DM NVX® AV-over-IP System

Design Guide

Crestron Electronics, Inc.

Original Instructions
The U.S. English version of this document is the original instructions.
All other languages are a translation of the original instructions.

Contents

Introduction

A Crestron® DM NVX® AV-over-IP system is a digital video and audio distribution system that switches 4K video sources and displays at up to 60 frames per second (fps) with up to full 4:4:4 color sampling and High Dynamic Range (HDR) video support. Using standard 1-Gigabit Ethernet infrastructure, a DM NVX system provides a highly flexible, cost-effective, and infinitely scalable network AV solution.

Pixel Perfect Processing technology is incorporated into DM NVX 4K60 4:4:4 endpoints to provide flawless video transport in all applications. A video signal is encoded and decoded to achieve imperceptible end-to-end latency of less than 1 frame. The image quality of the source is maintained across a 1-Gigabit network at any resolution up to 4K60 4:4:4.

Network video solutions with support of resolutions up to 4K60 4:2:0 or 1080p60 4:4:4 are also offered. The lower resolution endpoints enable selection of the optimized solution for price and performance.

DM NVX endpoints are available as encoder only, decoder only, and combined encoder/decoder products. A DM NVX Director™ virtual switching appliance can be added to configure, control, and manage a DM NVX system.

This guide aids in the design and installation of a DM NVX system. The guide provides information about the following:

- System design, which includes endpoint and network design
- System installation, which includes endpoint and network installation
- Case studies

In addition, a glossary is provided at the end of the guide.

System Design

The following sections provide design information related to DM NVX endpoints and the network.

Endpoint Design

A DM NVX system is composed of one or more encoder endpoints and one or more decoder endpoints. Additional components of a DM NVX system include the DM NVX Director virtual switching appliances and SFP (Single Form-factor Pluggable) transceiver modules.

The following sections provide information about DM NVX endpoints, DM NVX Director virtual switching appliances, SFP modules, and related system design considerations.

DM NVX Endpoints

DM NVX endpoints are available in the following form factors:

- Surface-mountable endpoints, which enable an easy fit in various types of locations, for example, behind a flat panel display
- Wall plate endpoint, which is designed for installation into a 2-gang electrical box
- OPS (Open Pluggable Specification) endpoint, which is compatible with the Intel® OPS standard and provides integration with an OPS-supported display
- Chassis-based cards, which are used with the DMF-CI-8 card chassis for sources in close proximity to a rack or for applications requiring a high density of endpoint

Surface-Mountable Endpoints

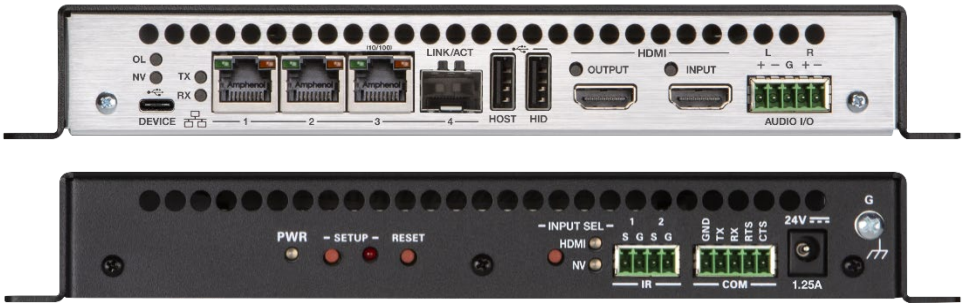
Surface-mountable endpoints consist of the following models based on the supported maximum resolution:

- Support of up to 4K60 4:4:4:
    - DM-NVX-36x Series encoders/decoders (DM-NVX-360 and DM-NVX-363)
    - DM-NVX-35x Series encoders/decoders (DM-NVX-350, DM-NVX-351, and DM-NVX-352)

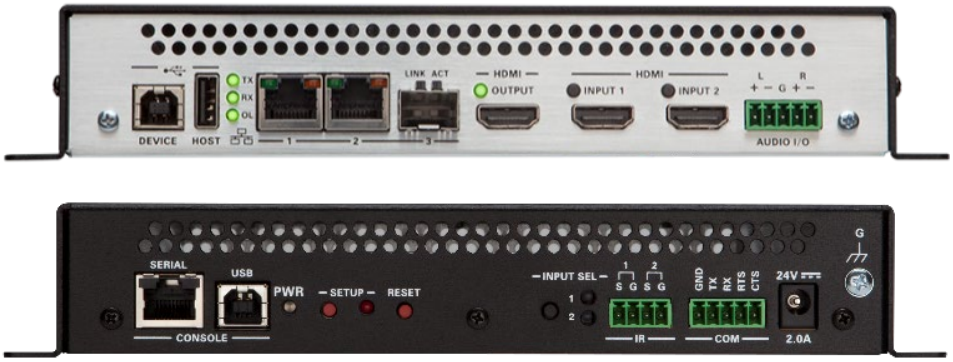
      NOTE: The DM-NVX-350 and DM-NVX-352 are discontinued.
    - DM-NVX-E30 encoder
    - DM-NVX-E760 encoder
    - DM-NVX-D30 decoder

- Support of up to 4K60 4:2:0:
    - DM-NVX-E20 encoder (for the wall plate model, refer to Wall Plate Endpoint on page 6)
    - DM-NVX-D20 decoder
    - DM-NVX-D200 decoder
- Support of up to 1080p60 4:4:4:
    - DM-NVX-E10 encoder
    - DM-NVX-D10 decoder

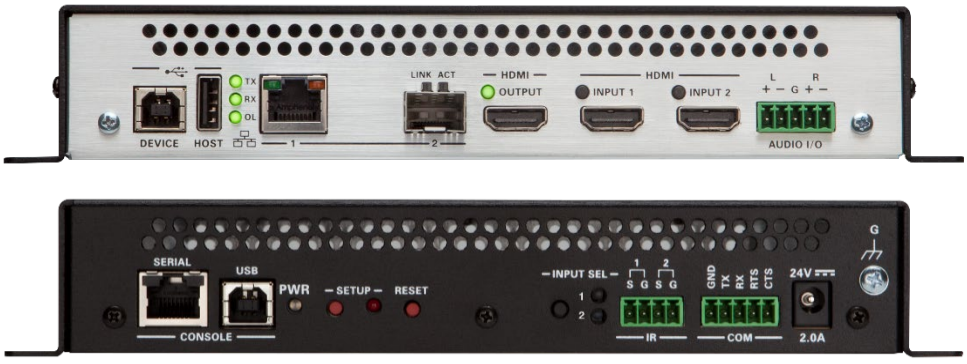
DM-NVX-360 and DM-NVX-363 Front and Rear Views



DM-NVX-350 and DM-NVX-351 Front and Rear Views



DM-NVX-352 Front and Rear Views

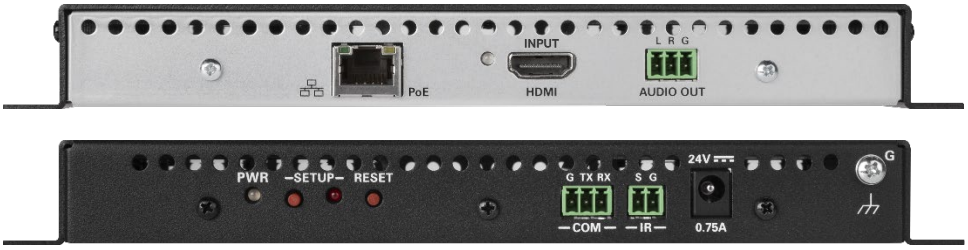


DM-NVX-E30 Front and Rear Views

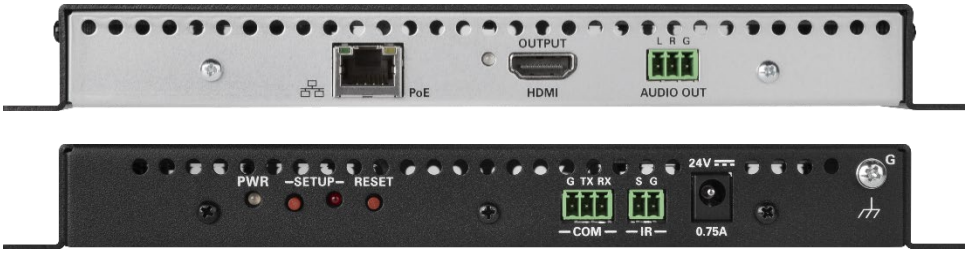
DM-NVX-E760 Front and Rear Views

DM-NVX-D30 Front and Rear Views

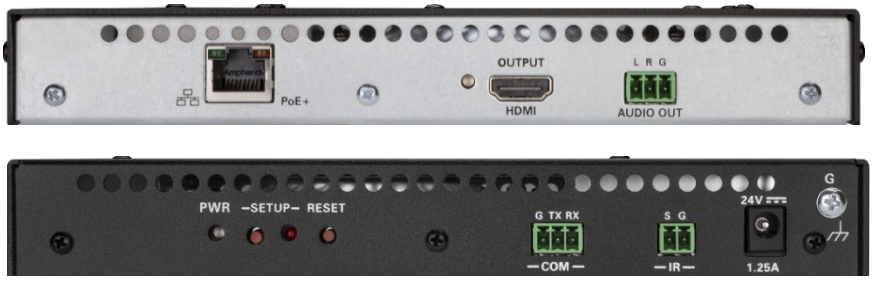
DM-NVX-E20 Front and Rear Views



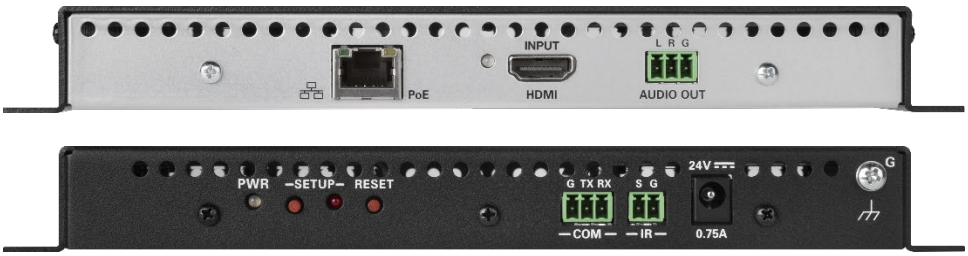
DM-NVX-D20 Front and Rear Views



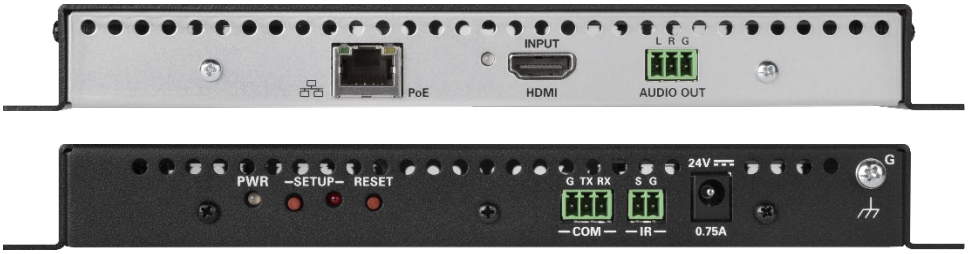
DM-NVX-D200 Front and Rear Views



DM-NVX-E10 Front and Rear Views



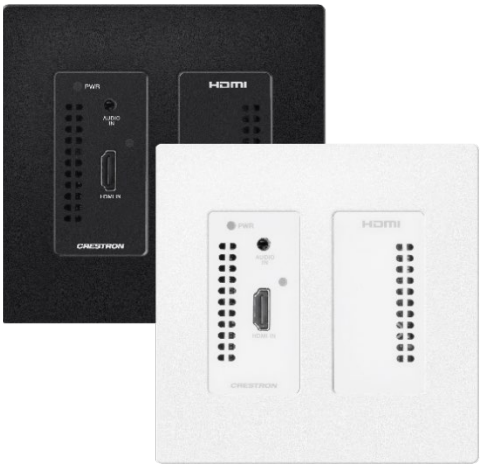
DM-NVX-D10 Front and Rear Views



Wall Plate Endpoint

A 2-gang wall plate endpoint is offered with the DM-NVX-E20-2G, which is available in black or white. Similar to the DM-NVX-E20 surface-mountable endpoint, the DM-NVX-E20-2G functions as an encoder only and supports resolutions up to 4K60 4:2:0.

DM-NVX-E20-2G Front View (Faceplate Sold Separately)



DM-NVX-E20-2G Front View (Shown in Black without Faceplate)

DM-NVX-E20-2G Rear, Angle View

OPS Endpoint

An OPS endpoint is available with the DM-NVX-D80-IOAV. The endpoint is designed for installation into the OPS slot of an OPS-supported display.

DM-NVX-D80-IOAV Front and Rear Views

Chassis-Based Cards

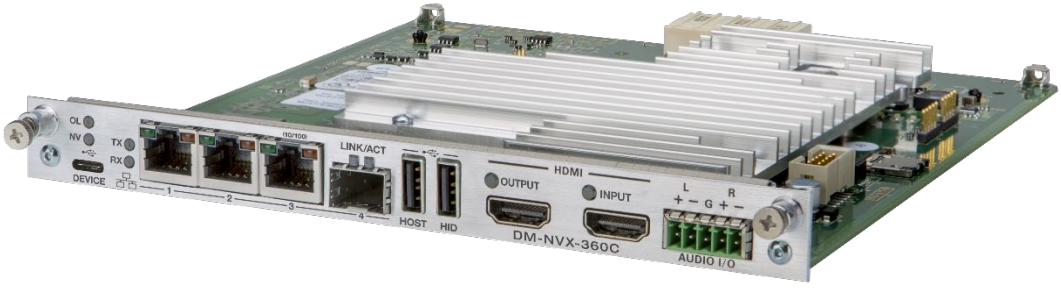
Chassis-based cards support resolutions up to 4K60 4:4:4 and consist of the following models:

- DM-NVX-36xC Series encoders/decoders (DM-NVX-360C and DM-NVX-363C)
- DM-NVX-35xC Series encoders/decoders (DM-NVX-350C, DM-NVX-351C, and DM-NVX-352C)

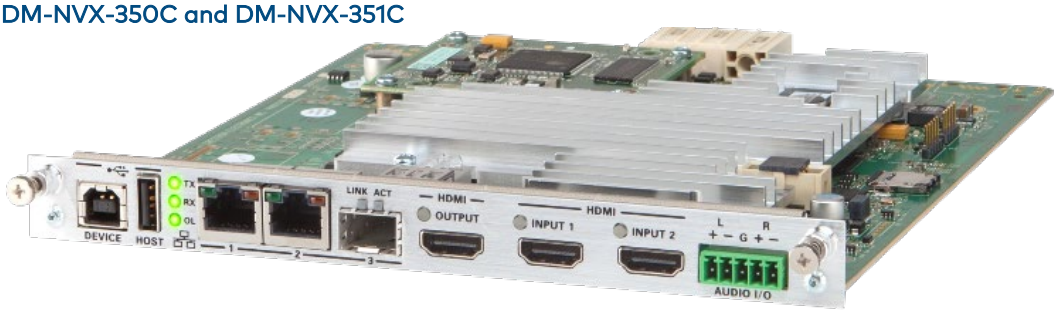
  NOTE: The DM-NVX-350C and DM-NVX-352C are discontinued.

