# ETHERNET SWITCH MATERIAL SPECIFICATION

Ensure Ethernet Switches are compatible with existing architecture and conforms to the following specifications:

A. Standards and Certifications
1. Institute of Electrical and Electronics Engineers (IEEE) and Operating Standards:
   a. IEEE 802.1D — Spanning Tree Algorithm
   b. IEEE 802.1p — Quality of Service (QoS), 8 level transmission priorities.
   c. IEEE 802.1s — Multiple Spanning-Trees
   d. IEEE 802.1Q — Virtual Local Area Network (VLAN) tagging
   e. IEEE 802.1w — Rapid Spanning Tree Algorithm
   f. IEEE 802.1x — Port Based Network Access Control
   g. IEEE 802.3 — 10Base-T
   h. IEEE 802.3u — 100Base-TX, 100Base-FX
   i. IEEE 802.3x — Flow Control
   j. IEEE 802.3z — 1000Base-LX
   k. IEEE 802.3ab — 1000Base-T
   l. IEEE 802.3ad — Link Aggregation (LACP)
   m. IEEE 802.3af — Power over Ethernet
   n. IEEE 802.3at — Power over Ethernet Plus
   o. IP Multicast — Filtering through Internet Group Management Protocol (IGMP) Snooping, IP Routing (Type A Switch), Inter-VLAN IP routing for full Layer 3 routing between two or more VLANs.  IP Unicast routing protocols including v6 – Static, RIP, RIPng, OSPF, IGRP, EIGRP, PIM, BGP, PBR, HSRP, Supports 1000 multicast groups, VRF, DHCP Snooping
2. Safety Certifications:
   a. Product Safety: — Underwriters Laboratories (UL) 60950 or UL 508.
   b. Electromagnetic Emissions — Federal Communication Commission (FCC) Part 15, Class A.
3. Environmental: — National Electrical Manufacturers Association (NEMA) TS1/TS2 – Environmental Requirements only.

B. Functional Requirements
1. Minimum of 12K Media Access Control (MAC) addresses for Type Hub configuration (Type A Switch)
2. Minimum of 8K MAC addresses for Type Field configuration (Type B Switch)
3. Port Mirroring
4. MAC Based Port Trunking
5. Store-and-forward Switching Method
6. Non-blocking full wire speed forwarding rate:
   a. 10 mbps: — 14,880 pps (packets per second)
   b. 100 mbps: — 148,800 pps (packets per second)
   c. 1000 mbps: — 1,488,000 pps (packets per second)

C. Management
1. Direct console port access via RS-232 or USB
2. Management Application available through secured HTML Web Browser
3. Remote configuration by SSH, HTTPS is allowed.  TELNET and HTTP are **FORBIDDEN**.
4. SNMP v1, v2, v3 - Bridge Management Information Base (MIB), VLAN MIB, Private MIB, RMON MIB - for alarm monitoring & diagnostic.
5. IGMP v1, v2, v3 (IGMP Snooping)
6. Security ACL's (Not Applicable for Type B)

D.   Interface and Connectors
   The configuration, range, and type of all SFPs should be as specified on contract plans or to meet contract plans distance and fiber requirements. All SFP port shall be supplied with a SFP unit. If SFP port is not in use, a SFP shall be supplied to match in units in use in other used ports port specification. Supplied units must be compatible Cisco SFPs. **NO SUBSTITUTIONS PERMITTED.**

Use the following table for Copper connections.

| Designation | Typical Distance | Nominal Wavelength | Fiber Type | Connector | Optical Budget |
|---|---|---|---|---|---|
| 10Base-TX | 100 m | N/A | N/A | RJ-45 | N/A |
| 100Base-TX | 100 m | N/A | N/A | RJ-45 | N/A |
| 1000Base-TX | 100 m | N/A | N/A | RJ-45 | N/A |

   Ensure the correct Fiber Transceiver is utilized based on distance and dB loss between switches.
   1.   Provide connectors as follows:
      a.   Copper:                                    RJ-45 F Female 8 Position 8 Contact (8P8C)
      b.   Fiber:                                       LC

E.   Indicators
   1.   LED Indicator showing Power Status.
   2.   LED Indicators showing status and activity of each port.

F.   Mechanical Specifications
   1.   Maximum Dimension:                  19" (W) X 18" (D) X 13" (H), up to 24.5" x 17.5" x 18.2" for Type CAV, E and F
   2.   Maximum Weight:                       15 lbs for Type A-D, 190 lbs for Type E & Type F
   3.   Ensure unit includes mounting brackets for being mounted in standard 19" rack without custom modifications.
   4.   Contractor to ensure that the switch fits in the cabinet.
   5.   Switch Type F must be DIN Rail mounted, no shelf mounting permitted.

