ORIGINATION FORM
Proposed Revisions to the Specifications

(Please provide all information - incomplete forms will be returned)

Date: November 21, 2019

Office: Traffic Engineering and Ope

Originator: Derek Vollmer

Specification Section: 996

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Article/Subarticle: New section

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****Will the proposed revision require changes to:**

Publication	Yes	No	Office Staff Contacted and date contacted
Standard Plans Index	○	◉	Rick Jenkins and Cheryl Hu
Traffic Engineering Manual	○	◉	Javier Ponce (10/14/2019)
FDOT Design Manual	○	◉	Bobby Bull (10/14/2019)
Construction Project Administration Manual	○	◉	Dan Hurtado (10/14/2019)
Basis of Estimate/Pay Items	○	◉	Melissa Hollis (10/14/2019)
Structures Design Guidelines	○	◉	Scott Arnold (10/14/2019)
Approved Product List	◉	○	Karen Byram (10/14/2019)
Materials Manual	○	◉	Susan Musselman (10/14/2

**This section must be completed prior to processing proposed revisions.

Will this revision necessitate any of the following:

Design Bulletin ☐ **Construction Bulletin** ☐ **Estimates Bulletin** ☐ **Materials Bulletin** ☐

Are all references to external publications current? **Yes** ◉ **No** ○

If not, what references need to be updated? (Please include changes in the redline document.)

Why does the existing language need to be changed?

A federal law will be effective August 2020. Moving material language from 684 and 682 into D

Summary of the changes:

Adding a requirement based on the Federal National Defense Law that restricts usage of devic

Are these changes applicable to all Department jobs? **Yes** ◉ **No** ○

If not, what are the restrictions?

Contact the State Specifications Office for assistance in completing this form.
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M E M O R A N D U M

DATE: December 12, 2019

TO: Specification Review Distribution List

FROM: Daniel Strickland, P.E., State Specifications Engineer

SUBJECT: Proposed Specification: **9960000 Intelligent Transportation System Device Materials.**

In accordance with Specification Development Procedures, we are sending you a copy of a proposed specification change.

This change was proposed by Derek Vollmer from the Traffic Engineering and Operations Office to move the material language from Section 684 and Section 682 into Division III of the Standard Specifications.

Please share this proposal with others within your responsibility. Review comments are due within four weeks and should be sent to Mail Station 75 or online at http://fdotewp1.dot.state.fl.us/programmanagement/development/industryreview.aspx . Comments received after **January 9, 2020,** may not be considered. Your input is encouraged.

DS/rf
Attachment

INTELLIGENT TRANSPORTATION SYSTEM DEVICE MATERIALS
(REV 11-21-19)

The following new Section is added after Section 995.

996-1 Description.

This Section governs the requirements for all permanent intelligent transportation system devices.

996-2 Video Equipment.

996-2.1 General: All video equipment shall be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.

All equipment shall be permanently marked with manufacturer name or trademark, part number, and date of manufacture or serial number. All parts shall be constructed of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal. All fasteners exposed to the elements be Type 304 or 316 passivated stainless steel.

996-2.2 CCTV Camera.

996-2.2.1 Camera: CCTV cameras shall be compliant with the John S. McCain National Defense Authorization Act for Fiscal Year 2019, Section 889, Prohibition on Certain Telecommunications or Video Surveillance Services or Equipment. CCTV cameras shall be compatible with the current version of the Department's SunGuide® software system. Camera types include dome pan-tilt-zoom (PTZ), external positioner-PTZ, and fixed. Video types include analog and internet protocol (IP).

Analog camera produces National Television System Committee (NTSC) composite video output of 1V peak-to-peak (Vp-p) at 75 ohms with a minimum resolution of 470 horizontal and 350 vertical TV lines.