- DM-NVX-E30C encoder
- DM-NVX-E760C encoder
- DM-NVX-D30C decoder

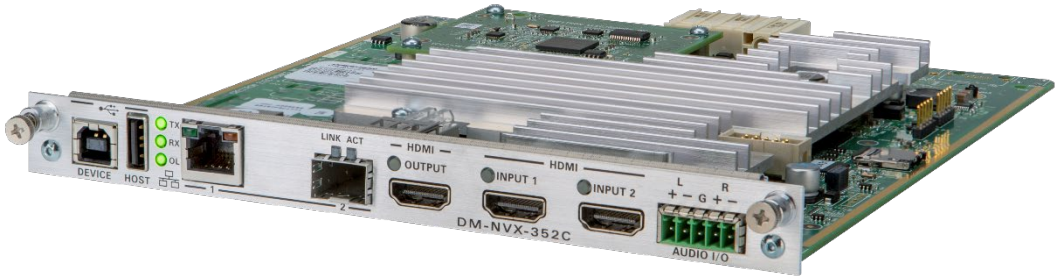
DM-NVX-360C and DM-NVX-363C



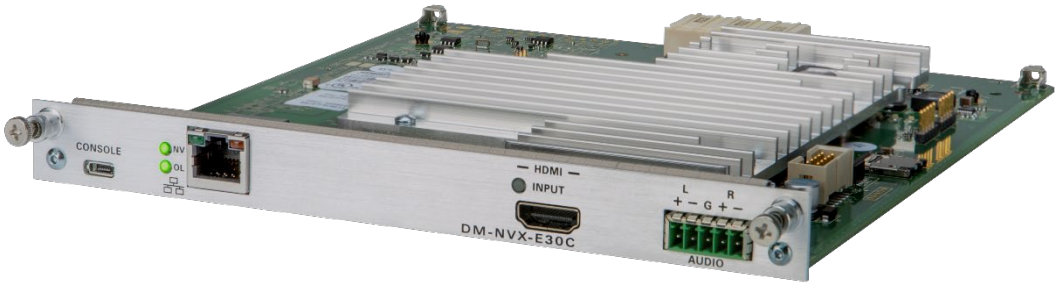
DM-NVX-350C and DM-NVX-351C



DM-NVX-352C



DM-NVX-E30C



DM-NVX-E760C

DM-NVX-D30C

Endpoint Comparison

The following tables provide a comparison of the various DM NVX endpoints.

DM NVX 4K60 4:4:4 Endpoints

FEATURE	DM-NVX-360	DM-NVX-360C	DM-NVX-363	DM-NVX-363C	DM-NVX-350	DM-NVX-350C	DM-NVX-351	DM-NVX-351C	DM-NVX-352	DM-NVX-352C	DM-NVX-E30	DM-NVX-E30C	DM-NVX-E760	DM-NVX-E760C	DM-NVX-D30	DM-NVX-D30C	DM-NVX-D80-IOAV
General																	
Description	Network AV encoder/ decoder	Network AV encoder/ decoder	Network AV encoder/ decoder with DSP downmixing and Dante® audio	Network AV encoder/ decoder with DSP downmixing and Dante audio	Network AV encoder/ decoder	Network AV encoder/ decoder	Network AV encoder/ decoder with DSP downmixing	Network AV encoder/ decoder with DSP downmixing	Network AV encoder/ decoder with Dante audio	Network AV encoder/ decoder with Dante audio	Network AV encoder	Network AV encoder	Network AV encoder with DM® Input	Network AV encoder with DM Input	Network AV decoder	Network AV decoder	Network AV OPS decoder
Form Factor	Surface mountable	Card	Surface mountable	Card	Surface mountable	Card	Surface mountable	Card	Surface mountable	Card	Surface mountable	Card	Surface mountable	Card	Surface mountable	Card	Intel® OPS
Video																	
Inputs	1 x HDMI®[1], 1 x DM NVX®[2]	1 x HDMI[1], 1 x DM NVX[2]	1 x HDMI[1], 1 x DM NVX[2]	1 x HDMI[1], 1 x DM NVX[2]	2 x HDMI[1], 1 x DM NVX[2]	2 x HDMI[1], 1 x DM NVX[2]	2 x HDMI[1], 1 x DM NVX[2]	2 x HDMI[1], 1 x DM NVX[2]	2 x HDMI[1], 1 x DM NVX[2]	2 x HDMI[1], 1 x DM NVX[2]	1 x HDMI[1]	1 x HDMI[1]	1 x DM 8G+® or DM Lite®	1 x DM 8G+ or DM Lite	1 x DM NVX	1 x DM NVX	1 x DM NVX
Output	HDMI[3]	HDMI[3]	HDMI[3]	HDMI[3]	HDMI[3]	HDMI[3]	HDMI[3]	HDMI[3]	HDMI[3]	HDMI[3]	—	—	—	—	HDMI[3]	HDMI[3]	Direct output to display (HDMI)
Maximum Input/Output Resolution	4K60 4:4:4	4K60 4:4:4	4K60 4:4:4	4K60 4:4:4	4K60 4:4:4	4K60 4:4:4	4K60 4:4:4	4K60 4:4:4	4K60 4:4:4	4K60 4:4:4	4K60 4:4:4	4K60 4:4:4	4K60 4:4:4	4K60 4:4:4	4K60 4:4:4	4K60 4:4:4	4K60 4:4:4
Custom Resolutions	Supported at pixel clock rates up to 600 MHz	Supported at pixel clock rates up to 600 MHz	Supported at pixel clock rates up to 600 MHz	Supported at pixel clock rates up to 600 MHz	Supported at pixel clock rates up to 600 MHz	Supported at pixel clock rates up to 600 MHz	Supported at pixel clock rates up to 600 MHz	Supported at pixel clock rates up to 600 MHz	Supported at pixel clock rates up to 600 MHz	Supported at pixel clock rates up to 600 MHz	Supported at pixel clock rates up to 600 MHz	Supported at pixel clock rates up to 600 MHz	Supported at pixel clock rates up to 600 MHz	Supported at pixel clock rates up to 600 MHz	Supported at pixel clock rates up to 600 MHz	Supported at pixel clock rates up to 600 MHz	Supported at pixel clock rates up to 600 MHz
Output Scaler[2]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—	—	—	—	—
Video Wall Mode	8 x 8	8 x 8	8 x 8	8 x 8	8 x 8	8 x 8	8 x 8	8 x 8	8 x 8	8 x 8	8 x 8	8 x 8	—	—	—	—	—
Widescreen Format Selection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—	—	—	—	—
Underscan	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—	—	—	—	—
Maximum HDCP	HDCP 2.3	HDCP 2.3	HDCP 2.3	HDCP 2.3	HDCP 2.2	HDCP 2.2	HDCP 2.2	HDCP 2.2	HDCP 2.2	HDCP 2.2	HDCP 2.2	HDCP 2.2	HDCP 2.3	HDCP 2.3	HDCP 2.2	HDCP 2.2	HDCP 2.2
HDCP Input/Output Configurable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Input EDID Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—
Auto-Routing	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—	—	—	—	—
Input Selection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—	—	—	—	—
Deep Color and HDR10	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
HDR10+ and Dolby Vision®	Yes	Yes	Yes	Yes	—	—	—	—	—	—	Yes	Yes	—	—	Yes	Yes	—
Video Timeout Control[2]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—	—	—	—	—
Crestron® QuickSwitch HD™ [4]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
On-Screen Display Basic Text Overlay	—	—	—	—	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—	—	—	—	—
DM Input Support	—	—	—	—	—	—	—	—	—	—	—	—	DM 8G+ output devices and DM Lite transmitters	DM 8G+ output devices and DM Lite transmitters	—	—	—

(Continued on following page)

FEATURE	DM-NVX-360	DM-NVX-360C	DM-NVX-363	DM-NVX-363C	DM-NVX-350	DM-NVX-350C	DM-NVX-351	DM-NVX-351C	DM-NVX-352	DM-NVX-352C	DM-NVX-E30	DM-NVX-E30C	DM-NVX-E760	DM-NVX-E760C	DM-NVX-D30	DM-NVX-D30C	DM-NVX-D80-IOAV
Audio																	
Inputs	1 x HDMI, 1 x DM NVX[2], 5-pin pluggable terminal block	1 x HDMI, 1 x DM NVX[2], 5-pin pluggable terminal block	1 x HDMI, 1 x DM NVX[2], 5-pin pluggable terminal block	1 x HDMI, 1 x DM NVX[2], 5-pin pluggable terminal block	2 x HDMI, 1 x DM NVX[2], 5-pin pluggable terminal block	2 x HDMI, 1 x DM NVX[2], 5-pin pluggable terminal block	2 x HDMI, 1 x DM NVX[2], 5-pin pluggable terminal block	2 x HDMI, 1 x DM NVX[2], 5-pin pluggable terminal block	2 x HDMI, 1 x DM NVX[2], 5-pin pluggable terminal block	2 x HDMI, 1 x DM NVX[2], 5-pin pluggable terminal block	1 x HDMI	1 x HDMI	1 x DM 8G+ or DM Lite	1 x DM 8G+ or DM Lite	1 x DM NVX	1 x DM NVX	1 x DM NVX
Outputs	1 x HDMI, 1 x DM NVX[2], 5-pin pluggable terminal block	1 x HDMI, 1 x DM NVX[2], 5-pin pluggable terminal block	1 x HDMI, 1 x DM NVX[2], 5-pin pluggable terminal block	1 x HDMI, 1 x DM NVX[2], 5-pin pluggable terminal block	1 x HDMI, 1 x DM NVX[2], 5-pin pluggable terminal block	1 x HDMI, 1 x DM NVX[2], 5-pin pluggable terminal block	1 x HDMI, 1 x DM NVX[2], 5-pin pluggable terminal block	1 x HDMI, 1 x DM NVX[2], 5-pin pluggable terminal block	1 x HDMI, 1 x DM NVX[2], 5-pin pluggable terminal block	1 x HDMI, 1 x DM NVX[2], 5-pin pluggable terminal block	5-pin pluggable terminal block	5-pin pluggable terminal block	5-pin pluggable terminal block	5-pin pluggable terminal block	1 x HDMI, 5-pin pluggable terminal block	1 x HDMI, 5-pin pluggable terminal block	OPS
Digital Input/ Output Audio Formats	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels	Dolby Digital®, Dolby Digital EX, Dolby Digital Plus, Dolby® TrueHD, Dolby Atmos®, DTS®, DTS ES, DTS 96/24, DTS HD® High Res, DTS HD Master Audio™, LPCM up to 8 channels	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, LPCM up to 8 channels
DSP Audio Downmix	—	—	Yes	Yes	—	—	Yes	Yes	—	—	—	—	—	—	—	—	—
Analog Output Audio Format	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	—
Analog Input Audio Format	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	Stereo 2-channel	—	—	—	—	—	—	—
DM NAX™ (AES67) Audio Format[5, 6]	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz
Dante Audio Format[7]	—	—	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz	—	—	—	—	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz	—	—	—	—	—	—	—
Breakaway Audio[2]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—	—	Yes	Yes	Yes
Available DM NVX Streams																	
Primary AV Stream	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DM NAX (AES67) Audio Stream Transmit/ Receive[5, 6]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dante Audio Stream Transmit/ Receive[7]	—	—	Yes	Yes	—	—	—	—	Yes	Yes	—	—	—	—	—	—	—

(Continued on following page)

FEATURE	DM-NVX-360	DM-NVX-360C	DM-NVX-363	DM-NVX-363C	DM-NVX-350	DM-NVX-350C	DM-NVX-351	DM-NVX-351C	DM-NVX-352	DM-NVX-352C	DM-NVX-E30	DM-NVX-E30C	DM-NVX-E760	DM-NVX-E760C	DM-NVX-D30	DM-NVX-D30C	DM-NVX-D80-IOAV
Streaming Protocols/Controls																	
Codec Type	Pixel Perfect Processing (default) or DM-NVX-D10/D20 Series[8]	Pixel Perfect Processing (default) or DM-NVX-D10/D20 Series[8]	Pixel Perfect Processing (default) or DM-NVX-D10/D20 Series[8]	Pixel Perfect Processing (default) or DM-NVX-D10/D20 Series[8]	Pixel Perfect Processing (default) or DM-NVX-D10/D20 Series[8]	Pixel Perfect Processing (default) or DM-NVX-D10/D20 Series[8]	Pixel Perfect Processing (default) or DM-NVX-D10/D20 Series[8]	Pixel Perfect Processing (default) or DM-NVX-D10/D20 Series[8]	Pixel Perfect Processing (default) or DM-NVX-D10/D20 Series[8]	Pixel Perfect Processing (default) or DM-NVX-D10/D20 Series[8]	Pixel Perfect Processing (default) or DM-NVX-D10/D20 Series[8]	Pixel Perfect Processing (default) or DM-NVX-D10/D20 Series[8]	Pixel Perfect Processing (default) or DM-NVX-D10/D20 Series[8]	Pixel Perfect Processing (default) or DM-NVX-D10/D20 Series[8]	Pixel Perfect Processing (default) or DM-NVX-D10/D20 Series[88]	Pixel Perfect Processing (default) or DM-NVX-D10/D20 Series[8]	Pixel Perfect Processing (default) or DM-NVX-D10/D20 Series[8]
RTP	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RTSP	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SDP	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MPEG2-TS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Session Initiation Multicast via RTSP	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stream Encryption	AES-128	AES-128	AES-128	AES-128	AES-128	AES-128	AES-128	AES-128	AES-128	AES-128	AES-128	AES-128	AES-128	AES-128	AES-128	AES-128	AES-128
Multicast TTL Configuration[9]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—
Default DSCP Value[9]	32, CS4	32, CS4	32, CS4	32, CS4	32, CS4	32, CS4	32, CS4	32, CS4	32, CS4	32, CS4	32, CS4	32, CS4	32, CS4	32, CS4	—	—	—
Custom DSCP Control[9]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—
Default RTSP Port	554	554	554	554	554	554	554	554	554	554	554	554	554	554	554	554	554
Custom RTSP Port Control[9]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—
Default TS Port	4570	4570	4570	4570	4570	4570	4570	4570	4570	4570	4570	4570	4570	4570	4570	4570	4570
Custom TS Port Control[9]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—
Fixed Bit Rate Default Value (Mbps)[9]	750	750	750	750	750	750	750	750	750	750	750	750	750	750	—	—	—
Adaptive Bit Rate[9]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—
Variable Bit Rate[9]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—
Custom Bit Rate Control[9]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—
Crestron Auto-Initiation	Yes (default)	Yes (default)	Yes (default)	Yes (default)	Yes (default)	Yes (default)	Yes (default)	Yes (default)	Yes (default)	Yes (default)	Yes (default)	Yes (default)	Yes (default)	Yes (default)	Yes (default)	Yes (default)	Yes (default)
Manual Stop	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Manual Start	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Statistics (Transmitted/ Received and Dropped Packet Counter)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DM NVX Routing and Subscriptions	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	—	—	—	—	Yes	Yes	Yes
Streaming Audio/Video Feedback	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

(Continued on following page)

DM NVX 4K60 4:4:4 Endpoints *(Continued)*

FEATURE	DM-NVX-360	DM-NVX-360C	DM-NVX-363	DM-NVX-363C	DM-NVX-350	DM-NVX-350C	DM-NVX-351	DM-NVX-351C	DM-NVX-352	DM-NVX-352C	DM-NVX-E30	DM-NVX-E30C	DM-NVX-E760	DM-NVX-E760C	DM-NVX-D30	DM-NVX-D30C	DM-NVX-D80-IOAV
Security																	
TLS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AES-128	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
HTTPS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
802.1X	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SSH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SSL	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SFTP	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Active Directory® Credential Management	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Crestron Control																	
XiO Cloud® Service	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DM NVX Director®	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
.AV Framework™ Platform	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SIMPL Programming	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SIMPL # Pro	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Crestron Studio® Software	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—
Crestron Home® OS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—
Auto Update Support	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VC-4 Series	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
USB																	
USB 2.0	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—	—	—	—	Yes
DM NUX and USB Legacy Model (USB-EXT-DM/ USB-NX2) Support	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—	—	—	—	Yes
Layer 2 Communication	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—	—	—	—	Yes
Layer 3 Communication	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—	—	—	—	Yes
Multiple Remote Support via DM NVX and DM NUX or Legacy Models (USB-EXT-DM/USB-NX2), Layer 2 only	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—	—	—	—	—
USB HID Control	Yes	Yes	Yes	Yes	—	—	—	—	—	—	—	—	—	—	—	—	—
Communications																	
IR	Yes	—	Yes	—	Yes	—	Yes	—	Yes	—	Yes	—	—	—	Yes	—	—
RS-232	Yes	—	Yes	—	Yes	—	Yes	—	Yes	—	Yes	—	—	—	Yes	—	Yes
CEC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	Yes	Yes	Yes