G.   Environmental Specifications
   1.   Meet or exceed the following criteria as specified in NEMA TS2.  Values listed below for reference only, as excerpted from most recent version of NEMA TS2.
      a.   Operating Voltage:               120 VAC ± 5VAC
      b.   Operating Frequency:           60 Hz ± 3 Hz
      c.   Power Interruption:               Comply with NEMA TS2
      d.   Operating Humidity:             10% to 90% relative humidity non-condensing
      e.   Transients, Input/Output:      Comply with NEMA TS2
      f.   Non-destruct Transient Immunity:   Comply with NEMA TS2
      g.   Vibration:                            Comply with NEMA TS2
      h.   Shock:                                 Comply with NEMA TS2

H.   Electrical Power
   1.   Equip the power supply with a minimum of a six (6) foot power cord terminating in a standard three (3) prong line plug.  Maximum power requirement must not exceed 80 watts for each unit except for Type E. Two (2) power supplies are required for Type A, Type E and Type F switches. Only Cisco power supplies are to be used with the Ethernet Switches.
   2.   Switch Type F Power Supplies shall be configured to provided redundant power form each power supplies to both switch and edge compute module. Power supplies shall also be configured to one power source to permit restarts with power distribution unit.

I.   Software
   1.   Provide Software License(s) with each unit with the paper copy.
   2.   All Devices shall be supplied with 3 years of extended service agreement

J.  Identification
1.  Identify Ethernet Switch with a metal plate containing the serial number with bar code identification. Provide phenolic nameplate with switch designation shown on Contract Documents. Provide manuals and training documentation, and electronic version of custom configurations on compact disc media.
2.  Provide a waterproof, laminated, self-adhesive, black-on-white label with the following:

Route-Direction-Identification-MP
Route = Primary route location of the Ethernet switch
Direction = WB, EB, NB, SB, MD (Median)
Identification = Abbreviated identification, i.e. EXP (Express), LOC (Local), etc.
MP = Milepost of Ethernet switch

K.  Standard Configuration
Unless otherwise specified in the contract plans, use the following port configuration:

| Switch Type | Switch Function | Minimum # of Required Ports | | | | | | Temperature | |
| | | 10/100 Base-TX Copper | 10/100/1000 Base-TX Copper | 100Base SFP | 1000Base SFP | 10/100/1000 Base Combo Ports | PoE/PoE+ (FE) Ports | Operating Range | Storage Range |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Type A | HUB[I] | - | 8 | 16 | 2 | - | - | -40°F to 140 °F | -40°F to 185°F |
| Type B | Field[II] | - | 8 or 14[1] | - | 2 or 4[1] | - | 8 | -40°F to 167°F | -40°F to 167°F |
| Type C | Broadband ISP[III] | - | 4 | - | - | - | - | -13°F to 140°F | -13°F to 149°F |
| Type D | HUB[IV] | - | 24 | - | 4 | - | - | 23°F to 113°F | -40°F to 158°F |

[1]=If expansion module is required based on plan set fiber configuration.

T/TX ports to have user-selectable speed setting (10/100 Mbps or 10/100/1000 Mbps where specified). In order not to conflict with existing term contracts, all switches, including SFP's, are to be Cisco – No Substitutions Permitted.

[I]    Type A must use Cisco IE-5000-16S12P with Layer 3 IP Services Image (SIEISK9T-15002SE) and dual power supply (2 x PWR-RGD-AC-DC-250).  It must also include the following part numbers: 1 x CON-SSSNT-IE50001S, 1 x SIE5UK9T-15206E, 1 x IE5000-DNA-A-H, 1 x IE5000-DNA-A-H-3Y, 1 x L-MGMT3X-TKN-K9=.

**REMOVE NOTE BELOW WHEN INSERTING INTO CONTRACT SPECIAL PROVISIONS.**
**Note for Designers:** For Type B switch, designer is to verify the number of required ports for each site and propose use of expansion module as needed on the fiber assignment diagram plan sheets.

[II]   All Type B switches are to be Cisco IE-3400-8P2S-A & It must also include but not be limited to the following part numbers-1 x IEM-3400-NW-A (with Smart Account), 1 x PWR-IE240W-PCAC-L, 1x CON-SNT-IE34008A, 1 x IE3300-6T2S=*, 1 x IOT-TRANSPORTATION, and 1 x IOT-ROADWAYS, 1 x L-MGMT3X-TKN-K9=.
*=If required based on plan set fiber configuration.

**REMOVE NOTE BELOW WHEN INSERTING INTO CONTRACT SPECIAL PROVISIONS.**
**Note for Designers:** For Type B switch, designer is to verify the number of required ports for each site and propose use of expansion module as needed.