Analog and IP cameras shall provide the following features and capabilities:

1. Day (color)/night (monochrome) switchover and iris control, with user-selectable manual and automatic control capabilities.
2. Ability to produce clear, detailed, and usable video images of the areas, objects, and other subjects visible from a roadside CCTV field site. Video produced by the camera is true, accurate, distortion free, and free from transfer smear, oversaturation, and any other image defect that negatively impacts image quality under all lighting and weather conditions in both color and monochrome modes.
3. User-selectable automatic gain control (AGC) that is peak-average adjustable to 28 dB.
4. A minimum signal-to-noise ratio of 50 dB.
5. Automatic color balance that references the white areas of the scene through the lens.
6. An automatic electronic shutter that is user selectable from 1/60 to 1/10,000 of a second.
7. PTZ cameras shall include a minimum 10x digital zoom.

8. PTZ cameras shall include programmable azimuth and compass display with ability to display pan and tilt position with a 1 degree resolution.

CCTV cameras shall provide titling and masking features including, but not limited to, programmable camera title, programmable preset titles for each preset position, and programmable privacy zones. Programmable titles shall allow a minimum of 18 characters per line.

996-2.2.2 Lens: Standard definition PTZ cameras shall include a minimum 22x motorized optical zoom lens with automatic iris. High definition CCTV cameras shall include a minimum 18x motorized optical zoom lens with automatic iris. The lens shall provide automatic and manual focus and iris control. Fixed cameras shall have a 3-9 mm varifocal lens with automatic iris. The lens shall have a maximum aperture of at least f/1.6 and the depth of field shall provide a clear image of roadside areas under all lighting conditions.

996-2.2.3 Pan/Tilt Mechanism for Dome-Type Cameras: Dome PTZ cameras shall meet the following requirements:

1. Have an integrated pan/tilt mechanism that provides 360 degree continuous pan with a minimum 90 degree tilt range (i.e., 0 degrees to minus 90 degrees);

2. Provide for variable speed control;

3. Have a preset position return accuracy of plus or minus 0.36 degree, or less than 0.10% or better;

4. Support a minimum of 64 presets; support a minimum of one tour with a minimum of 32 presets; and support a minimum of eight programmable blackout zones.

The positioner within the dome-type CCTV camera shall have a minimum automatic pan speed of 240 degrees per second to a preset camera position, a maximum manual pan speed of 80 degrees per second minimum and a maximum manual tilt speed of 40 degrees per second minimum.

996-2.2.4 Pan/Tilt Mechanism for External Positioner-Type Cameras: External positioner-type CCTV cameras shall include a pan/tilt mechanism that provides 360 degree continuous pan with a minimum 115 degree tilt range (i.e., minus 90 to plus 25 degrees), provide for variable speed control, have a preset position return accuracy of plus or minus 0.36 degree or less than 0.10% or better, and support a minimum of 32 presets.

996-2.2.5 Communication: Analog CCTV cameras shall support the National Transportation Communications for ITS Protocol (NTCIP) 1205 v1.08. The camera shall communicate with other devices using Telecommunications Industry Association/Electronic Industries Alliance (TIA/EIA)-232 or TIA-422 at a rate of 9600 bps, transmission control protocol (TCP)/IP, or user datagram protocol (UDP)/IP. All CCTV cameras shall provide for remote firmware upgrades via the communication interface.

IP cameras shall support either NTCIP 1205v01.08 or the Open Network Video Interface Forum (ONVIF) Core, Streaming, and Media Service specifications.

The camera shall implement all objects, operations, and commands required by SR-682-1.2.1-01, Supplemental CCTV Camera NTCIP and ONVIF Requirements, as published on the Department's State Traffic Engineering and Operations Office website at the following URL: https://www.fdot.gov/traffic/Traf_Sys/Product-Specifications.shtm.

996-2.2.6 Electrical Requirements: Cameras shall operate on a nominal voltage of 120 VAC. Provide an appropriate voltage converter for devices that require operating voltages of less than 120 VAC.

996-2.2.7 Mechanical Requirements: Camera housings and hardware shall be light in color.

