

EXPECTED IMPLEMENTATION JULY 2024 (FY 2024-25)

684 NETWORK DEVICES. (REV 11-16-23) (FA 12-4-23) (FY 2024-25)

SECTION 684 is deleted and the following substituted:

SECTION 684 NETWORK DEVICES

684-1 Description.

Furnish and install network devices as shown in the Plans. Meet the requirements of Section 603.

684-2 Materials.

684-2.1 General: Meet the following requirements:

Managed Field Ethernet Switch*	Section 996
Managed Hub Ethernet Switch	Section 996
Device Server*	Section 996
Digital Video Encoder*	Section 996
Digital Video Decoder*	Section 996
Media Converter*	Section 996

*Use products listed on the Department's APL.

684-2.2 Managed Field Ethernet Switch: Ensure that the managed field Ethernet switch (MFES) provides Ethernet connectivity between devices, systems, and locations as required by the Contract Documents.

Ensure that the ITS network administrator will be able to manage each MFES individually and as a group for switch configuration, performance monitoring, and troubleshooting.

Ensure that the MFES is fully compatible and interoperable with connected Ethernet devices and the traffic control system network.

Ensure the MFES provides a switched Ethernet connection for each connected device and at least one open RJ45 Ethernet port for technician access.

684-2.2.1 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 an MFES having a minimum of two optical 100 Base FX ports capable of transmitting data at 100 megabits per second unless otherwise shown in the Plans. Ensure the MFES 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 will transmit (TX) data and one fiber will receive (RX) data. The optical ports must have an optical power budget of at least 15 dB, or as detailed in the Contract Documents.

684-2.2.2 Copper Ports: Provide an MFES that includes a minimum of four copper ports unless otherwise shown in the Plans.

EXPECTED IMPLEMENTATION JULY 2024 (FY 2024-25)

Ethernet over very high speed digital subscriber line (EoVDSL) ports are permitted for use in applications where fiber optic cable is not available.

684-2.3 Managed Hub Ethernet Switch: Ensure that the managed hub Ethernet switch (MHES) provides wire-speed Ethernet connectivity at transmission rates of up to ten gigabits per second to and from adjacent MHES within the traffic control network.

Ensure that the 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 is fully compatible and interoperable with field devices and the traffic control system network.

Ensure the MHES includes any license(s) required to utilize all Layer 3 features.

Ensure the MHES provides a switched Ethernet connection for each connected device and at least one open RJ45 Ethernet port for technician access.

684-2.3.1 Optical Ports: Ensure that all fiber optic link ports are modular SFP/SFP+ ports that operate at 1310 or 1550 nanometers in single mode and support 100Base-FX, 1000Base-X, and 10GBase-X. Ensure that the optical ports are Type LC unless otherwise shown in the Plans. Do not use mechanical transfer registered jack (MTRJ) type connectors.

Provide an MHES having a minimum of six optical Gigabit Ethernet ports as required to interface adjacent network devices. Optical ports must be capable of 100M, 1G, and 10Gbps data rates unless otherwise shown in the Plans. Ensure the MHES is configured with the number and type of ports detailed in the Contract Documents. Furnish hot-swappable fiber optical transceivers. Provide optical ports designed for use with a pair of fibers; one fiber will transmit (TX) data and one fiber will receive (RX) data. The optical ports must have an optical power budget of at least 15 dB, or as detailed in the Contract Documents.

684-2.3.2 Copper Ports: Provide an MHES that includes a minimum of twelve gigabit Ethernet copper ports unless otherwise shown in the Plans. All copper ports must be Type RJ-45 and auto-negotiate speed (e.g., 10/100/1000 Base) and duplex (i.e., full or half).

684-2.4 Device Server: Ensure that the device server provides Ethernet connectivity to devices with serial data interfaces as required by the Contract Documents. The device server must operate using a nominal input voltage of 120 V_{AC}. If the device requires nominal input voltage of less than 120 V_{AC}, furnish the appropriate voltage converter.

684-2.5 Digital Video Encoder and Decoder: Ensure that the complete video and data transmission system, defined as the combination of digital video encoder (DVE) and digital video decoder (DVD) hardware together with the existing or planned network infrastructure, simultaneously transports video and data from multiple remote field locations to multiple monitoring locations for roadway surveillance and traffic management.

EXPECTED IMPLEMENTATION JULY 2024 (FY 2024-25)

Provide a software decoding and control package that allows the viewing of any video source connected to the network through a DVE, and which allows the pan-tilt-zoom (PTZ) control of any PTZ camera on the network, the discovery of DVE and DVD devices on the network, and the control and adjustment of programmable parameters in the DVE and DVD equipment, including the network addresses of these devices, at no additional cost.

684-2.5.1 Digital Video Decoder: Provide a DVD that is either a hardware-based network device or a software application that resides on a workstation PC. Ensure that the software application provides PC desktop display of IP network video streams.