(Continued on following page)

DM NVX 4K60 4:4:4 Endpoints *(Continued)*

FEATURE	DM-NVX-360	DM-NVX-360C	DM-NVX-363	DM-NVX-363C	DM-NVX-350	DM-NVX-350C	DM-NVX-351	DM-NVX-351C	DM-NVX-352	DM-NVX-352C	DM-NVX-E30	DM-NVX-E30C	DM-NVX-E760	DM-NVX-E760C	DM-NVX-D30	DM-NVX-D30C	DM-NVX-D80-IOAV
Power																	
Power over Ethernet (PoE+/PoE++/ UPOE)	PoE+	—	PoE+	—	PoE++/UPOE	—	PoE++/UPOE	—	PoE++/UPOE	—	PoE+	—	PoE++/UPOE	—	PoE+	—	—
24 VDC Barrel Connector	Yes	—	Yes	—	Yes	—	Yes	—	Yes	—	Yes	—	Yes	—	Yes	—	—
DMF-CI-8	—	Yes	—	Yes	—	Yes	—	Yes	—	Yes	—	Yes	—	Yes	—	Yes	—
Networking Interfaces																	
Copper Ports, 1000 Mbps	2	2	2	2	2	2	2	2	2	2	1	1	2	2	1	1	1
Copper Port, 100 Mbps	1	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—
SFP, 1000 Mbps	1	1	1	1	1	1	1	1	1	1	—	—	1	1	—	—	—
Ethernet Protocols																	
IPv4 only or both IPv4 and IPv6	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DHCP	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Static IP Address Configuration	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IGMPv2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IGMPv3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SMPTE 2022	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DNS Resolution	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FEC (Forward Error Correction)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Additional Physical Ports and Buttons																	
Serial Console	—	—	—	—	Yes	—	Yes	—	Yes	Yes	—	—	—	—	—	—	—
USB Console	—	—	—	—	Yes	—	Yes	—	Yes	—	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Input Select Button	Yes	—	Yes	—	Yes	—	Yes	—	Yes	—	—	—	—	—	—	—	—
Setup Button	Yes	—	Yes	—	Yes	—	Yes	—	Yes	—	Yes	—	Yes	—	Yes	—	Yes
Reset Button	Yes	—	Yes	—	Yes	—	Yes	—	Yes	—	Yes	—	Yes	—	Yes	—	Yes
Environmental																	
Temperature	32° to 104° F (0° to 40° C)	—	32° to 104° F (0° to 40° C)	—	32° to 104° F (0° to 40° C)	—	32° to 104° F (0° to 40° C)	—	32° to 104° F (0° to 40° C)	—	32° to 104° F (0° to 40° C)	—	32° to 104° F (0° to 40° C)	—	32° to 104° F (0° to 40° C)	—	32° to 104° F (0° to 40° C)
Relative Humidity (Noncondensing)	10% to 90%	—	10% to 90%	—	10% to 90%	—	10% to 90%	—	10% to 90%	—	10% to 90%	—	10% to 90%	—	10% to 90%	—	10% to 90%
Heat Dissipation	74 BTU/hr	—			85 BTU/hr	—	85 BTU/hr	—	85 BTU/hr	—	48 BTU/hr	—	68 BTU/hr	—	48 BTU/hr	—	51 BTU/hr
Acoustic Noise	33 dBA typical	—	33 dBA typical	—	33 dBA typical	—	33 dBA typical	—	33 dBA typical	—	33 dBA typical	—	33 dBA typical	—	33 dBA typical	—	33 dBA typical

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DM NVX 4K60 4:4:4 Endpoints *(Continued)*

FEATURE	DM-NVX-360	DM-NVX-360C	DM-NVX-363	DM-NVX-363C	DM-NVX-350	DM-NVX-350C	DM-NVX-351	DM-NVX-351C	DM-NVX-352	DM-NVX-352C	DM-NVX-E30	DM-NVX-E30C	DM-NVX-E760	DM-NVX-E760C	DM-NVX-D30	DM-NVX-D30C	DM-NVX-D80-IOAV
Other																	
Firmware Upgrade Capability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Restore Default Settings Capability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Reboot Capability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Simple Network Time Protocol (SNTP)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

1. A DVI or Dual-Mode DisplayPort™ interface is supported via an HDMI input using a suitable adapter or interface cable. (CBL-HD-DVI interface cables are available separately.)
2. This feature is supported in Receiver mode only.
3. A DVI interface is supported via the HDMI output using a suitable adapter or interface cable. (CBL-HD-DVI interface cables are available separately.)
4. QuickSwitch HD technology applies only when switching occurs between sources that have the same resolution and HDCP value.
5. For DM NVX devices with two HDMI inputs, only one HDMI input can be selected as the DM NAX (AES67) Transmit audio source. The HDMI input that is used for primary AV is the only input that can be used for DM NAX (AES67) audio.
6. DM NAX audio over IP (AES67) requires firmware release 3.x or later for DM-NVX-35x(C), DM-NVX-E30(C), DM-NVX-D30(C), and DM-NVX-D80-IOAV devices.
7. For DM NVX devices with two HDMI inputs, only one HDMI input can be selected as the Dante Transmit audio source. The HDMI input that is used for primary AV is the only input that can be used for Dante audio..
8. For encoders, the stream type must be set by using the web interface or a control system. The default setting is **Pixel Perfect Processing** for interoperability with DM NVX 4K60 4:4:4 decoders.
   For interoperability with a DM-NVX-D10, DM-NVX-D20, or DM-NVX-D200 decoder, the stream type must be set to **DM-NVX-D10/D20 Series**. In addition, the resolution of the encoders must be set so that it does not exceed the maximum resolution of the DM-NVX-D10, DM-NVX-D20, or DM-NVX-D200 decoder.

   For decoders, the proper stream type is automatically used. For interoperability with DM NVX 4K60 4:4:4 encoders, **Pixel Perfect Processing** is automatically used as the stream type of the decoders. For interoperability with DM-NVX-E10/E20 Series encoders, **DM-NVX-D10/D20 Series** is automatically used as the stream type of the decoders.
9. This feature is supported in Transmitter mode only.

DM NVX 4K60 4:2:0 Endpoints

FEATURE	DM-NVX-E20	DM-NVX-E20-2G(-B-T/-W-T)	DM-NVX-D20	DM-NVX-D200
General				
Description	Network AV encoder	Network AV encoder	Network AV decoder	Network AV decoder with scaler
Form Factor	Surface mountable	Wall plate, 2-gang	Surface mountable	Surface mountable
Video				
Inputs	1 x HDMI®[1]	1 x HDMI®[1]	1 x DM NVX	1 x DM NVX
Output	—	—	HDMI[2]	HDMI[2]
Maximum Input/Output Resolution	4K60 4:2:0	4K60 4:2:0	4K60 4:2:0	4K60 4:2:0
Custom Resolutions	Supported at pixel clock rates up to 300 MHz	Supported at pixel clock rates up to 300 MHz	Supported at pixel clock rates up to 300 MHz	Supported at pixel clock rates up to 300 MHz
Output Scaler	—	—	—	Yes
Video Wall Mode	—	—	—	Yes
Widescreen Format Selection	—	—	—	Yes
Underscan	—	—	—	—
Maximum HDCP	HDCP 2.3	HDCP 2.3	HDCP 2.3	HDCP 2.3
HDCP Input/Output Configurable	Yes	Yes	Yes	Yes
Input EDID Control	Yes	Yes	—	—
Auto-Routing	—	—	—	—
Input Selection	—	—	—	—
Deep Color	Yes	Yes	Yes	Yes
HDR10, HDR10+ and Dolby Vision®	—	—	—	—
Video Timeout Control	—	—	—	Yes
Crestron® QuickSwitch HD™	—	—	—	—
On-Screen Display Basic Text Overlay	—	—	—	—
DM Input Support	—	—	—	—

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DM NVX 4K60 4:2:0 Endpoints *(Continued)*

FEATURE	DM-NVX-E20	DM-NVX-E20-2G(-B-T/-W-T)	DM-NVX-D20	DM-NVX-D200
Audio				
Inputs	1 x HDMI	1 x HDMI, 3.5 mm TRS mini phone jack	1 x DM NVX	1 x DM NVX
Outputs	3-pin pluggable terminal block	—	1 x HDMI, 3-pin pluggable terminal block	1 x HDMI, 3-pin pluggable terminal block
Digital Input/ Output Audio Formats	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, DTS:X, LPCM up to 8 channels	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, DTS:X, LPCM up to 8 channels	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, DTS:X, LPCM up to 8 channels	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, DTS:X, LPCM up to 8 channels
DSP Audio Downmix	—	—	—	—
Analog Output Audio Format	Stereo 2-channel	—	Stereo 2-channel	Stereo 2-channel
Analog Input Audio Format	—	Stereo 2-channel	—	—
DM NAX™ (AES67) Audio Format	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz
Dante Audio Format	—	—	—	—
Breakaway Audio	Yes	Yes	Yes	Yes
Available DM NVX Streams				
Primary AV Stream	Yes	Yes	Yes	Yes
DM NAX (AES67) Audio Stream Transmit/ Receive	Yes	Yes	Yes	Yes
Dante Audio Stream Transmit/ Receive	—	—	—	—

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DM NVX 4K60 4:2:0 Endpoints *(Continued)*

FEATURE	DM-NVX-E20	DM-NVX-E20-2G(-B-T/-W-T)	DM-NVX-D20	DM-NVX-D200
Streaming Protocols/Controls				
Codec Type	DM-NVX-D10/D20 Series	DM-NVX-D10/D20 Series	DM-NVX-D10/D20 Series	DM-NVX-D10/D20 Series
RTP	Yes	Yes	Yes	Yes
RTSP	Yes	Yes	Yes	Yes
SDP	Yes	Yes	Yes	Yes
MPEG2-TS	Yes	Yes	Yes	Yes
Session Initiation Multicast via RTSP	Yes	Yes	Yes	Yes
Stream Encryption	AES-128	AES-128	AES-128	AES-128
Multicast TTL Configuration	Yes	Yes	—	—
Default DSCP Value	32, CS4	32, CS4	—	—
Custom DSCP Control	Yes	Yes	—	—
Default RTSP Port	554	554	554	554
Custom RTSP Port Control	Yes	Yes	Yes	Yes
Default TS Port	4570	4570	4570	4570
Custom TS Port Control	Yes	Yes	—	—
Fixed Bit Rate Default Value (Mbps)	750	750	—	—
Adaptive Bit Rate	Yes	Yes	—	—
Variable Bit Rate	—	—	—	—
Custom Bit Rate Control	Yes	Yes	—	—
Crestron Auto-Initiation	Yes (default)	Yes (default)	Yes (default)	Yes (default)
Manual Stop	Yes	Yes	Yes	Yes
Manual Start	Yes	Yes	Yes	Yes
Statistics (Transmitted/ Received and Dropped Packet Counter)	Yes	Yes	Yes	Yes
DM NVX Routing and Subscriptions	—	—	Yes	Yes
Streaming Audio/Video Feedback	Yes	Yes	Yes	Yes

(Continued on following page)

DM NVX 4K60 4:2:0 Endpoints *(Continued)*

FEATURE	DM-NVX-E20	DM-NVX-E20-2G(-B-T/-W-T)	DM-NVX-D20	DM-NVX-D200
Security				
AES-128	Yes	Yes	Yes	Yes
HTTPS	Yes	Yes	Yes	Yes
802.1X	Yes	Yes	Yes	Yes
SSH	Yes	Yes	Yes	Yes
SSL	Yes	Yes	Yes	Yes
SFTP	Yes	Yes	Yes	Yes
Active Directory® Credential Management	Yes	Yes	Yes	Yes
Crestron Control				
XiO Cloud® Service	Yes	Yes	Yes	Yes
DM NVX Director®	Yes	Yes	Yes	Yes
.AV Framework™ Platform	Yes	Yes	Yes	Yes
SIMPL Programming	Yes	Yes	Yes	Yes
SIMPL # Pro	Yes	Yes	Yes	Yes
Crestron Studio® Software	Yes	Yes	Yes	Yes
Crestron Home® OS	Yes	Yes	Yes	Yes
Auto Update Support	Yes	Yes	Yes	Yes
VC-4 Series	Yes	Yes	Yes	Yes
USB				
USB 2.0	—	—	—	—
DM NUX and USB Legacy Model (USB-EXT-DM/USB-NX2) Support	—	—	—	—
Layer 2 Communication	—	—	—	—
Layer 3 Communication	—	—	—	—
Multiple Remote Support via DM NVX and DM NUX or Legacy Models (USB-EXT-DM/USB-NX2), (Layer 2 only)	—	—	—	—
USB HID Control	—	—	—	—
Communications				
IR	Yes	—	Yes	Yes
RS-232	Yes	—	Yes	Yes
CEC	Yes	Yes	Yes	Yes

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DM NVX 4K60 4:2:0 Endpoints *(Continued)*

FEATURE	DM-NVX-E20	DM-NVX-E20-2G(-B-T/-W-T)	DM-NVX-D20	DM-NVX-D200
Power				
Power over Ethernet (PoE)	PoE	PoE	PoE	PoE+
24 VDC Barrel Connector	Yes	—	Yes	Yes
24 VDC 2-Pin Pluggable Terminal Block	—	Yes	—	—
DMF-CI-8	—	—	—	—
Networking Interfaces				
Copper Ports, 1000 Mbps	1	1	1	1
Copper Port, 100 Mbps	—	—	—	—
SFP, 1000 Mbps	—	—	—	—
Ethernet Protocols				
IPv4 only or both IPv4 and IPv6	Yes	Yes	Yes	Yes
DHCP	Yes	Yes	Yes	Yes
Static IP Address Configuration	Yes	Yes	Yes	Yes
IGMPv2	Yes	Yes	Yes	Yes
IGMPv3	Yes	Yes	Yes	Yes
SMPTE 2022	Yes	Yes	Yes	Yes
DNS Resolution	Yes	Yes	Yes	Yes
FEC (Forward Error Correction)	—	—	—	—
Additional Physical Ports and Buttons				
Serial Console	—	—	—	—
USB Console	—	—	—	—
Input Select Button	—	—	—	—
Setup Button	Yes	Yes	Yes	Yes
Reset Button	Yes	Yes	Yes	Yes
Environmental				
Temperature	32° to 104° F (0° to 40° C)	32° to 104° F (0° to 40° C)	32° to 104° F (0° to 40° C)	32° to 104° F (0° to 40° C)
Relative Humidity (Noncondensing)	10% to 95%	10% to 95%	10% to 95%	10% to 95%
Heat Dissipation	29 BTU/hr	31.48 BTU/hr	29 BTU/hr	40.6 BTU/hr
Acoustic Noise	None (fanless)	33 dBA typical	None (fanless)	33 dBA typical

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DM NVX 4K60 4:2:0 Endpoints *(Continued)*

FEATURE	DM-NVX-E20	DM-NVX-E20-2G(-B-T/-W-T)	DM-NVX-D20	DM-NVX-D200
Other				
Firmware Upgrade Capability	Yes	Yes	Yes	Yes
Restore Default Settings Capability	Yes	Yes	Yes	Yes
Reboot Capability	Yes	Yes	Yes	Yes
Simple Network Time Protocol (SNTP)	Yes	Yes	Yes	Yes

1. A DVI or Dual-Mode DisplayPort™ interface is supported via an HDMI input using a suitable adapter or interface cable. (CBL-HD-DVI interface cables are available separately.)
2. A DVI interface is supported via the HDMI output using a suitable adapter or interface cable. (CBL-HD-DVI interface cables are available separately.)