Camera housings shall include a sunshield to reduce the solar heating of the camera. The total weight of dome-type CCTV cameras (including the housing, sunshield, and all internal components) shall be less than 17.0 lbs. The lower dome of the camera housing shall be constructed of distortion free clear plastic.

Pressurized dome-type housings shall be capable of pressurization at 5 psi using dry nitrogen, have a low-pressure alarm feature, and a NEMA 4X/IP-67 rating.

If a non-pressurized dome-type housing enclosure is used, the unit shall be vented with a thermostat-controlled heater and blower. The non-pressurized enclosure shall have a NEMA 4/IP-66 rating.

The total weight of external positioner-type CCTV cameras (including housing, sunshield, all internal components, and external pan and tilt mechanism) shall be less than 35 lb.

996-2.2.8 Environmental Requirements: CCTV cameras shall perform all required functions during and after being subjected to the environmental testing procedures described in NEMA TS2, Sections 2.2.7, 2.2.8, and 2.2.9.

All CCTV cameras, mounting hardware, and any other camera-related material that is exposed to the environment shall be designed for 150 mph wind speeds and meet the requirements of the Department's Structures Manual.

996-2.2.9 Additional Requirements for IP Cameras:

996-2.2.9.1 Video Encoding: The camera shall utilize the Moving Picture Experts Group's MPEG4 part 10 (H.264) video compression technology in accordance with the ISO and IEC requirements detailed in the ISO/IEC 14496-10:2009 Standard.

Cameras shall establish unicast and multicast sessions using the Real-Time Streaming Protocol (RTSP) and provide for a 99.999% error-free operation. The encoded video shall transmit using programmable bit rates and the camera supports, at a minimum, a fixed bit rate mode.

996-2.2.9.2 Encoded Video Interoperability: The camera's encoded video shall be able to be displayed using video display control systems listed on the APL.

996-2.2.9.3 Encoded Video Requirements: The camera's encoded video shall support resolutions that include; but are not limited to, those defined in Table 1.1. The camera shall deliver color and monochrome video at 30 frames per second (fps), regardless of resolution.

Table 1.1 – Minimum Resolution Requirements	
Format	Vertical Resolutions
H.264	240, 480
Note: The resolutions attained depend on the data transmission rate.	

996-2.2.9.4 Network Interface: The camera's Local Area Network (LAN) connection shall support the requirements detailed in the IEEE 802.3 Standard for 10/100 Ethernet connections. The camera shall have a minimum of one 10/100 Base-TX connection Ethernet port.

Unshielded twisted pair/shielded twisted pair network cables shall be compliant with the TIA-568 Standard. The network communication shall conform to TCP,

UDP, Version 4 of the IP, RTSP, and Version 2 of the Internet Group Multicast Protocol (IGMP), at a minimum. If the camera supports NTCIP, then the camera shall be able to be controlled via TCP/IP or UDP/IP.

996-2.2.9.5 Configuration Management: The camera shall support local and remote configuration and management via serial login, telnet login, or a web-based interface. Configuration and management functions shall include access to all user-programmable features including, but not limited to, network configuration, video settings, device monitoring, and security functions.

996-2.3 Video Display Control System.

996-2.3.1 Display Control System: The video display control system shall allow the operator to control and manage the display of video and computer-generated graphics on the display equipment connected to the system as well as provide selection and switching of multiple sources for display, including video streams available on the TMC Ethernet network. The display control system shall also allow for operator control of all displays from the same workstation that is used for the SunGuide® operator interface. The video display control system shall decode and display all video streams produced by encoders listed on the APL.

The video display control system simultaneously displays a minimum of 32 video windows, each containing streaming video at a minimum resolution of 720 pixels by 480 pixels and frame rate of 30 fps. The system shall allow any display window to be sized from 1/32 of the total display area up to the total display area, and any size in between.

The video display control system hardware shall be designed to be rack mounted and secured in an EIA 19 inch equipment rack. Any system incorporating Personal Computer (PC) hardware shall use current microprocessor technology and commercial, off-the-shelf components, including RAM, hard disk drives, and network interface cards sufficient to provide the functional requirements of the system.