[III]  Type C must use a hardened Cisco IR1821-K9 VPN Router to the latest revision with 4-Port 10/100/1000 Mbps Managed Switch for a field environment.  It must also include the following part numbers: 1 x CON-SNT-IR18219K, 1 x IOSXE-AUTO-MODE, 1 x NETWORK-PNP-LIC, 1 x SIR1800UK9-179, 1 x

SL-1800-NA/BOOS-K9, 1 x L-18-HSEC-K9, 1 x PWR-MF4-125W-AC(=), 1 x IR-PWR-G2A-NA, 1 x CAB-USB-UB, 1 x FW-FN980-5G-GL, 1 x GLC-FE-T-I, 1 x GLC-TE.

**IV** Type D must use Cisco C9300-24T-A with 1 x C9300-NM-8X and provide Ethernet Switch Type D with Layer 3 IP Services Image. It must also include the following part numbers: 3x CON-SSSNT-C93002TA, 1 x C9300-NW-A-24, 1 x S9300UK9-169, 1 x PWR-C1-350WAC-P, 1 x PWR-C1-350WAC-P/2, 2 x CAB-TA-NA, 1 x C9300-SSD-NONE, 1 x C1A1TCAT93001, 1 x C1A1TCAT93001-3Y, 1 x C1-C9300-24-DNAA-T, 1 x C1-9300-TRK-3Y, 25 x C1-ISE-BASE-T, 25 x C1-ISE-BASE-TRK-3Y, 25 x C1-ISE-PLS-T, 25 x C1-ISE-PLS-TRK-3Y, 25 x C1-SWATCH-T, 25 x C1-SWATCH-TRK-3Y.

**REMOVE NOTE BELOW WHEN INSERTING INTO CONTRACT SPECIAL PROVISIONS.**
**Note for Designers:** Type D switch is required at every Communication Hub. Check with OIT for number required.

| Switch Type | Switch Function | Minimum # of Required Ports | | Supervisor Engines | Power Supplies (Data +PoE) | Rack Height | Temperature | |
|---|---|---|---|---|---|---|---|---|
| | | 10/100/1000 Base-TX | GE SFP | | | | Operating Range | Storage Range |
| Type E | HUB**V** | 96 | 24 | 2 | 4 | 10 RU | 32°F to 104°F | -40°F to 167°F |

**V** Type E must use Cisco C9407R-96U-BNDL-A Chassis with two (2) x C9400-LC-48U blades and one C9400-LC-24S blade, Supervisor Engine C9400-SUP-1XL-B with Redundant Supervisor Engine (C9400-SUP-1XL), quad power supplies (4 x C9400-PWR-3200AC), and four 13 foot power cables (CAB-US620P-C19-US). It must also include the following part numbers: 1 x CON-SSSNT-C9407R9A, 2 x C9400-NW-A, 2 x C9400-S-BLANK, 4 x C9400-PWR-BLANK, 1 x S9400UK9-1610, 1 x C9400-DNA-A, 1 x C9400-DNA-A-3Y, 2 x C9400-SSD-NONE, 1 x C9400-SUP-1XL/2, 1 x C9400-SSD-NONE, 1 x C9400-LC-48U-B.

| Switch Type | Switch Function | Minimum # of Required Ports | | | | | | Temperature | |
|---|---|---|---|---|---|---|---|---|---|
| | | 10/100 Base-TX Copper | 10/100/1000 Base-TX Copper | 100Base SFP | 1000Base SFP | 10/100/1000 Base Combo Ports | PoE/PoE++ (FE) Ports | Operating Range | Storage Range |
| Type F | Connected Vehicle **VI** | - | 8 or 14[1] | | 2 or 4[1] | 14 | 8 | -40°F to 158°F | -40°F to 185°F |

[1]=If expansion module is required based on plan set fiber configuration.

**VI** Type F must use a hardened Cisco IE-3400-8P2S-A & It must also include but not be limited to the following part numbers-1 x IC3000-2C2F-K9, 1 x IEM-3300-6T2S=*, 1 x IEM-3400-NW-A (with Smart Account), 2 x PWR-IE240W-PCAC-L, 1 x CON-SNT-IE34008A, , 1 x CON-SNT-IC30002C, 2 x IOT-TRANSPORTATION, 2 x IOT-ROADWAYS, 1 x IOTFND-SOFTWARE-K9, 1 x IOTFND-IC3000, 1 x SVS-IOTFND-SUPT-B , 1 x EI-SUBSCRIPTIONS, 1 x SW-IC3000-U-K9, 1 x EI-ADV, 1 x EI-DA-R, 1 x SVS-EI-BAS, 1 x L-MGMT3X-TKN-K9=.
*=If required based on plan set fiber configuration.
**REMOVE NOTE BELOW WHEN INSERTING INTO CONTRACT SPECIAL PROVISIONS.**
**Note for Designers:** For Type F switch, designer is to verify the number of required ports for each site and propose use of expansion module as needed on the fiber assignment diagram plan sheets.

L.   List of Equipment
  1.   Provide the following with each Ethernet Switch:
    a.   Documentation
    b.   Cisco power supply
    c.   All required custom connections
    d.   Console Cable
    e.   Mounting brackets/shelf (if required)