DM NVX 1080p60 4:4:4 Endpoints

FEATURE	DM-NVX-E10	DM-NVX-D10
General		
Description	Network AV encoder	Network AV decoder
Form Factor	Surface mountable	Surface mountable
Video		
Inputs	1 x HDMI®[1]	1 x DM NVX
Output	—	HDMI[2]
Maximum Input/Output Resolution	1080p60 4:4:4	1080p60 4:4:4
Custom Resolutions	Supported at pixel clock rates up to 165 MHz	Supported at pixel clock rates up to 165 MHz
Output Scaler	—	—
Video Wall Mode	—	—
Widescreen Format Selection	—	—
Underscan	—	—
Maximum HDCP	HDCP 1.4	HDCP 1.4
HDCP Input/Output Configurable	Yes	Yes
Input EDID Control	Yes	—
Auto-Routing	—	—
Input Selection	—	—
Deep Color	Yes	Yes
HDR10, HDR10+ and Dolby Vision®	—	—
Video Timeout Control	—	—
Crestron® QuickSwitch HD™	—	—
On-Screen Display Basic Text Overlay	—	—
DM Input Support	—	—

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DM NVX 1080p60 4:4:4 Endpoints *(Continued)*

FEATURE	DM-NVX-E10	DM-NVX-D10
Audio		
Inputs	1 x HDMI	1 x DM NVX
Outputs	3-pin pluggable terminal block	1 x HDMI, 3-pin pluggable terminal block
Digital Input/ Output Audio Formats	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, DTS:X, LPCM up to 8 channels	Dolby Digital, Dolby Digital EX, Dolby Digital Plus, Dolby TrueHD, Dolby Atmos, DTS, DTS ES, DTS 96/24, DTS HD High Res, DTS HD Master Audio, DTS:X, LPCM up to 8 channels
DSP Audio Downmix	—	—
Analog Output Audio Format	Stereo 2-channel	Stereo 2-channel
Analog Input Audio Format	—	—
DM NAX™ (AES67) Audio Format	Stereo 2-channel 48 kHz	Stereo 2-channel 48 kHz
Dante Audio Format	—	—
Breakaway Audio	Yes	Yes
Available DM NVX Streams		
Primary AV Stream	Yes	Yes
DM NAX (AES67) Audio Stream Transmit/ Receive	Yes	Yes
Dante Audio Stream Transmit/ Receive	—	—

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DM NVX 1080p60 4:4:4 Endpoints *(Continued)*

FEATURE	DM-NVX-E10	DM-NVX-D10
Streaming Protocols/Controls		
Codec Type	DM-NVX-D10/D20 Series	DM-NVX-D10/D20 Series
RTP	Yes	Yes
RTSP	Yes	Yes
SDP	Yes	Yes
MPEG2-TS	Yes	Yes
Session Initiation Multicast via RTSP	Yes	Yes
Stream Encryption	AES-128	AES-128
Multicast TTL Configuration	Yes	—
Default DSCP Value	32, CS4	—
Custom DSCP Control	Yes	—
Default RTSP Port	554	554
Custom RTSP Port Control	Yes	Yes
Default TS Port	4570	4570
Custom TS Port Control	Yes	—
Fixed Bit Rate Default Value (Mbps)	750	—
Adaptive Bit Rate	Yes	—
Variable Bit Rate	—	—
Custom Bit Rate Control	Yes	—
Crestron Auto-Initiation	Yes (default)	Yes (default)
Manual Stop	Yes	Yes
Manual Start	Yes	Yes
Statistics (Transmitted/ Received and Dropped Packet Counter)	Yes	Yes
DM NVX Routing and Subscriptions	—	Yes
Streaming Audio/Video Feedback	Yes	Yes

(Continued on following page)

DM NVX 1080p60 4:4:4 Endpoints *(Continued)*

FEATURE	DM-NVX-E10	DM-NVX-D10
Security		
AES-128	Yes	Yes
HTTPS	Yes	Yes
802.1X	Yes	Yes
SSH	Yes	Yes
SSL	Yes	Yes
SFTP	Yes	Yes
Active Directory® Credential Management	Yes	Yes
Crestron Control		
XiO Cloud® Service	Yes	Yes
DM NVX Director®	Yes	Yes
.AV Framework™ Platform	Yes	Yes
SIMPL Programming	Yes	Yes
SIMPL # Pro	Yes	Yes
Crestron Studio® Software	Yes	Yes
Crestron Home® OS	Yes	Yes
Auto Update Support	Yes	Yes
VC-4 Series	Yes	Yes
USB		
USB 2.0	—	—
DM NUX and USB Legacy Model (USB-EXT-DM/USB-NX2) Support	—	—
Layer 2 Communication	—	—
Layer 3 Communication	—	—
Multiple Remote Support via DM NVX and DM NUX or Legacy Models (USB-EXT-DM/USB-NX2), (Layer 2 only)	—	—
USB HID Control	—	—
Communications		
IR	Yes	Yes
RS-232	Yes	Yes
CEC	Yes	Yes

(Continued on following page)

DM NVX 1080p60 4:4:4 Endpoints *(Continued)*

FEATURE	DM-NVX-E10	DM-NVX-D10
Power		
Power over Ethernet (PoE)	PoE	PoE
24 VDC Barrel Connector	Yes	Yes
24 VDC 2-Pin Pluggable Terminal Block	—	—
DMF-CI-8	—	—
Networking Interfaces		
Copper Ports, 1000 Mbps	1	1
Copper Port, 100 Mbps	—	—
SFP, 1000 Mbps	—	—
Ethernet Protocols		
IPv4 only or both IPv4 and IPv6	Yes	Yes
DHCP	Yes	Yes
Static IP Address Configuration	Yes	Yes
IGMPv2	Yes	Yes
IGMPv3	Yes	Yes
SMPTE 2022	Yes	Yes
DNS Resolution	Yes	Yes
FEC (Forward Error Correction)	—	—
Additional Physical Ports and Buttons		
Serial Console	—	—
USB Console	—	—
Input Select Button	—	—
Setup Button	Yes	Yes
Reset Button	Yes	Yes
Environmental		
Temperature	32° to 104° F (0° to 40° C)	32° to 104° F (0° to 40° C)
Relative Humidity (Noncondensing)	10% to 95%	10% to 95%
Heat Dissipation	29 BTU/hr	29 BTU/hr
Acoustic Noise	None (fanless)	None (fanless)

(Continued on following page)

DM NVX 1080p60 4:4:4 Endpoints *(Continued)*

FEATURE	DM-NVX-E10	DM-NVX-D10
Other		
Firmware Upgrade Capability	Yes	Yes
Restore Default Settings Capability	Yes	Yes
Reboot Capability	Yes	Yes
Simple Network Time Protocol (SNTP)	Yes	Yes

1. A DVI or Dual-Mode isplayPort™ interface is supported via an HDMI input using a suitable adapter or interface cable. (CBL-HD-DVI interface cables are available separately.)
2. A DVI interface is supported via the HDMI output using a suitable adapter or interface cable. (CBL-HD-DVI interface cables are available separately.)

DM NVX Director Virtual Switching Appliances

A DM NVX Director virtual switching appliance emulates the functionality of the traditional hardware-based matrix switcher (for example, the DM-MD8X8-CPU3). The virtual switching appliance allows comprehensive system configuration, management, and signal routing of a DM NVX system.

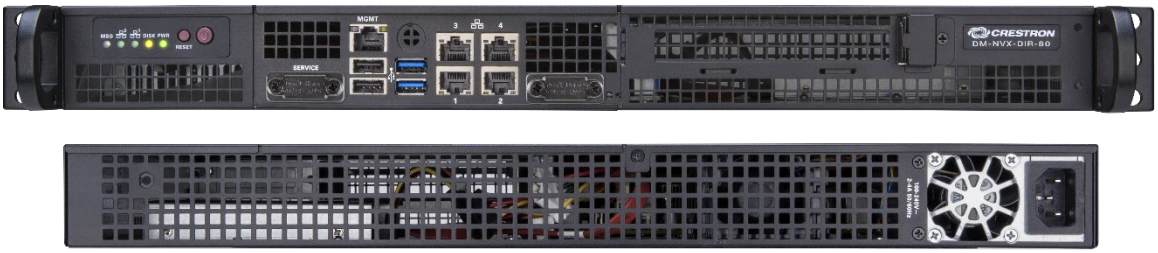
The DM NVX Director web interface allows automatic discovery of each DM NVX endpoint on the network and the assignment of each endpoint to a domain. The web interface also enables custom endpoint naming and search tools, an XML-based device map file for import and export, logging, diagnostics, and SNMP messaging support.

DM NVX Director models consist of the DM-NVX-DIR-80, DM-NVX-DIR-160, and DM-NVX-DIR-ENT. The following sections provide information about each model.

DM-NVX-DIR-80

The DM-NVX-DIR-80 includes four 1-Gigabit Ethernet RJ-45 interfaces and a dedicated Intelligent Platform Management Interface (IPMI). Best suited for single large rooms, the DM-NVX-DIR-80 supports 80 devices and a single domain.

DM-NVX-DIR-80 Front and Rear Views



DM-NVX-DIR-160

The DM-NVX-DIR-160 includes four 1-Gigabit Ethernet RJ-45 interfaces and a dedicated IPMI. Best suited for groups of small rooms, the DM-NVX-DIR-160 supports 160 devices and 20 domains.

DM-NVX-DIR-160 Front and Rear Views

DM-NVX-DIR-ENT

The DM-NVX-DIR-ENT includes six 1-Gigabit Ethernet RJ-45 interfaces, six 10-Gigabit Ethernet SFP+ interfaces (four of which are also compatible with 1-Gigabit Ethernet), a dedicated IPMI, and redundant power supplies. The DM-NVX-DIR-ENT supports 1,000 devices and 240 domains.

DM-NVX-DIR-ENT Front and Rear Views

DM NVX Director Virtual Switching Appliance Comparison

The following table summarizes the major differences among the DM NVX Director virtual switching appliances.

DM NVX Director Virtual Switching Appliances

MODEL	NUMBER OF NETWORK INTERFACES	MAXIMUM NUMBER OF DOMAINS	MAXIMUM NUMBER OF DM NVX DEVICES
DM-NVX-DIR-80	4	1	80
DM-NVX-DIR-160	4	20	160
DM-NVX-DIR-ENT	12	240	1,000

SFP-1G and SFP-10G Transceiver Modules

Crestron SFP-1G and SFP-10G transceiver modules provide fiber connectivity, which offers greater transmission distances than traditional copper. SFP-1G modules can be used with the DM NVX endpoints and DM-NVX-DIR-ENT. SFP-10G modules can be used with the DM-NVX-DIR-ENT only. The following sections provide information about the modules.

SFP-1G Modules

Available SFP-1G modules consist of the following:

- **SFP-1G-SX**: 850 nm multimode fiber connections up to 550 m (1800 ft) over LC-terminated OM3 or OM4 fiber
- **SFP-1G-LX**: 1310 nm single-mode fiber connections up to 10 km (6.2 mi) using LC-terminated G.652 fiber
- **SFP-1G-BX-U**: 1310 nm/1490 nm single-mode fiber uplink connections up to 10 km (6.2 mi) using LC-terminated G.652 fiber
- **SFP-1G-BX-D**: 1310 nm/1490 nm single-mode fiber downlink connections up to 10 km (6.2 mi) using LC-terminated G.652 fiber

SFP-1G Modules

For each endpoint and for the DM-NVX-DIR-ENT, the connectivity options and the distance requirements determine the appropriate module that is to be used.

SFP-10G Module

The SFP-10G-SR module is available for the DM-NVX-DIR-ENT. The SF-10G-SR supports 850 nm multimode fiber connections up to 300 m (1000 ft) over LC-terminated OM3 and up to 400 m (1300 ft) over LC-terminated OM4 fiber.

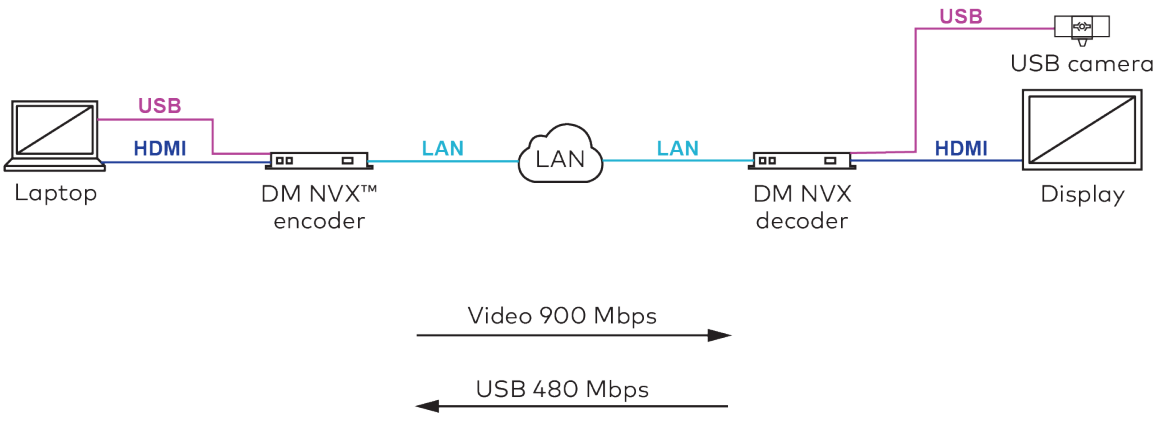
Endpoint Bandwidth Design and Management

A single DM NVX network link can carry the following data streams:

- **Primary Audio/Video Stream**: HDMI® or analog audio and HDMI video that are encoded and sent to the network for decoding by a remote endpoint
- **DM NAX™ (AES67) or Dante® Audio Stream**: Audio stream that is encoded and sent for decoding independently of the primary audio/video stream
- **USB Device and Host Traffic**: USB data from the DM NVX device or host port (available on DM-NVX-35x, DM-NVX-35xC, DM-NVX-36x, and DM-NVX-36xC devices only)
- **Other Ethernet Traffic**: Control data as well as data from DM NVX network ports connected to third-party devices such as displays or cameras. Ethernet traffic also includes network protocol traffic such as DHCP, DNS, and RADIUS for 802.1X.