The video display control system shall be expandable and scalable to support any combination of inputs and outputs.

The video display control system shall have a minimum configuration of 4 composite video inputs, 4 component (red, green, and blue (RGB) video inputs, and 4 DVI inputs as well as network connections, decoders, and associated hardware and software required to display 32 inputs simultaneously at a minimum resolution of 720 pixels by 480 pixels and a frame rate of 30 fps.

The video display control system shall have a minimum configuration of 4 composite video outputs, 2 component (RGB video outputs), and 4 DVI outputs.

996-2.3.2 Display Control Software: The display control software shall allow multiple operators to control all features and functions of the video display control system. These features and functions include, but are not limited to, selection of video sources for display; adjusting the size, location, and layout of video and other graphic information the system displays; and system configuration and setup. The control software shall be able to operate a video wall composed of multiple display components as though it were a single, high-resolution display.

The display control software is compatible with the Department's SunGuide® software system.

The display control software shall include a non-proprietary Software Development Kit (SDK) including, but not limited to, an Application Programming Interface

(API) that describes interfaces and protocols which can be used to integrate system features and functions with third-party applications.

996-2.3.3 Controller Inputs and Outputs: The video display control system shall support and display a variety of video and data inputs simultaneously, including composite and component National Television System Committee (NTSC) video, Digital Visual Interface (DVI), Video Graphics Array (VGA), Super Video Graphics Array (SVGA), and Super Extended Graphics Array (SXGA) computer graphics. All inputs and outputs shall allow for operator control in order to display any or all of this information on any number of display devices within the system. All inputs and outputs shall be sized with and without constrained proportions across multiple screens and moved at will around any display area and combination of displays.

The video display control system shall be expandable and scalable to support any combination of inputs and outputs. The video display control system with a minimum configuration of 4 composite video inputs, 4 component (RGB video inputs), and 4 DVI inputs as well as network connections, decoders, and associated hardware and software required to display 32 inputs simultaneously at a minimum resolution of 720 pixels by 480 pixels and a frame rate of 30 fps, or as shown in the Plans. Provide the video display control system with a minimum configuration of 4 composite video outputs, 2 component (RGB video outputs), and 4 DVI outputs. The video display control system can be expanded to accommodate at least 128 discreet inputs and outputs.

A single input shall be able to be routed to multiple displays simultaneously and multiple inputs can be routed to a single display simultaneously for viewing in separate windows. All inputs and outputs shall be synchronized by the video display control system and switching between inputs or outputs does not cause displayed images to unlock, roll, or otherwise exhibit visible distortion.

996-2.3.3.1 Analog Video: The video display control system shall be able to accept S-video, composite, and component video sources, and can digitize these signals for manipulation and display on any display device attached to the system. All analog video inputs shall use BNC connectors.

Analog video sources shall display within their own windows and can be resized up to or beyond their native resolution to conform to the wall display size.

996-2.3.3.2 Digital Video: The video display control system shall be able to accept digital video sources and can manipulate and display these signals on any display attached to the system. All digital video outputs shall use DVI connectors, HDMI connectors or display port connectors.

Each MPEG video stream shall display within its own window and be freely movable and sizable up to or beyond its native resolution to conform to the wall display size.

996-2.3.3.3 RGB Video: Include an analog input that enables the TMC operator to project an exact copy of his or her workstation desktop display on the video wall display. Analog RGB inputs shall allow native images up to 1,280 pixels by 1,024 pixels at 60 Hz to be displayed on the video wall.

RGB inputs shall be sizable up to or beyond their native resolution to conform to the wall display size.

996-2.3.3.4 Streaming Media: The video display control system shall be able to display a minimum of 32 compressed video streams simultaneously in MPEG-2 over

TCP/UDP/RTP over IP and supports multicasting as defined in Version 2 of the Internet Gateway Message Protocol (IGMP). The video display control system can display MPEG-4 and H.264. The MPEG video input interface is, at minimum, a 10/100 megabit per second network port per every 15 streams.