Provide all setup, control programs, and diagnostic software related to the DVE or DVD.

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

Ensure that any software-based decoder applications do not interfere with SunGuide® software operating when installed and used together on a shared hardware platform. Ensure that the software-based decoder offers an open Application Programming Interface (API) and software development kit available to the Department at no cost for integration with third party software and systems.

684-2.5.2 Interoperability: Provide DVE and DVD devices and software that are interoperable and interchangeable with DVE and DVD devices and software from other manufacturers.

684-2.5.3 Network Interface: Ensure that fiber ports are single mode with a minimum link budget of 30 dB or the type and power detailed in the Contract Documents.

684-2.6 Media Converter: The media converter must allow transition between the transmission media shown in the Plans or required to construct a functional system, such as conversion from twisted pair to optical fiber or from twisted pair to coaxial cable.

Ensure that fiber ports are single mode with a minimum link budget of 30 dB or the type and power detailed in the Contract Documents.

Media converters must operate on a nominal voltage of 120 V_{AC} if POE is unavailable. Supply an appropriate voltage converter for devices that require operating voltages of less than 120 V_{AC}.

684-3 Installation.

684-3.1 General: Install network devices at the locations shown in the Plans. Ensure that network devices are mounted securely and are 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.

684-4 Field Acceptance Testing.

684-4.1 General: Conduct field acceptance testing in accordance Section 611.

EXPECTED IMPLEMENTATION JULY 2024 (FY 2024-25)

684-4.2 MFES Field Acceptance Testing: Conduct inspection and testing at the installed equipment location according to the approved test plan. Perform the following:

1. Verify that physical construction has been completed as detailed in the Plans.
2. Inspect the quality and tightness of ground and surge protector connections.
3. Verify proper voltages for all power supplies and related power circuits.
4. Connect devices to the power sources.
5. Verify all connections, including correct installation of communication and power cables.
6. Verify network connection and MFES configuration using a laptop PC.

684-4.3 MHES Field Acceptance Testing: Conduct inspection and testing at the installed equipment location according to the approved test plan. Perform the following:

1. Verify that physical construction has been completed as detailed in the Plans.
2. Inspect the quality and tightness of ground and surge protector connections.
3. Verify proper voltages for all power supplies and related power circuits.
4. Connect devices to the power sources.
5. Verify all connections, including correct installation of communication and power cables.
6. Verify network connection and MHES configuration using a laptop PC.

684-4.4 Device Server Field Acceptance Testing: Conduct inspection and testing at the installed equipment location according to the approved test plan. Perform the following:

1. Verify that physical construction has been completed as specified in the Plans.
2. Verify the quality and tightness of ground and surge protector connections.
3. Verify proper voltages for all power supplies and related power circuits.
4. Connect devices to the power sources.
5. Verify all connections, including correct installation of communication and power cables.
6. Verify network connection and device server configuration using a laptop PC.
7. Verify serial data transmission through the device server.

684-4.5 DVE and DVD Field Acceptance Testing: Conduct inspection and testing at the installed equipment location according to the approved test plan. Perform the following:

1. Verify that physical construction has been completed as detailed in the Plans.
2. Inspect the quality and tightness of ground and surge protector connections.

EXPECTED IMPLEMENTATION JULY 2024 (FY 2024-25)

3. Verify proper voltages for all power supplies and related power circuits.
4. Connect devices to the power sources.
5. Verify all connections, including correct installation of communication and power cables.
6. Verify video image is present and free from oversaturation and any other image defect in both color and monochrome mode.
7. Verify network connection to the DVE and DVD through ping and telnet session from a remote PC.
8. Verify serial data transmission through the DVE and DVD serial ports.
9. Verify support of unicast, multicast, and SAP.

684-5 Warranty.

684-5.1 General: Ensure that network devices have a manufacturer's warranty covering defects for 1 year from the date of final acceptance. 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.

684-6 Method of Measurement.

The Contract unit price for each network device, furnished and installed, will include furnishing, placement, and testing of all equipment and materials, and for all tools, labor, hardware, operational software packages and firmware, supplies, support, personnel training, shop drawings, documentation, and incidentals necessary to complete the work.

Provide software-based decoders at no additional cost when furnished in conjunction with DVEs.

A software-based DVD provided individually must be paid under the pay item below.

684-7 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section.

Payment will be made under:

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| Item No. 684- | 1- | Managed Field Ethernet Switch-each. |
| Item No. 684- | 2- | Device Server-each. |
| Item No. 684- | 3- | Digital Video Encoder with Software Decoder-each. |
| Item No. 684- | 4- | Digital Video Decoder-each. |
| Item No. 684- | 5- | Media Converter-each. |
| Item No. 684- | 7- | Managed Hub Ethernet Switch-each |