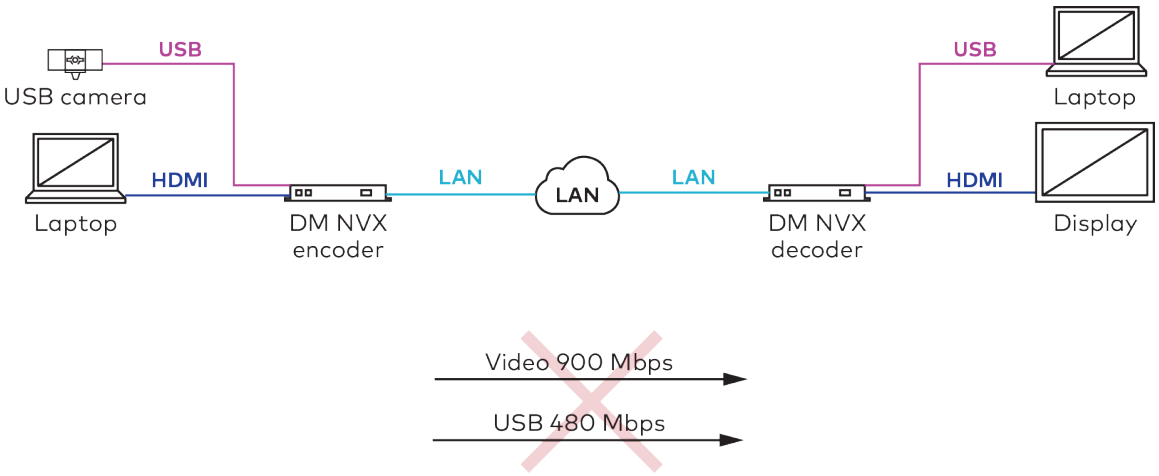
Default video bit rate settings are sufficient for most installations but can be adjusted to accommodate unique situations. Ethernet bandwidth ratings are bidirectional; therefore, full USB 2.0 bandwidth is supported for DM-NVX-35x, DM-NVX-35xC, DM-NVX-36x, and DM-NVX-36xC devices. In an installation in which video from a PC is encoded and sent to a decoder at a display, and a high-bandwidth USB camera at the display sends USB video back to the PC, no bandwidth issues exist. Although the sum of all traffic may exceed 1 Gbps in this scenario, the traffic in each direction is less than 1 Gbps.

Example of Bidirectional Bandwidth under 1 Gbps



An encoder that attempts to send 900 Mbps video and 480 Mbps USB 2.0 traffic exceeds the maximum network link bandwidth of 1 Gbps and, as a result, the link will fail.

Example of Failed Link with Required Bandwidth Greater than 1 Gbps



DM-NVX-35x, DM-NVX-35xC, DM-NVX-36x, and DM-NVX-36xC devices support Layer 2 and Layer 3 transport of USB 2.0 data. For Layer 2 transport, one local connection to the device port of a DM NVX device supports up to seven remote host port connections simultaneously. When multiple remote connections are required, a hub must be used to connect to each remote host port. To prevent excessive USB traffic for Layer 2 support of multiple remote connections, only one high-bandwidth USB device can be used regardless of the number of remote connections.

For USB 2.0 Layer 3 transport, one local connection supports only one remote connection. Layer 3 supports USB 2.0 transport of data across VLANs.

The OPS port of the DM-NVX-D80-IOAV includes USB 2.0 host port functionality, enabling the DM-NVX-D80-IOAV to function as a remote extender. For OPS-supported displays with touch screen capability, the OPS port of the DM-NVX-D80-IOAV routes USB signals from the touch screen to a computer.

Endpoint Design Considerations

To implement an optimal configuration for a DM NVX system, consider the following factors for each endpoint:

- If rack-mount sources are required or if a high density of endpoints must exist in close proximity to each other, use card-based endpoints.
- If simultaneous stereo downmixing alongside multichannel audio output is required, use the DM-NVX-351, DM-NVX-351C, DM-NVX-363, or DM-NVX-363C.
- If Dante® audio networking is required, use the DM-NVX-363 or DM-NVX-363C.
- For an encoder-only endpoint that supports resolutions up to 4K60 4:4:4 and when input switching is not required, use the DM-NVX-E30 or DM-NVX-E30C.
- For an encoder-only endpoint that supports resolutions up to 4K60 4:2:0 and when input switching is not required, use the DM-NVX-E20 or DM NVX-E20-2G.
- For an encoder-only endpoint that supports resolutions up to 1080p60 4:4:4 and when input switching is not required, use the DM-NVX-E10.
- For an encoder-only endpoint that is interoperable with DM 8G+® output devices and DM Lite® transmitters, use the DM-NVX-E760 or DM-NVX-E760C. Examples of DM 8G+ output devices are the DMC-4KZ-CO-HD and DMB-4K-O-C of DM switchers, the DM-TX-4KZ-100-C-1G transmitter, and the DMPS3-4K-350-C and DMPS3-4K-250-C presentation systems. Examples of DM Lite transmitters are the HD-TX-101-C-E and HD-TX-101-C-1G-E.
- For a decoder-only endpoint without video scaling and support of resolutions up to 4K60 4:4:4, use the DM-NVX-D30, DM-NVX-D30C, or DM-NVX-D80-IOAV. The DM-NVX-D80-IOAV must be used with an OPS-supported display.
- For a decoder-only endpoint with video scaling and support of resolutions up to 4K60 4:2:0, use the DM-NVX-D200. If video scaling is not required, use the DM-NVX-D20.

NOTE: The DM-NVX-D200 and DM-NVX-D20 decoders are designed for use with the DM-NVX-E20, DM-NVX-E20-2G, or DM-NVX-E10 encoder. If the decoders are used with DM-NVX-4K60-4:4:4 encoders (for example, the DM-NVX-36x(C) Series), the stream type of the encoder must be configured to interoperate with the DM-NVX-D200 or DM-NVX-D20. The resolution of the encoder must also be configured so that it does not exceed the maximum resolution of the DM-NVX-D200 or DM-NVX-D20. Configuration of the encoder is accomplished by using the web interface or a control system.

It is recommended that the DM-NVX-D200 and `DM-NVX-D20 not be used with 4K60 4:4:4 encoders in order to maintain the higher resolutions supported by the 4K60 4:4:4 encoders.

- For a decoder-only endpoint with support of resolutions up to 1080p60 4:4:4 and when video scaling is not required, use the DM-NVX-D10.

  NOTE: The DM-NVX-D10 decoder is designed for use with the DM-NVX-E10 encoder. If the DM-NVX-D10 is used with a DM-NVX-4K60-4:4:4 encoder (for example, a DM-NVX-36x(C) Series encoder), the stream type of the encoder must be configured to interoperate with the DM-NVX-D10. The resolution of the encoder must also be configured so that it does not exceed the maximum resolution of the DM-NVX-D10. Configuration of the encoder is accomplished by using the web interface or a control system.

  It is recommended that the DM-NVX-D10 not be used with 4K60 4:4:4 encoders or with the DM-NVX-E20 Series 4K60 4:2:0 encoders in order to maintain the higher resolutions supported by the 4K60 4:4:4 and 4:2:0 encoders.

- Follow the guidelines for cable types as specified in TIA/EIA-568 for choosing and certifying cables in a DM NVX installation.
- Refer to the following table for guidelines on some of the primary network connectivity options that can be used at the endpoint.

  Primary Endpoint-to-Network Connectivity Guidelines

CONNECTION	CABLE TYPE	MAXIMUM TRANSMISSION DISTANCE
RJ-45	Cat5e or higher	100 m (330 ft)
SFP-1G-SX	OM3 MMF OM4 MMF	550 m (1800 ft)
SFP-1G-LX	G.652 SMF	10 km (6.2 mi)
SFP-1G-BX-U	G.652 SMF	10 km (6.2 mi)
SFP-1G-BX-D	G.652 SMF	10 km (6.2 mi)

- Various DM NVX surface-mountable endpoints provide IR and serial ports to control in-room devices. If required, use a Crestron 3-Series® or later control processor in a design that uses IR and serial ports or in a design that requires relay I/O or Cresnet® device control.
- Although both a USB 2.0 host port and a USB 2.0 device port are available on DM-NVX-35x, DM-NVX-35xC, DM-NVX-36x, and DM-NVX-36xC endpoints, both ports cannot be used simultaneously.
- High-bandwidth USB devices such as cameras and storage can have an impact on overall video bandwidth. For additional information about how to manage high-bandwidth USB devices and the direction of bandwidth consumption, refer to "Endpoint Bandwidth Design and Management" on page 30.
- If additional HDMI inputs are required for local switching at the endpoint within typical HDMI cable distances of 15 ft (5 m), consider using other Crestron solutions—such as the Crestron DM MD and DMPS families of products—in conjunction with the endpoint.
- In many DM NVX installations, configure specific control surfaces (such as Crestron touch screens) and additional switch options (such as local HDMI switches) at endpoints.

Network Design

DM NVX systems require a designed and provisioned Ethernet network to function correctly. Be sure to gather requirements and documentation, coordinate with IT staff, and complete network design prior to site work.

Minimum Network Requirements

Minimum network requirements must be met for a successful installation. Minimum requirements consist of the following:

- **Network switch:**
  - 1-Gigabit port for every connected DM NVX endpoint
  - Nonblocking backplane
  - Layer 3
  - IGMPv2 implementation
- **Network switch settings:**
  - IGMPv2 snooping enabled
  - IGMPv2 querier enabled
  - Fast-leave enabled (also known as immediate-leave)
- **Inter-switch uplinks (if required):**
  - The uplinks must have sufficient bandwidth for all encoders and decoders connected to the network switch. Allocate 1 Gigabit per encoder or decoder connected to the switch.
  - Uplinks must be configured properly to support multicast traffic.

Network Design Overview

DM NVX networks must be designed to isolate traffic on network segments specifically architected for DM NVX devices. This can be accomplished by using separate infrastructure, Virtual Local Area Networks (VLANs), or Multi-Protocol Label Switching (MPLS). DM NVX network segments carry DM NVX multicast streams, DM NVX control, and ancillary traffic.

The location of other Crestron network devices relative to network infrastructure must be determined. A decision must be made as to whether the devices are to coexist on the same network segment as the DM NVX segment or on another segment that has traversal capabilities to the DM NVX segment but is not multicast enabled. Networked AV devices other than DM NVX devices can be placed on the DM NVX network segment if their bandwidth requirements are relative to the DM NVX endpoint bandwidth requirements.

A DM NVX device can have several addresses:

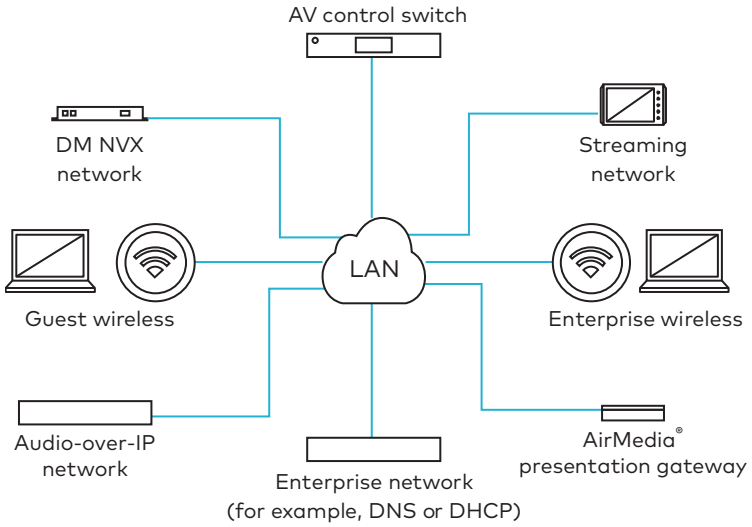
- An IP address is required for control of the device and access to the web configuration interface and console. For the DM-NVX-352, DM-NVX-352C, DM-NVX-363, and DM-NVX-363C, an IP address for the Dante module is also required.
- Multicast addresses are required for multicast streams:
  - One multicast address is required for the primary multicast stream of audio and video.
  - Another multicast address is required for the DM NAX (AES67) audio multicast stream.
  - (DM-NVX-352, DM-NVX-352C, DM-NVX-363, and DM-NVX-363C only) A Dante multicast address is also required if a Dante multicast stream is used.

  During endpoint configuration, the primary multicast address must be set manually to an even-numbered IP address. The DM NAX (AES67) audio multicast stream address can be automatically assigned to a value of one higher than the primary IP multicast stream address. Alternatively, the DM NAX (AES67) audio multicast stream can be manually set to the desired multicast address.

  A Dante multicast address is automatically assigned. The address must be unique and must not match a DM NVX multicast address. If the Dante multicast address does match a DM NVX multicast address, the DM NVX multicast address must be changed. (For information about Dante networking, refer to the information provided on the Audinate website at www.audinate.com.)

The DM NVX network segment must receive network services, including DNS, DHCP, Active Directory, and RADIUS services. Coordinate with IT staff to provide access to these services and to create the proper traversal rules to the DM NVX network segment.

Network Segmentation along Logical Boundaries



Consideration must be given to blocking at both the switch level and the network design level. DM NVX network switches must have enough switch fabric bandwidth to support full nonblocking bidirectional gigabit bandwidth on all ports simultaneously. This is a common feature in enterprise-grade gigabit network switches, but it should not be assumed that a switch is nonblocking or is configured as nonblocking.

Due to system size or physical layout, most DM NVX installations require multiple network switches. The network switches must connect to each other via a high-bandwidth uplink port. For network design purposes, assume that each DM NVX link consumes the full gigabit of link bandwidth.

Consider the example of a standard 48-port Gigabit Ethernet switch with one 40-gigabit uplink (or four 10-gigabit uplinks). Since each DM NVX endpoint consumes 1 gigabit of bandwidth, this switch can support up to 40 DM NVX devices in a nonblocking way. If more devices are connected, the uplink becomes a bottleneck, introducing the potential for difficult-to-diagnose blocking problems.

Network Topologies

Connect devices such as control processors, touch screens, servers, personal computing devices, and DM NVX endpoints directly to network switches. In a large network with multiple layers of switch hierarchy, situate these devices at the network's edge. The network edge switches are often connected via uplinks to other switches and routers. This aggregates traffic from the network edge and forms the network's core. The relationships between network switches and their interconnection to each other define the network's topology.

The following general rules apply for sizing network switches in terms of switch fabric nonblocking bandwidth:

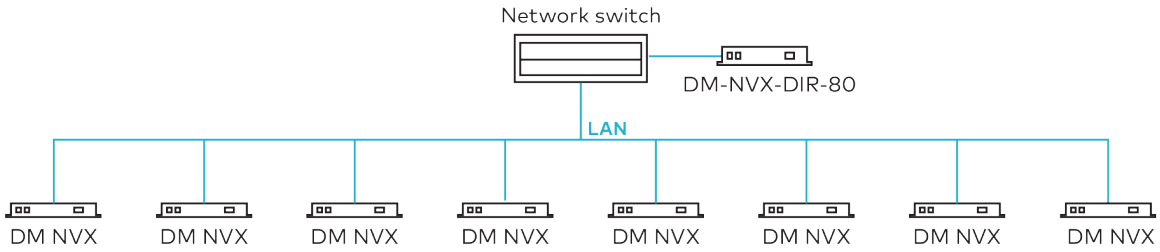
- The network core must support a nonblocking bandwidth and port speed equal to 1 gigabit multiplied by the lesser of the total number of anticipated encoder endpoints or the total number of anticipated decoder endpoints, plus the number of USB extenders.
- The network edge must support a nonblocking bandwidth and uplink speed equal to 1 gigabit multiplied by the greater of the total number of anticipated encoder endpoints or the total number of anticipated decoder endpoints, plus the number of discrete USB extenders.

Star

The default recommended network topology is a star. Using a fully nonblocking switch, the star topology allows any combination of one or more endpoints to connect to any other combination of endpoints. It also easily allows the network to grow beyond a single switch if the uplink in the switch supports the maximum specified bandwidth.

For small DM NVX systems that employ only one network switch, use a nonblocking switch to prevent a bottleneck. Star topologies can accommodate very large DM NVX installations by using large modular switch frames.