996-2.3.3.5 Primary Display Output: Video display control system can process the various signal input types to be viewed, such as the RGB feeds from monitor outputs and streaming video feeds. The unit shall provide direct digital streaming video through cable feeds using a digital video decoder. The video display control system shall provide the layout definitions for each signal to be displayed and save the predefined layouts and shall also permit switching of the predefined layouts and accept external alarm triggers to change the layouts.

The output capacity shall have sufficient memory and processing speed to provide fast rendering of video and image displays. The output has, at a minimum, a dual DVI connector that allows a digital connection of 1,280 horizontal pixels by 1,024 vertical pixels or greater resolution. The color depth is a minimum of 24 bits per pixel

996-2.3.4 Electrical Requirements: Provide equipment that operates on 120 V_{AC} at a frequency of 60 Hz. Furnish a transformer or other necessary means of power conversion for any device that requires another voltage or frequency.

996-3 Network Devices.

996-3.1 General: All network devices shall be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.

996-3.2 Managed Field Ethernet Switch.

996-3.2.1 Description: The Managed Field Ethernet Switch (MFES) shall be compliant with the John S. McCain National Defense Authorization Act for Fiscal Year 2019, section 889, Prohibition on Certain Telecommunications or Video Surveillance Services or Equipment.

The MFES provides wire-speed fast Ethernet connectivity at transmission rates of 100 megabits per second.

Each MFES shall be managed individually and as a group for switch configuration, performance monitoring, and troubleshooting. The MFES shall include Layer 2+ capabilities, including, QoS, IGMP, rate limiting, security filtering, and general management.

The MFES shall support half and full duplex Ethernet communications.

The MFES shall provide 99.999% error-free operation. The MFES shall comply with the Electronic Industries Alliance (EIA) Ethernet data communication requirements using single-mode fiber optic transmission medium and Category 5E copper transmission medium.

The MFES shall have 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.

996-3.2.2 Networking Standards: The MFES shall comply with all applicable IEEE networking standards for Ethernet communications, including but not limited to:

1. IEEE 802.1Q standard for Local and Metropolitan Area Networks - Bridges and Bridged Networks used with port-based Virtual Local Area Networks (VLANs) and Rapid Spanning Tree Protocol (RSTP).
2. IEEE 802.1P standard for Quality of Service (QoS).

3. IEEE 802.3 standard for LAN and Metropolitan Area Network (MAN) access and physical layer specifications.

4. IEEE 802.3u supplement standard regarding 100 Base TX/100 Base FX.

5. IEEE 802.3x standard regarding flow control with full duplex operation.

996-3.2.3 Optical Ports: All fiber optic link ports operate at 1,310 or 1,550 nanometers in single mode. All optical ports are Type ST, SC, LC, or FC only. Mechanical transfer registered jack (MTRJ) type connectors are not allowed.

MFES shall provide two optical 100 Base FX ports capable of transmitting data at 100 megabits per second. MFES shall 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 shall have an optical power budget of at least 15 dB.

996-3.2.4 Copper Ports: MFES shall include a minimum of four copper ports. All copper ports shall be Type RJ-45 and shall auto-negotiate speed (i.e., 10/100 Base) and duplex (i.e., full or half). All 10/100 Base TX ports shall meet the specifications detailed in this section and shall be compliant with the IEEE 802.3 standard pinouts.

Ethernet over very high speed digital subscriber line (EoVDSL) ports shall support standard telephone-grade twisted copper pair and automatically negotiate the fastest data rate possible depending on cable length and quality.

996-3.2.5 Management Capability: The MFES shall support all Layer 2 management features and certain Layer 3 features related to multicast data transmission and routing. These features shall include, but not be limited to:

1. An MFES 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 and 148,800 packets per second for 100 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 secure shell (SSH) and secure Web-based GUI.

