags normally experienced on commercial power lines. Check the local power service to determine if any special design is needed for the equipment. Include extra cost, if required, in the bid of this item.

- Wiring. Provide wiring that meets the requirements of the National Electric Code. Provide wires that are cut to proper length before assembly. Provide cable slacks to facilitate removal and replacement of assemblies, panels, and modules. Do not double-back wire to take up slack. Lace wires neatly into cable with nylon lacing or plastic straps. Secure cables with clamps. Provide service loops at connections.

- Transient Suppression. Provide DC relays, solenoids and holding coils that have diodes or other protective devices across the coils for transient suppression.

- Power Service Protection. Provide equipment that contains readily accessible, manually resettable or replaceable circuit protection devices (such as circuit breakers or fuses) for equipment and power source protection.

  Provide and size circuit breakers or fuses such that no wire, component, connector, PC board or assembly must be subjected to sustained current in excess of their respective design limits upon the failure of any single circuit element or wiring.

- Fail Safe Provision. Provide equipment that is designed such that the failure(s) of the equipment does not cause the failure of any other unit of equipment.

**n.** Mechanical Requirements. Ensure the dimensions are 9 in. H X 6 in.W X 2 in.D maximum weigh 4 pounds maximum and the enclosure is made of rugged 18-gauge high-strength steel case. Include metal mounting plate. Ensure the unit is suitable for stand-alone, shelf, pedestal or wall mounting.

Coat printed circuit boards with a clear-coat moisture and fungus resistant material (conformal coating).

- Modular Design. Provide equipment that is modular in design to allow major portions to be readily replaced in the field. Ensure modules of unlike functions are mechanically keyed to prevent insertion into the wrong socket or connector.

  Identify modules and assemblies clearly with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance.

- Connectors and Harnesses. Provide external connections made by means of connectors. Provide connectors that are keyed to preclude improper hookups. Color code and/or appropriately mark wires to and from the connectors.

  Provide connecting harnesses of appropriate length and terminated with matching connectors for interconnection with the communications system equipment.

  Provide pins and mating connectors that are plated to improve conductivity and resist corrosion. Cover connectors utilizing solder type connections by a piece of heat shrink tubing securely shrunk to insure that it protects the connection.

  Ensure patch fibers with mixed connectors are uniquely color coded for easy identification.

- Environmental Requirements. Provide all equipment capable to meet the uncontrolled environmental operations characterized by a temperature range of -40°C (-40°F) to +70°C (160°F) and a humidity range of 10% to 95% (non-condensing).

**3.** Construction.

**A.** General. Provide equipment that utilizes the latest available techniques for design and construction with a minimum number of parts, subassemblies, circuits, cards, and modules to maximize standardization and commonality.

Ensure equipment and appurtenances meets the specified requirements and at a minimum, all NEMA TS-1 specifications and standards on environmental operating conditions.

Design the equipment for ease of maintenance. Provide component parts that are readily accessible for inspection and maintenance. Provide test points that are for checking essential voltages and waveforms.

Do not use existing GFI outlets in the controller cabinet to plug in MFHES power cord. At each controller cabinet where an MFHES will be installed, install a duplex power outlet for the MFHES. This outlet will be a standard 110VAC u-channel mounted duplex outlet.

Ensure switch will be mountable inside the controller cabinet. Ensure switch is able to fit inside the controller cabinet in a secure location, accessible by field technicians, and maintaining all applicable bend radii for fiber optic cable. Ensure that the switch supports full duplex Ethernet communications.

**B.** Electronic Components. Provide this item in accordance with Special Specifications 6013 "Electronic Components".

**C.** Mechanical Components. Provide external screws, nuts and locking washers that are stainless steel; no self-tapping screws will be used. Provide parts made of corrosion resistant material, such as plastic, stainless steel, anodized aluminum or brass. Protect materials from fungus growth and moisture deterioration. Separate dissimilar metals by an inert dielectric material.

**D.** Documentation Requirements. Provide one (1) copy of the manufacturer's operation manual at each installation location. Deliver 10 additional paper copies of the manufacturer's operation manual, plus an electronic copy (in either .doc or .pdf format) to the Engineer prior to the first MFHES installation.

**E.** Testing.

**(1).** Manufacturer's Test Results. Provide documentation of all manufacturer's test results in order to meet the specifications contained herein prior to approval.

**(2).** Outside Vendor/Third Party Test Results. In lieu of or in addition to the above, outside vendor/third party test results will be accepted.

**F.** Experience Requirements. Meet the following requirements, as a minimum, for Contractor or designated subcontractors involved in the installation and testing of the Ethernet equipment:

Three years experience in the installation of Ethernet equipment.

Two installed systems where Ethernet switches are installed and the systems have been in continuously satisfactory operation for at least two (2) year. Submit as proof, photographs or other supporting documents, and the names, addresses and telephone numbers of the operating personnel who can be contacted regarding the system.

Provide necessary documentation of subcontractor qualifications pursuant to contract award.

**G.** Technical Assistance. Ensure that a manufacturer's technical representative is available on site to assist the technical personnel at each installation site and with Ethernet equipment installation and communication system configuration.

Do not execute the initial powering up of the Ethernet equipment without the permission of the manufacturer's representative.

**H.** Warranty. All equipment, materials and other appurtenances will be warranted by the manufacturer for five years following the acceptance of the system by City of Houston. The warranty will include the specific installation characteristics for the geographic region and project limits.

**4.** Measurement. Item will be measured as each unit furnished, installed, made fully functional and tested in accordance with these special specifications or as directed by the Engineer. A unit will include one (1) MFHES meeting all specifications, standards and requirements contained herein, power supply cord or adapter, all mounting hardware, manufacturer's operation manual, required testing results, manufacturers technical specification, and the cost of all materials, training, warranty, equipment (excepting the non-GFI outlet), and all accessories necessary to the complete installation of the unit.

**5.** Payment. The Work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Managed Field Hardened Ethernet Switch". This price will include all equipment described under this Item with all cables and connectors; all documentation and testing and will also include the cost of furnishing all labor, materials, software, warranty, training, equipment, and incidentals.

END OF SECTION