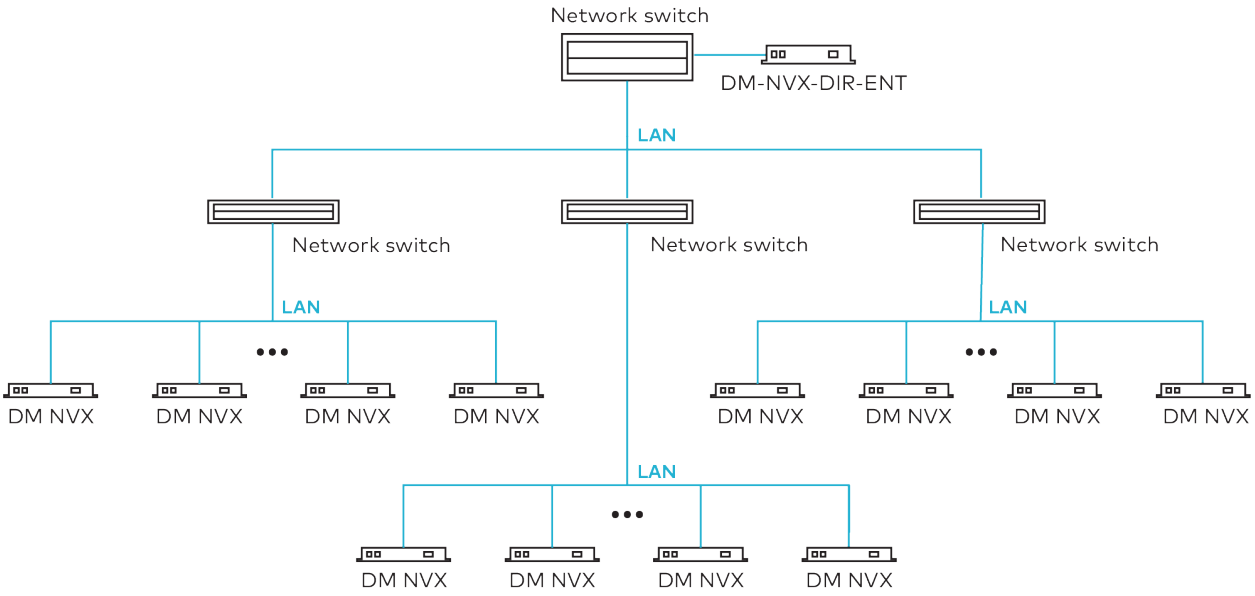
Star Network Using a Nonblocking Switch



Tree

A tree network is a combination of more than one star network existing on a core-switching infrastructure. The tree network allows failure in one part of the attached star networks without widely affecting the other star networks. Configure the core network, which is the larger network switch, for redundancy and scalability.

Tree Topology Using Nonblocking Switches on a Core Network



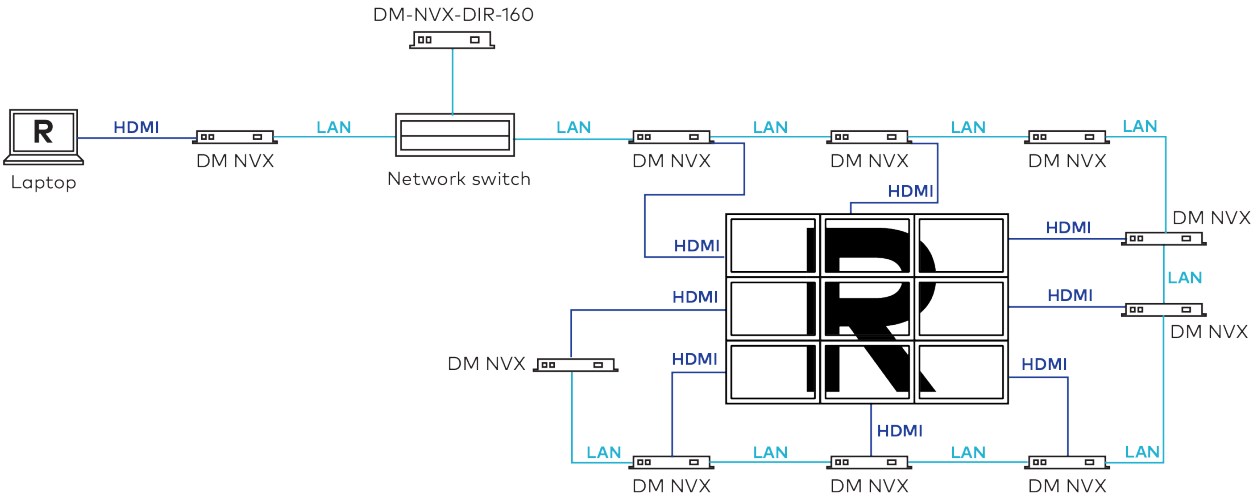
Daisy Chain

Daisy chaining is appropriate for specific deployment applications such as video walls or jury boxes in which all displays receive the same video source as the first DM NVX endpoint in the chain.

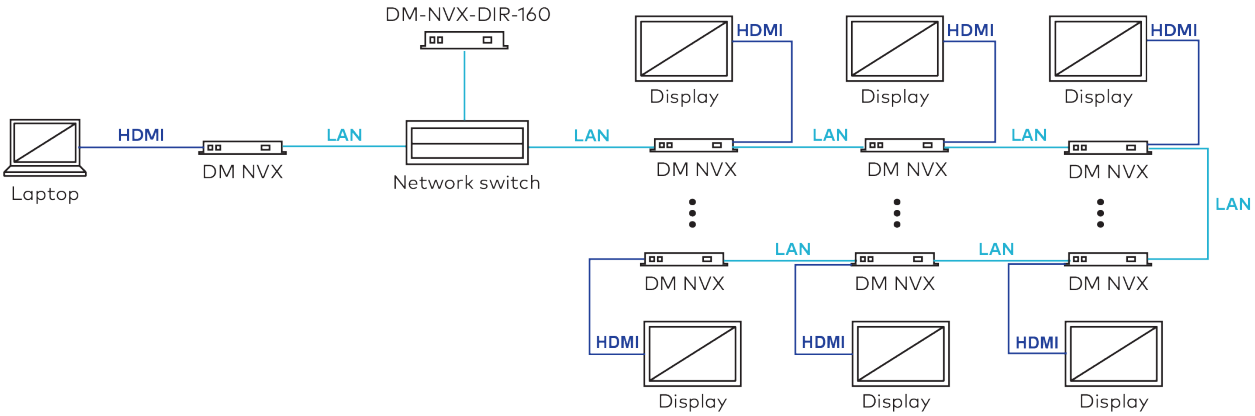
For video wall applications and any other application in which displays are near each other and share the same source, up to 16 endpoints can be daisy chained together. Larger video walls can be divided into individual daisy chains that each contain up to 16 endpoints.

For applications such as information signage in which more than one display is viewable concurrently without being dependent on the viewing of another display in the daisy chain, up to 64 endpoints can be daisy chained together.

Daisy Chain Network Configuration for 3 x 3 Video Wall



Daisy Chain Network Configuration for 12-Person Jury Box



Due to limited bandwidth for audio and video, a USB host or device on a daisy chained endpoint is not recommended. For maximum flexibility and the ability to reconfigure video walls with multiple sources, connect DM NVX endpoints directly to switches rather than daisy chain the endpoints.

Other Topologies and Network Functionality

Other valid deployment topologies for DM NVX networks are ring and mesh. These deployments require project-specific discovery and configuration of the network switch. For projects using advanced topologies for deployments, a networking professional must be involved early in the network design process.

Network Multicast Functionality

DM NVX networks rely on multicast functionality to send and receive video—even in the simplest case of a single encoder endpoint and a single decoder endpoint. Internet Group Management Protocol (IGMP) multicast in the Ethernet context replaces a fixed switching architecture in AV distribution.

Segregation of DM NVX traffic by using a VLAN or MPLS is usually the first step in enabling multicast. A VLAN or MPLS ensures that DM NVX traffic stays on the DM NVX network and does not route to other network segments and interfere with their operation. A VLAN or MPLS also ensures that traffic from other network segments does not interfere with DM NVX operation. Within that segment, all ports can be flooded by IGMP traffic regardless of whether that traffic was intended to be sent or received by a network device at any time. This will result in interference with network operation and can be a means of implementing a denial-of-service attack on a network if done maliciously.

To ensure that only traffic between intended multicast senders and multicast receivers appears at a given port, IGMP snooping must be enabled. IGMP snooping refers to the ability of the network switch to limit multicast traffic only to ports between intended senders and receivers. The DM NVX network supports both versions of IGMP snooping: IGMPv2 and IGMPv3.

In order for the network switch to know where route limiting is implemented in the network for multicast traffic, an IGMP querier must be enabled. In most instances, a single network switch is selected by address to act as the IGMP querier; however, if multiple switches are configured as queriers, the switch with the lowest numerical IP address on the network is typically the default. The default leave time for the querier (typically about 125 seconds) is sufficient for a DM NVX network.

Protocol Independent Multicast (PIM)

Protocol Independent Multicast (PIM) is a family of multicast routing protocols for IP networks. PIM offers one-to-many and many-to-many distribution of data. PIM modes include PIM Sparse Mode (PIM-SM), PIM Dense Mode (PIM-DM), and PM Source-Specific Multicast Mode (PIM-SSM). PIM-SM must be used for large DM NVX networks. PIM-SM finds the shortest trees per path from a multicast source to multicast receivers on a network and is more scalable than PIM-DM or PIM-SSM. PIM-SM also prevents edge-to-switch link saturation and network loops in multicast traffic routing.

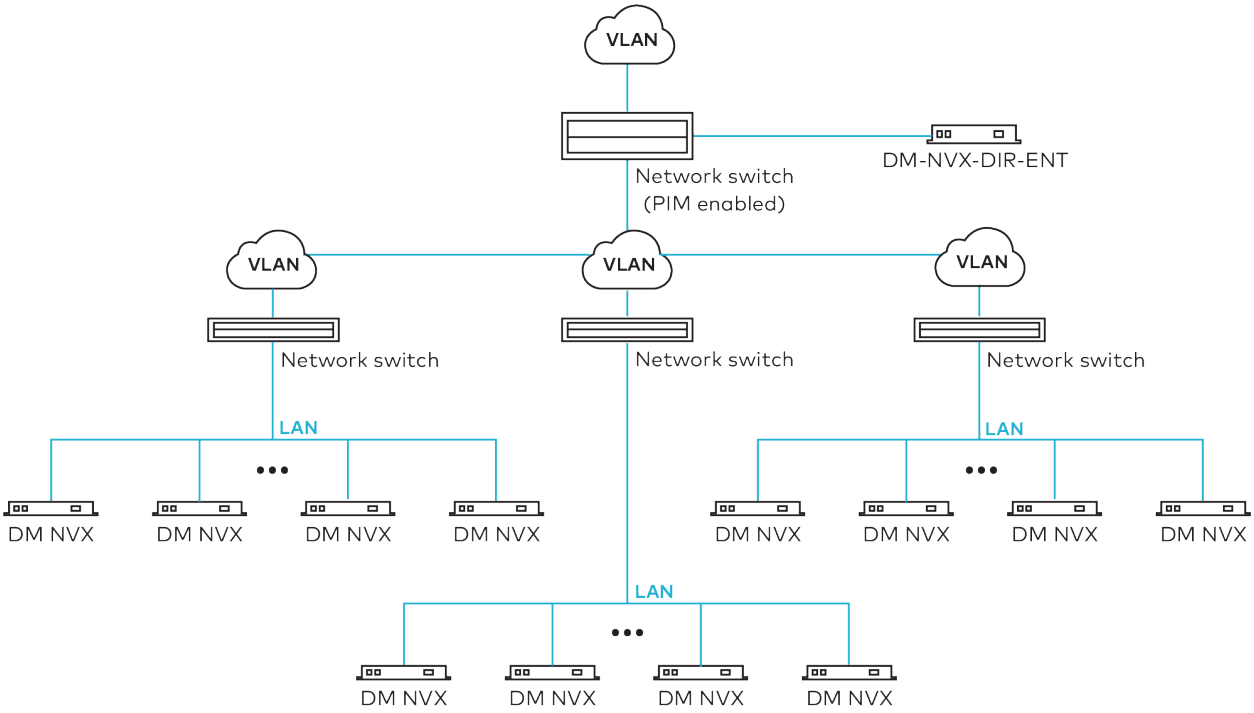
Enabling network Quality of Service (QoS) helps prioritize DM NVX traffic over other traffic at both the source and the destination. The highest priority on IGMP multicast traffic must be enabled. An example of enabling network QoS is as follows:

- Enable 802.1Q VLAN tagging support in the network switch.
- Enable and assign an 802.1P priority (for example, 5, 6, or 7) to DM NVX addresses and ports or IGMP protocol traffic.

- For other traffic, such as HTTP for web services or SSH for console access, assign lower priority numbers (for example, 0 to 4) based on their addresses, ports, or protocols.
- For successful QoS operation, ensure that all traffic types are included in the QoS setup.

NOTE: In addition to 802.1Q and 802.1P mentioned on the preceding page, other QoS protocols exist and are dependent on the switch vendor. The protocols are configured similar to the 802.1Q and 802.1P examples on the preceding page.

PIM Multicast Routing Protocol for an IP Network



Network Security

Security requires the support of particular capabilities within all devices on the network. DM NVX networks employ the following security features:

- 802.1X authentication is used to ensure that devices on the network have been authorized by the network administration team. Unauthorized devices are prevented from being added to the network and from having access to sensitive content.
- Active Directory services for endpoint administration can be used to ensure that administrative privileges for DM NVX devices can be centrally managed, granted, and revoked when necessary.
- DM NVX endpoints use Advanced Encryption Standard (AES) block cipher with Public Key Infrastructure (PKI) for stream encryption to protect content from unauthorized access as it crosses the network.

- SSL-based secure Cresnet over IP (CIP) for DM NVX control ensures that control processors and DM NVX devices communicate with the intended party device and that any unauthorized device on the network cannot monitor commands and status.
- SSH-based command line console access for device configuration and status protects the device console from access by unauthorized users.

SSL-based Cresnet over IP and SSH-based command line console access are automatically configured within DM NVX devices and support software. The designer should focus on 802.1X and Active Directory services within the design.

For additional information about deploying security with Crestron products, refer to the IP Considerations Guidelines for the IT Professional Design Guide (Doc. 4579) at www.crestron.com/manuals and to Answer ID 5571 in the Online Help section of the Crestron website (www.crestron.com/onlinehelp).

Network Design Considerations

Consider and apply the following network design best practices:

- Use nonblocking Layer 3 switches with port-based QoS such as 802.1P with 802.1Q at all stages of the design. Use sufficient switch bandwidth and port speeds. Less expensive switches cause loss of capability in the network.
- Choose switches with sufficient bandwidth at each segment—from edge to core—to accommodate a nonblocking architecture for DM NVX endpoints and any additional needs.
- Choose an appropriate network topology. Consider the network, including basic functionality and redundancy, and whether video walls or repetitive display signage is necessary. When planning a topology for the network, ensure that network IT staff and network architects are involved in the decisions.
- Enable an IGMP querier on at least one switch in the DM NVX network. The IGMP querier ensures that all switches know which multicast transmitters and receivers are connected to which switches in the network. Enabling an IGMP querier on multiple switches causes the switch with the lowest value of IP source address to take priority and act as the querier.
- Consult the network switch manufacturer's documentation to ensure that the uplinks are properly configured to support multicast traffic.
- Use switches that support 802.1X for endpoint authentication by implementing 802.1X endpoint authentication through TLS or MS-CHAP v2. Only authorized endpoints can communicate with the network.
- Ensure that VLANs or MPLS are implemented correctly. Leveraging existing switch infrastructure with VLANs or MPLS can cause conflicts with network provisioning needs. If a dedicated DM NVX network is not going to be used, VLANs must be implemented correctly with their own IP subnet, and MPLS networks must be configured correctly.