6. Support of the Simple Network Management Protocol (SNMP) version 1/2/3. Verify that the MFES can be accessed using the resident EIA-232 management port or a telecommunication network.

7. Support of Remote Authentication Dial-In User Service (RADIUS) or Terminal Access Controller Access-Control System Plus (TACACS+)

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 Secure Copy (SCP) or Secure File Transfer Protocol (SFTP) and either Network Time Protocol (NTP) or the Simple Network Time Protocol (SNTP). Ensure that the MFES supports port mirroring for troubleshooting purposes when combined with a network analyzer.

996-3.2.6 Mechanical Requirements: The equipment shall be permanently marked with manufacturer name or trademark, part number, and serial number. Every conductive contact surface or pin shall be gold-plated or made of a noncorrosive, nonrusting, conductive

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

996-3.2.7 Electrical Requirements: The MFES shall operate on a nominal Voltage of 120 V Alternating Current (VAC). Supply an appropriate voltage converter for devices that require operating voltages of less than 120 VAC. The MFES shall have diagnostic Light Emitting Diodes (LEDs), including link, TX, RX, and power LEDs.

996-3.2.8 Environmental Requirements: MFES shall operate properly during and after being subjected to the environmental testing procedures described in NEMA TS 2, Sections 2.2.7, 2.2.8., and 2.2.9.

996-3.3 Device Server.

996-3.3.1 Description: The device server allows the connection of serial devices with EIA-232, EIA-422, and EIA-485 connections to an Ethernet network. The device server provides a TCP/IP interface to one or more field devices using EIA-232/422/485 standard connections. The device server supports TCP/IP, User Datagram Protocol (UDP)/IP, Dynamic Host Configuration Protocol (DHCP), Address Resolution Protocol (ARP), Internet Control Message Protocol (ICMP), Simple Network Management Protocol (SNMP), Hypertext Transfer Protocol (HTTP), and telnet.

The device server shall provide 99.999% error-free operation and EIA-compatible Ethernet data communication by way of a Category 5E copper or fiber optic transmission medium.

The device server is resistant to all electromagnetic interference.

Data security shall comply with Version 2 of the Secure Shell Protocol (SSHv2), or the NIST requirements as defined in the Federal Information Processing Standard (FIPS) Publication (PUB)-197 for the Advanced Encryption Standard (AES).

The device server has a minimum mean time between failures (MTBF) of 10 years, or 87,600 hours.

996-3.3.2 Serial Interface: The device server provides a minimum of one serial data interface and connector that conforms to EIA-232/422/485 standards. The serial interface supports 2-wire and 4-wire EIA-485 connections. The serial ports support data rates up to 230 kbps; error detection procedures utilizing parity bits (i.e., none, even, and odd); and stop bits (1 or 2).

The device server provides flow control (request to send [RTS]/clear to send [CTS] and transmit on/transmit off [XON/XOFF]), as well as allow control of the Data Terminal Ready (DTR), Data Carrier Detect (DCD), Data Set Ready (DSR), CTS, and RTS signals. The device server supports RTS toggle for half-duplex emulation.

996-3.3.3 Network Interface: The device server includes a minimum of one Ethernet port, which shall provide a 10/100 Base TX or a 10/100 Base FX connection as specified in the Plans. All copper-based network interface ports utilize registered jack (RJ)-45 connectors. The optical ports are Type ST, SC, LC, or FC only. Mechanical transfer registered jack (MTRJ) type connectors are not allowed.

996-3.3.4 Configuration and Management: The device server shall support local and remote configuration and management, which shall include access to all user-programmable features, including but not limited to addressing, port configuration, device monitoring, diagnostic utilities, and security functions. The device server shall support configuration and management via SNMP, telnet login, and browser-based interface.

996-3.3.5 Mechanical Requirements: The equipment shall be permanently marked with manufacturer name or trademark, part number, date of manufacture and serial number. Do not use self-tapping screws on the exterior of the assembly. All parts are made of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal.

996-3.3.6 Electrical Requirements: The device server operates using a nominal input voltage of 120 VAC. If the device requires nominal input voltage of less than 120 VAC, furnish the appropriate voltage converter. The maximum power consumption shall not exceed 12 watts. The device server has diagnostic LEDs, including link, TX, RX, and power LEDs.

996-3.3.7 Environmental Requirements: The device server performs all required functions during and after being subjected to the environmental testing procedures described in NEMA TS2, Sections 2.2.7, 2.2.8, and 2.2.9.

996-3.4 Digital Video Encoder and Decoder.

996-3.4.1 Description: The Digital Video Encoder (DVE) and Digital Video Decoder (DVD) are specialized network-based hardware devices and software which allow video and data signals to be transmitted across IP networks. The video and data packets produced by the DVE and placed onto the network allow reconstruction of digital video signals by hardware-based and software-based DVDs that are also attached to the network.

996-3.4.2 Software: All setup, control programs, and diagnostic software related to the DVE or DVD shall be provided. All equipment licenses, where required for any software or hardware in the system, shall be provided.

996-3.4.3 MPEG-2 Format: DVE and DVD components utilize the Moving Picture Experts Group's MPEG-2 video compression technology in accordance with the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) requirements detailed in the ISO/IEC 13818 standard. The DVE and DVD are capable of unicast and multicast operation. DVEs support the Session Announcement Protocol (SAP) as recommended by the Internet Engineering Task Force (IETF) RFC 2974. The DVE provides 99.999% error-free operation. The MPEG-2 DVE and DVD equipment support programmable bit rates. MPEG-2 equipment supports fixed bit rate mode.

996-3.4.4 H.264 Format: DVE and DVD components utilize the video compression technology in accordance with the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) requirements detailed in the ISO/IEC 14496-10:2009 standard. The DVE and DVD are capable of unicast and multicast operation. DVEs shall support the Session Announcement Protocol (SAP) as recommended by the Internet Engineering Task Force (IETF) RFC 2974, and Real Time Streaming Protocol (RTSP). The DVE provides 99.999% error-free operation. H.264 DVE and DVD equipment support programmable bit rates. H.264 equipment supports fixed bit rate mode.

996-3.4.5 Digital Video Encoder: The DVE is a hardware-based network device that is able to accept a minimum of one analog National Television System Committee (NTSC) video input and digitize it for transport across IP networks. The DVE provides a minimum of one serial data interface for transmission of command and control data to other devices (typically camera PTZ commands), as well as console and configuration functions. Provide compatible decoder software along with the DVE.

996-3.4.6 Hardware-based Decoder: The hardware-based DVD has a minimum of one video output. The DVD that has a minimum of one data interface for configuration functions. The DVD includes an Ethernet interface for connection to IP networks.

996-3.4.7 Interoperability: The DVE is compatible and fully interoperable with software and hardware DVDs from the DVE manufacturer, as well as a minimum of two software and hardware DVDs from other manufacturers. The DVD is compatible and fully interoperable with DVEs from the DVD manufacturer, as well as a minimum of two other DVEs from other manufacturers. The DVE and DVD can be controlled using SunGuide® or support stream selection and switching using ONVIF commands.

996-3.4.8 Video Requirements: Composite video inputs and outputs utilize BNC connectors. Analog video inputs and outputs support 1 volt peak-to-peak (Vp-p) NTSC composite video. The DVE and DVD operate with both color and monochrome video, and DVEs allow the user to select and adjust video resolution. The DVE and DVD support resolutions that include, but are not limited to, those defined in Table 1. The DVE and DVD are capable of delivering color and monochrome video at 30 fps regardless of resolution.

Table 1 – Resolution Requirements

Format	Resolutions
MPEG-2	352 x 240, 352 x 480, 720 x 480
H.264	176 x 120, 352 x 240, 720 x 480

Note: The resolutions attained depend on the data transmission rate.