- Account for even-numbered DM NVX primary stream multicast address assignments since both primary and secondary multicast streams are possible. The assignment of multicast IP addresses for primary streams should be even numbered to allow the secondary stream to be assigned to the odd-numbered IP address, which is one higher than the primary stream's IP address. For multicast IP address assignment, refer to the guidelines in IETF RFC 3171.
- Use the Active Directory service for administration security:
  - Create an Active Directory group responsible for device administration.
  - Add device administrators to the group.
  - Add the group to the DM NVX device on the Device page of the web interface.

  Use of the Active Directory service with DM NVX endpoint logins allows for easy, seamless, and better controlled access from a central directory authority with fewer risks.
- Use a DHCP server with link-layer filtering, and configure the IP addresses of endpoints using DHCP rather than static IP addresses. Using a DHCP server with short lease times, MAC address filtering, and sufficient address space for future needs makes network management easier.
- Enable IGMPv2 (DM NVX default) or IGMPv3 multicast snooping on all switches in the DM NVX network. This is a requirement for all designs in order to enable multicast delivery to multiple endpoints. Without IGMP snooping enabled, switches that receive a multicast stream will transmit that stream to all ports simultaneously and saturate all network links.
- Use the Rapid Spanning Tree Protocol (RSTP) on the network to ensure that network loops are discoverable and to prevent deployment issues. Network management should account for RSTP discovery downtime when the network changes.
- Use and plan for DM NVX Director management of endpoints.
- Use daisy chaining to connect video wall endpoints or repeated displays. For video walls or endpoints that receive the same source from a single transmitter to feed multiple identical displays or in a video wall using a single source, it is simpler and less expensive to daisy chain the network.
- Disable IGMP proxy functionality on Crestron control processors with routers to ensure that DM NVX multicast traffic does not interfere with the control processor. The CP3N, Pro3, and AV3 control processors as well as DMPS3 presentation systems should have IGMP proxy functionality disabled when connected to the DM NVX network.
- Account for high-bandwidth external USB devices that are to be connected to DM NVX devices. Ensure that the bandwidth is accounted for as a separate 1-gigabit link since USB 2.0 bandwidth can consume 480 Mbps of the 1-gigabit link.

- Ensure that multicast IP addresses do not share the multicast MAC addresses. Sharing MAC addresses can cause network collisions and prevent normal operation of the DM NVX network.
- For Dante or AES67 audio networking with DM-NVX-352, DM-NVX-352C, DM-NVX-363, and DM-NVX-363C devices, additional network considerations may need to be addressed. For Ethernet switch guidelines, refer to the information provided on the Audinate website at www.audinate.com/networks-and-switches.

System Installation

The installation phase should ensure that the interaction among designer, installer, programmer, and end user is considered in all installation decisions.

Endpoint Installation

Each DM NVX endpoint has unique installation requirements that depend on the following:

- Copper or fiber network connectivity of the endpoint
- Surface-mountable or card-based endpoint
- Configuration of a combined encoder/decoder endpoint as a transmitter or a receiver or whether the endpoint is to switch dynamically between modes
- Additional local HDMI inputs that require configuration
- Use of source autoswitching or external switching control
- Additional audio sources that require encoding
- USB device or host functionality
- Whether the endpoint is part of a video wall or goes to multiple identical displays
- Requirement for serial or IR control or both

A Crestron touch screen can be linked through a spare LAN port on an endpoint.
An audio input/output port can be repurposed to be a balanced line input for external analog audio input or for line output to a speaker system at the endpoint.
The endpoint features and attached devices can be configured through programming or through the web interface.

Depending on the location of the control processor, serial and IR control of endpoint devices may be routed directly from that control processor. Access to HDMI and USB inputs and outputs can be provided through Crestron HDMI breakout devices for tabletops and walls.

Surface-mountable endpoints can be mounted in any orientation as required. Typical locations for surface-mountable endpoints include inside closets and drop ceilings, underneath tables, and in podiums. The specific location is determined by the following factors:

- Length of HDMI and USB cable runs
- Location of display and audio devices, network connectivity, power for the device, and physical security requirements

Serial and IR connectivity can be run at longer lengths and are typically not drivers of the endpoint mounting location.

For card-based endpoints, the DMF-CI-8 card chassis is placed in a closet or locked rack near the source and display devices. (To ensure that the environmental conditions in the rack meet the specifications outlined, refer to the DMF-CI-8 product page on the Crestron website.)

Serial and IR interfaces are not provided by card-based endpoints. The functionality must be provided by other means, such as through a local Crestron control processor on the DM NVX network.

For a maintenance-free installation, follow these guidelines:

- While considering cable distances, plan the optimum location for the surface-mountable or card-based endpoint—especially when distance-limited HDMI cables are involved.
- Avoid direct access to the endpoint by the end users. End users can induce failures or create a security risk due to unauthorized network access. Ensure that HDMI cables and wall plates are routed away from the endpoint appropriately.
- Use Category 2 certified HDMI cables to meet the minimum HDMI specifications at 4K or 1080p and to prevent problems such as degradation or loss of video or audio.
- Use properly terminated network cables. Network cabling must be either of the following:
  - Fiber that is terminated with a clean LC connector
  - Shielded or unshielded Cat 5e or higher copper cable that is terminated with an RJ-45 connector
- Observe the minimum bend radiuses and pull forces of cables to maintain cable integrity and prevent failures.
- Use plenum-rated cables in plenum spaces. Cables such as Crestron DigitalMedia™ plenum-rated cables are suitable. Fire-rated conduit for any fiber or copper cabling used in plenum spaces is also suitable.
- Practice good cable dressing—especially for card-based endpoints in racks.
- Manage EDID and HDCP proactively. For additional information, refer to the Crestron DigitalMedia System Design Guide (Doc. 4546) at www.crestron.com/manuals.

- HDR and deep color sources may not display correctly on endpoints with non-HDR or non-deep color displays. Ensure that the capabilities of the sources are matched to the capabilities of the displays.
- Use descriptive names for endpoints either through the DM NVX web interface or by replacing the default name in the Crestron Toolbox™ software. Do not rely on the default name or the Crestron IP ID.
- Physically secure the endpoint to a fixed point or rack to prevent movement over time. Secure all mounting points and mounting hardware for surface-mountable endpoints, card chassis, and card-based endpoints.
- Leverage use of the DM NVX Director server for endpoint configuration. The presence of a DM NVX Director server makes it easy to configure and control multiple DM NVX endpoints on the network.
- Thoroughly document the installation of endpoints—including drawings, lists, and descriptions—in order to provide detailed information for those who are to maintain or upgrade the DM NVX network.

Network Installation

The installation of a DM NVX network varies greatly depending on a number of factors, including the following:

- Whether existing network infrastructure such as switches and cabling are to be reused
- Location of closets, racks, Intermediate Distribution Frames (IDFs), and Main Distribution Frame/Combined Distribution Frame (MDF/CDF) relative to the endpoints

For optimal installation and maintenance of the DM NVX network, follow these best practices:

- Use or repurpose existing infrastructure in DM NVX network installation cases.
- Use physical security for the network. Secure all network locations (MDF/CDF and IDF down to individual closets) from unauthorized access.
- Disable any unused ports on the network switches.
- Use a structured cabling approach such as those described in the TIA/EIA-568 standard. Include keystones in jacks and patch panels, shielded or unshielded solid copper conductor cable not exceeding 295 ft (90 m), and patch cables not exceeding 33 ft (10 m) to connect between patch panels. Use cable testers to verify the integrity of the installation and capacity for future expansion and backup.
- Use Crestron switch configuration files.
- Configure the routing of external servers. If nondedicated DHCP, RADIUS, Active Directory, or other servers are used, ensure that the servers access the DM NVX network.
- Thoroughly document all DM NVX network hardware and configurations.

Crestron Service Provider Handoff

Consult the Crestron Service Providers (CSPs) once the DM NVX network and endpoints are installed and interconnected. Typical activities of a CSP in a DM NVX installation may include the following:

- Writing appropriate control programs for controllers on the network
- Programming appropriate serial and IR control for endpoint devices
- Configuring external analog and digital audio source input and output
- Configuring video walls
- Designing button and UI features for control surfaces such as touch screens and switches
- Managing EDID for endpoint devices

As CSPs implement and deploy the program, installers and designers should test and review the functionality. The programmer must document the program functionality to avoid future issues.

Case Studies

This section provides the following case studies using DM NVX products:

- Case Study 1: Community College 4K AV Distribution Network
- Case Study 2: 4K Residential AV Distribution Network
- Case Study 3: 4K AV Distribution over Fiber

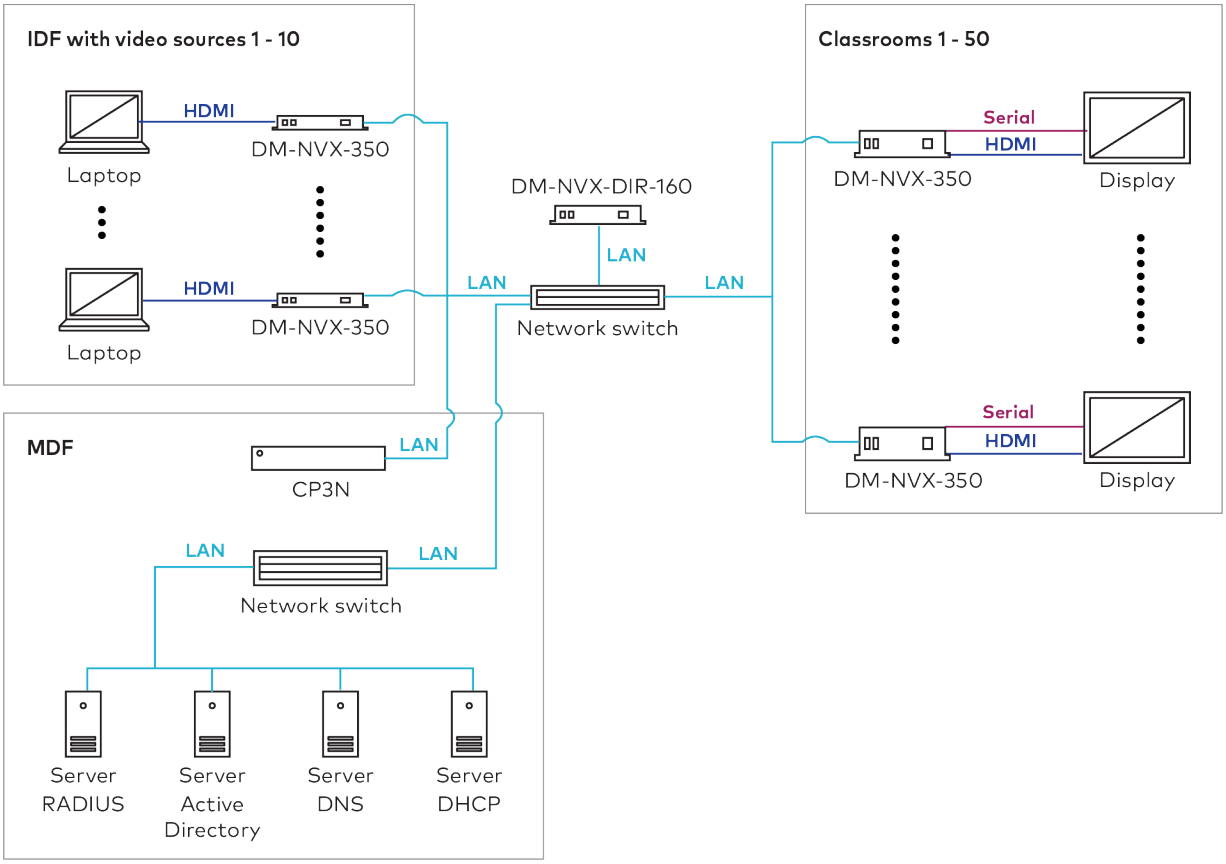
Case Study 1: Community College 4K AV Distribution Network

A client wants to distribute ten 4K HDMI video sources located in an IDF closet to 50 classrooms at a community college. More classrooms and 10 video sources are to be added in the future. The existing network cabling infrastructure is to be used—only the network hardware is required. External sound bars must be used for audio output at the displays.

Solution:

- The Crestron design is based on the use of DM-NVX-350 encoders and decoders and the DM-NVX-DIR-160:
  - Ten DM-NVX-350 encoders with video source connections are located in the IDF closet.
  - Each of the 50 classrooms has a DM-NVX-350 decoder that connects to a display. The DM-NVX-350 decoders feed video to the displays and provide serial control of the displays.
  - A DM-NVX-DIR-160 is used to set up, control, and monitor the DM NVX system. The DM-NVX-DIR-160 also provides the capability to add classrooms and ten video sources in the future.
- Using a star network topology, any source can be routed to any destination.
- The system can be controlled via the Crestron App for mobile and tablet devices.
- A Crestron CP3N control processor is installed in the MDF closet to provide centralized control for the entire system. Since no additional external control from the control processor is necessary, the processor connects directly to the network switch.
- A nonblocking network switch is used. The network switch has enough ports for 10 video source endpoints and 50 video display endpoints. In addition, the network switch can be reconfigured to support an additional 10 sources.

Case Study 1 Solution Diagram



Case Study 2: 4K Residential AV Distribution Network

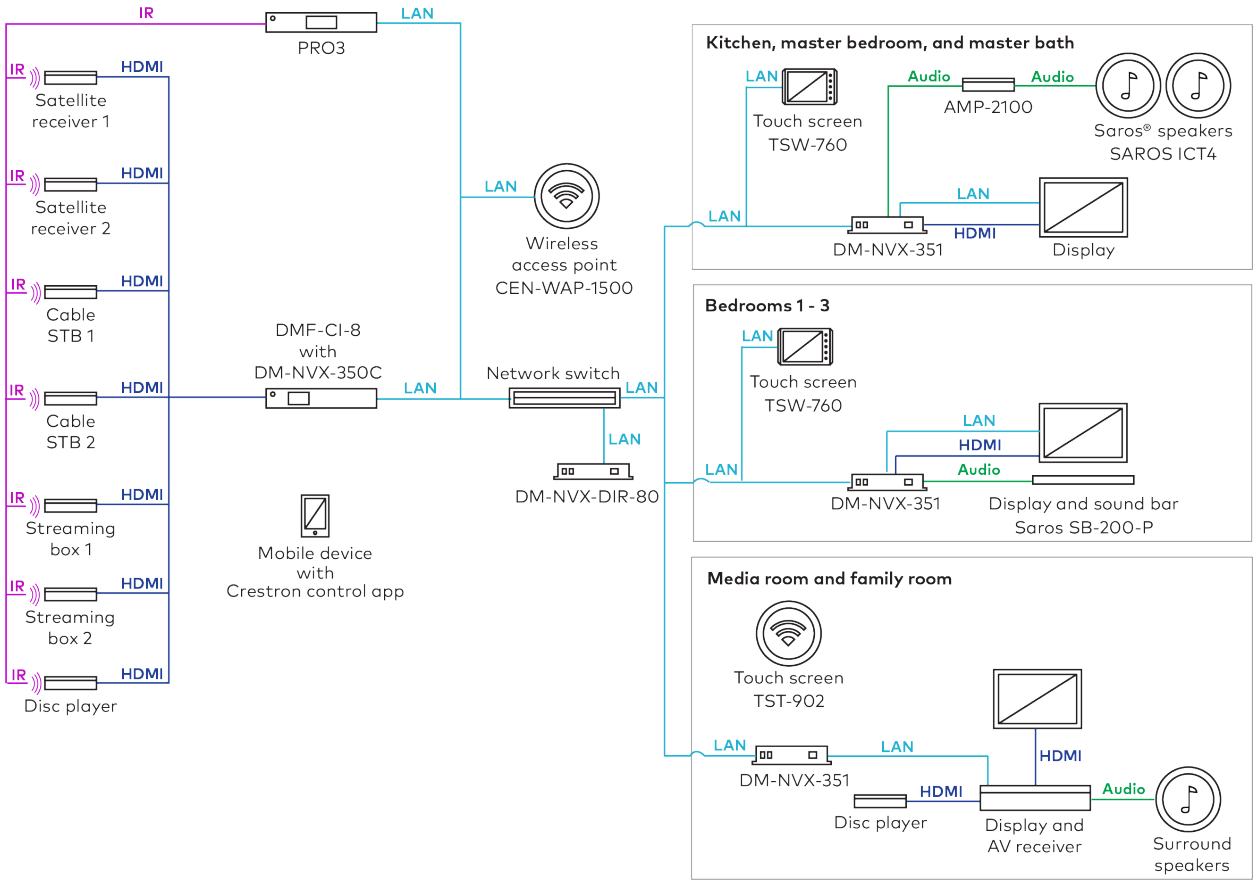
A privately owned home needs a retrofit 4K video distribution system. Sources are located in the basement rack room and are distributed to TV and surround sound receiver locations throughout the house. The desired system requires two satellite receivers, two cable set-top boxes (STBs), two streaming boxes, and one disc player. The media room and family living room require surround sound systems with a local 4K HDR Blu-ray™ player and 4K HDR displays. All other rooms require external speakers with stereo output. The kitchen, master bedroom, and master bathroom require in-ceiling speakers. Touch screens are the desired control surfaces. The media room and family living room are not able to have wire runs for the touch screens—only local power is available. Existing network infrastructure can be reused.

Solution:

- The Crestron design is based on the use of DM-NVX-350C cards as encoders, DM-NVX-351 surface-mountable endpoints as decoders, and the DM-NVX-DIR-80:
  - Seven DM-NVX-350C cards are installed in a DMF-CI-8 chassis in the basement rack. Each of the seven video sources in the basement rack room connects to a DM-NVX-350C encoder.
  - The kitchen, master bedroom, and master bathroom each have a DM-NVX-351 decoder that connects to a display and provides audio downmixing. The stereo line audio output of a DM-NVX-351 connects to a two-channel amplifier with two Crestron Saros® IC4T in-ceiling speakers per room.
  - Bedrooms 1, 2, and 3 each have a DM-NVX-351 decoder that connects to a display and provides audio downmixing. The stereo line audio output of a DM-NVX-351 connects to a Crestron Saros SB-200-P sound bar.
  - The media room and family room each include a surround sound system that connects to a DM-NVX-351. The HDMI OUT from a surround sound system connects to a display. In-room speakers connect to the surround sound system.
  - A DM-NVX-DIR-80 is used to set up, control, and monitor the DM NVX system.
- The kitchen and three bedrooms each use a TSW-760 touch screen. The rooms can also be controlled using the Crestron App for mobile and tablet devices.
- Due to a cable routing constraint, the media room and family room each have a TST-902 wireless touch screen for control. The rooms can also be controlled using the Crestron App for mobile and tablet devices.
- A Crestron PRO3 control processor with expansion cards controls the entire system by providing IR and other peripheral control.

- Using a star network topology, any source can be routed to any destination.
- A Crestron specified network switch is used. The network switch has enough ports for seven video source endpoints and five video display endpoints. In addition, the network switch can be reconfigured to support future expansion for newer sources.

Case Study 2 Solution Diagram



Case Study 3: 4K AV Distribution over Fiber

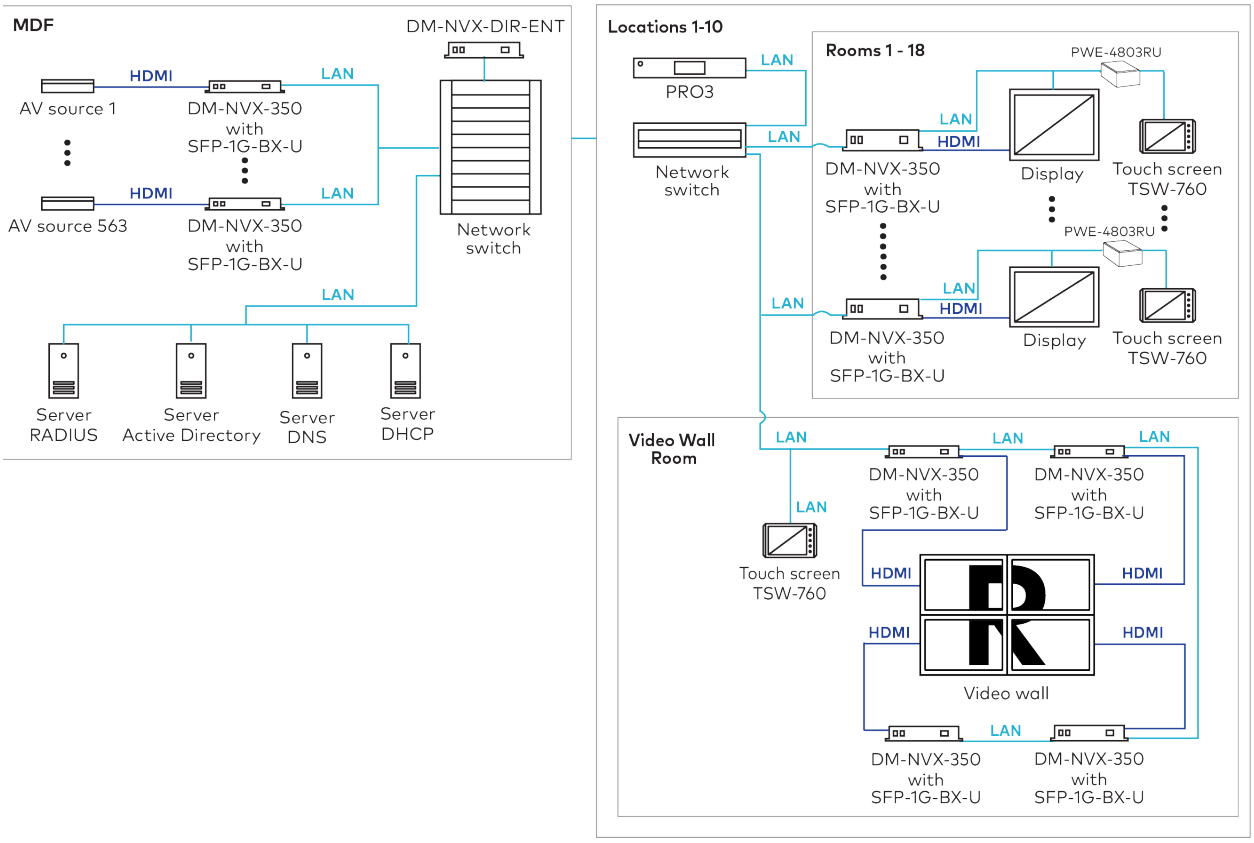
A client requires 4K AV distribution of 563 sources that are co-located at the MDF for 10 different locations on a campus up to 0.8 km (0.5 mi) from the MDF. Each location contains 18 separate displays and four 2 x 2 video walls across multiple rooms. The client needs to use a fiber-optic network for all video distribution. All device logins must be tied to the campus Active Directory, DHCP, and 802.1X services for policy reasons. Core redundancy is required to minimize campus-wide disruptions. Users must be able to switch between sources at any display independently.

Solution:

- The Crestron design is based on the use of DM-NVX-350 endpoints as encoders and decoders, a fiber-optic network across a large MDF, and the DM-NVX-DIR-ENT:
  - Endpoints consist of 563 DM-NVX-350 encoders at the MDF, 180 DM-NVX-350 decoders for the rooms, and 40 DM-NVX-350 decoders for the 2 x 2 video walls in the 10 locations (4 decoders for each location).
  - Single-mode 1310 nm/1490 nm fiber is used. The network switches are configured using SFP 1G BX downlink modules, and the DM-NVX-350 encoders and decoders use SFP-1G-BX-U uplink modules for fiber connections.
  - A DM-NVX-DIR-ENT allows fiber to be used for the DM NVX system. The DM-NVX-DIR-ENT is used to set up, control, and monitor the DM NVX system.
- A Crestron PRO3 control processor is used in each of the 10 locations.
- A TSW-760 touch screen is used in each of the 18 rooms across 10 locations, totaling 180 touch screens. In addition, a TSW-760 touch screen is used for each video wall room in the 10 locations, totaling 10 touch screens that provide user control of the entire system. Each touch screen is powered by a Crestron PWE-4803RU PoE injector.
- A tree architecture requires a minimum core switch bandwidth of 252 Gbps for 563 encoders and 252 (180 + 72) decoders. The existing core switch is capable of 1 Tbps and will be reused and reconfigured for 1 Tbps as required.
- Each of the 10 locations requires 22 DM-NVX-350 decoders to provide a nonblocking switch with at least 22 free ports.
- The network switches are configured to route the campus RADIUS server for 802.1X, the campus Active Directory server for login authentication at each endpoint, the campus DNS server for name assignment, and the campus DHCP server for IP assignment and MAC filtering; similarly, the endpoints are configured to utilize these services.

- Four of the 22 DM-NVX-350 decoders in each of the 10 locations are daisy chained to connect the decoders in the video wall rooms. The 3-port switch of the DM NVX endpoints consists of the following connections:
  - SFP-1G-BX-U connection to the edge switch
  - RJ-45 connection used in the daisy chain to connect the other video wall endpoints
  - RJ-45 connection to the TSW-760 touch screen for video wall room control

Case Study 3 Solution Diagram



Glossary

802.1P: A network quality of service labeling protocol that assigns a number from zero to seven to determine network traffic priority; defined in IEEE 802.1P-1998

802.1Q: A network protocol that allows for VLANs and tagging of VLAN traffic and enables 802.1P to provide quality of service features; defined in IEEE 802.1Q-2014

802.1X: A network control protocol to authenticate devices connected to an Ethernet network on a port-by-port basis by encapsulating the Extensible Authentication Protocol; defined in IEEE 802.1X-2010

Active Directory: An application protocol developed for Microsoft® Windows® networks that authenticates and authorizes users and devices using login mechanisms and also stores and controls additional information on the network regarding users and resources

Core: The central point of a network from which all network devices and intermediate infrastructure are normally accessible

Closet: The distribution point for networking infrastructure localized to a floor or group of rooms

Dynamic Host Configuration Protocol (DHCP): A network protocol that distributes network parameters such as IP addresses through a server to clients requesting them; defined in IETF RFC 2131

Domain Name System (DNS): A system of naming computers on a network that have numerical IP addresses; defined across multiple IETF RFCs starting with IETF RFC 1034

Domain Controller: A server-running domain service such as AD or LDAP

Extensible Authentication Protocol (EAP): A protocol for authentication of point-to-point network connections using multiple methods including TLS and MS-CHAP v2; defined in IETF RFC 3748 and IETF RFC 5247

Edge: The endpoint of a network connection that allows end device interconnection with the network

Extended Display Identification Data (EDID): A data structure usually communicated over HDMI and DVI interfaces between audio/video sources and displays to identify the capabilities of the devices on the link; defined in VESA EDID Version 3 and EIA/CEA-861

Intermediate Distribution Frame (IDF): The signal distribution frame that allows interconnection between the main distribution frame and premises closets

International Electrotechnical Commission (IEC): A nonprofit organization that publishes standards regarding electrical and electronic standards

Institute for Electrical and Electronics Engineers (IEEE): A nonprofit organization that publishes electrical and electronics standards particularly for network communication through the IEEE 802 family of standards

Internet Engineering Task Force (IETF): A standards organization that establishes and maintains voluntary standards for Internet networking globally

Internet Group Management Protocol (IGMP): A network protocol that allows multicast traffic to pass over adjacent routers on an IPv4 network; defined in IETF RFC 2236 for v2, and IETF RFC 3376 and IETF RFC 4604 for v3

Internet Protocol (IP): A communications protocol that relays information across network boundaries between addresses; defined in IETF RFC 791 for IP version 4

Infrared (IR): A method of providing device control using light waves just beyond the range of red light

International Standardization Organization (ISO): A nongovernmental organization that publishes standards on all topics for international use, including audio and video compression standards; works jointly with the IEC to develop certain standards such as JPEG 2000

JPEG: An acronym for Joint Picture Experts Group

Media Access Control (MAC): A 48-bit address in the Ethernet protocol that establishes the unique physical device in a network that is routed to or from that physical device

Main Distribution Frame (MDF): The signal distribution frame for networking that connects premises physical plant equipment to outside physical plant equipment

Moving Picture Experts Group (MPEG): A working group of the ISO and IEC that sets standards for audio and video compression and related technologies

Microsoft Challenge-Handshake Authentication Protocol (MS-CHAP): A network authentication protocol that is used for network devices by RADIUS servers. MS-CHAP is defined in IETF RFC 2433 for MS-CHAP v1 and IETF RFC 2759 for MS-CHAP v2.

Multicast: One-to-many data transfer that allows scalable distribution of audio and video in an efficient manner

Multi-Protocol Label Switching (MPLS): A labeling protocol for network traffic such that short labels rather than long network headers are used to route traffic appropriately; defined in IETF RFC 3031

Network Topology: The layout of a network as it would appear visually in a simplified form

Protocol Independent Multicast–Sparse Mode (PIM-SM): A protocol for routing multicast traffic such that the routes are optimized and effectively prevent flooding of uplinks in network infrastructure; defined in IETF RFC 7761

Plenum: Part of a building where heating, ventilation, and air conditioning are provided

Public Key Infrastructure (PKI): A set of procedures and policies for the different roles required in securely managing digital certificates and the infrastructure used to exchange both asymmetric encryption keys and symmetric encryption keys

Quality of Service (QoS): A performance improvement feature that prioritizes more important network traffic over less important traffic in a network switch

Remote Authentication Dial-in User Service (RADIUS): A network protocol that provides authentication, authorization, and accounting for network devices and users in a secure way, especially for IEEE 802. 1x protocol, and deployed in a client-server model; defined in IETF RFC 2865 and IETF RFC 2866

Request For Comments (RFC): A standards publication from the IETF

Real-time Transport Protocol (RTP): A network protocol for the actual delivery of audio and video streaming media; defined in IETF RFC 3550

Rapid Spanning Tree Protocol (RSTP): A network control protocol for discovering and accounting for network loops and redundancies; defined in
IEEE 802. 1d-2004

Real-Time Streaming Protocol (RTSP): A network control protocol for streaming media to establish and control streaming audio and video sessions between endpoints; defined in IETF RFC 7826

Secure Shell (SSH): A protocol utilizing cryptography that secures network services such as a command line shell; defined across a number of IETF RFCs beginning with IETF RFC 4250 by the IETF SECSH working group

Structured Cabling: A standard for developing network and cable infrastructure; defined in TIA/EIA-568

Symmetric Encryption: An algorithm or method of using cryptography such that a single key is used for both the encryption and decryption of information to be protected

Transport Layer Security (TLS): A protocol implementing cryptographic security on a computer network; defined in IETF RFC 5246 and IETF RFC 6176

Transport Stream (TS): A media format that encapsulates audio, video, synchronization, and other information for transport; defined in ISO/IEC 13818-1

Universal Datagram Protocol (UDP): A protocol that transfers information over an IP network in a connectionless way such that data delivery is not guaranteed yet prevents the lack of a verified and established connection to prevent data delivery; defined in IETF RFC 768

Unicast: A one-to-one delivery protocol that is simple but not scalable for multipoint audio and video distribution

Virtual Local Area Network (VLAN): A nonphysically sequestered broadcast domain or partition isolated at the data link layer, effectively sequestering switch ports and network traffic across one or more switches from all other ports and traffic

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Specifications are subject to
change without notice.