996-3.4.9 Serial Interface: Hardware-based DVEs provide a minimum of one serial data interface that support EIA/TIA-232 and TIA-422. The serial ports support data rates up to 115 kbps; error detection procedures utilizing parity bits (i.e., none, even, and odd); and stop bits (1 or 2).

Hardware-based DVEs provide a TCP/IP interface to their serial port using a network socket connection with configurable IP address and port number. Serial interface ports may utilize RJ-45 connectors, D-sub connectors, or screw terminals.

996-3.4.10 Network Interface: The DVE/DVD LAN connection supports the requirements detailed in the IEEE 802.3 standard for 10/100 Ethernet connections. The DVE/DVD has a minimum of one Ethernet port, which shall be a 10/100 Base TX connection or a 100 Base FX ST, SC, LC or FC interface. The connector complies with applicable EIA and TIA requirements. Copper-based network interface ports shall utilize RJ-45 connectors. Fiber ports are single mode with a minimum link budget of 30 dB.

The network communication conforms to User Datagram Protocol (UDP), Version 4 of the Internet Protocol (IP) and Version 2 of the Internet Group Multicast Protocol (IGMP).

996-3.4.11 Front Panel Status Indicators: DVEs and DVDs have LED displays, Liquid Crystal Displays (LCDs), or similar illuminated displays to indicate status for power and data activity.

996-3.4.12 Configuration and Management: DVEs and DVDs shall support local and remote configuration and management. Configuration and management functions shall include access to all user-programmable features, including but not limited to addressing, serial port configuration, video settings, device monitoring, and security functions. DVE and DVD support configuration and management via serial login, telnet login, web browser, or Simple Network Management Protocol (SNMP).

996-3.4.13 Mechanical Requirements: The equipment shall be permanently marked with manufacturer name or trademark, part number, date of manufacture and serial number. Do not use self-tapping screws on the exterior of the assembly. All equipment uses parts made of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal.

996-3.4.14 Electrical Requirements: All equipment operates on a nominal voltage of 120 VAC. If the device requires operating voltages of less than 120 VAC, supply the appropriate voltage converter.

996-3.4.15 Environmental Requirements: DVEs and DVDs installed in roadside cabinets shall perform all required functions during and after being subjected to the environmental testing procedures described in NEMA TS2, Sections 2.2.7, 2.2.8, and 2.2.9. Hardware DVD installed in a climate-controlled environment, such as a TMC computer room, has an operating temperature range of 32 to 104°F.

996-3.5 Media Converter.

996-3.5.1 Description: The media converter connects different transmission media for the purposes of transmitting Ethernet data.

996-3.5.2 Network Interface: The media converter LAN connection supports the requirements detailed in the IEEE 802.3 standard for 10/100 Ethernet connections. The media converter has a minimum of one Ethernet port, which shall be, at a minimum, a 10/100 Base TX connection or a 100 Base FX ST, SC, LC or FC interface. The connector complies with applicable EIA and TIA requirements. Copper-based network interface ports utilize RJ-45 connectors. Fiber ports are single mode with a minimum link budget of 30 dB.

996-3.5.3 Mechanical Requirements: The equipment shall be permanently marked with manufacturer name or trademark, part number, date of manufacture and serial number. All conductive contact surface or pin are gold-plated or made of a noncorrosive, nonrusting, conductive metal. Do not use self-tapping screws on the exterior of the assembly. All parts shall be made of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal.

996-3.5.4 Electrical Requirements: Ethernet to coax media converters shall operate using Power Over Ethernet (POE). Media converters shall operate on a nominal voltage of 120 VAC if POE is unavailable. Supply an appropriate voltage converter for devices that require operating voltages of less than 120 VAC. Ensure that the media converter has diagnostic LEDs, including link, TX, RX, and power LEDs.

996-3.5.5 Environmental Requirements: Ensure media converters perform all required functions during and after being subjected to the environmental testing procedures described in NEMA TS2, Sections 2.2.7, 2.2.8, and 2.2.9.