Crestron® DigitalMedia™ System

Design Guide

Crestron Electronics, Inc

This document was written by the Technical Publications department at Crestron.

Contents

Introduction

The DigitalMedia system is a complete transportation, switching, and distribution system for digital, analog, and streaming video. It is the only fully engineered, field-proven end-to-end digital solution that supports emerging technologies.

Crestron Electronics, Inc. started designing products with HDMI® technology over ten years ago and has shipped more than 60,000 DigitalMedia systems including more than 1.5 million HDMI ports over the last eight years. The DM® system is the only solution for the digital age, distributing all analog and uncompressed HD digital signals and managing embedded data, such as HDCP, EDID, and CEC.

DM matrix switchers are flexible, modular systems that can accept virtually every signal type and transmit them long-distance as digital DM signals. The built-in exclusive QuickSwitch HD™ technology maintains a constant handshake for continuous, glitch-free HD switching. At the endpoints, DM receivers output HDMI and control to the display.

Purpose of this Guide

The purpose of this design guide is to provide the following:

- DM solutions for HD distribution issues
- Detailed information to assist in the design of the HD media distribution system
- A functional background on how HD, specifically HDMI, is constructed and transmitted
- Information on what Extended Display Identification Data (EDID) is and how to design a DM system with EDID

DigitalMedia Overview

DigitalMedia distributes uncompressed digital audio and video signals over UTP (unshielded twisted pair) copper wire or fiber optic cable. A full selection of switcher input cards, transmitters, and room controllers (receivers) provides extensive connectivity throughout the installation, supporting a complete range of analog and digital signal types. DigitalMedia intelligently manages all of the different signals and devices, matching each source's output to the capabilities of the selected display(s).

DigitalMedia is ready for the future with switching support for 4K Ultra HD built in. The DM product line features a complete range of devices to enable reliable 4K matrix switching using Crestron 4K certified sources and displays

Crestron HDMI extenders and switchers are fully 4K compatible. DM streaming capabilities enable high-definition signal distribution over an existing infrastructure, removing any distance limitations and allowing for the routing of signals wherever new wires cannot be run. Ideal applications for DM streaming include digital signage, mobile device connectivity, and signal routing between buildings or global offices.

NOTE: For more information on 4K, refer to the 4K White Paper on the Crestron website.

NOTE: For additional DigitalMedia related information, refer to the Crestron True Blue Online Help.

DigitalMedia supports the following:

- Distribution of uncompressed digital audio and video over UTP wire or fiber
- HDMI and 7.1 channel HD lossless audio
- Video resolutions up to 4K Ultra HD
- Full 1080p60 up to 330 ft (100 m) without repeaters using standard CAT5e cable (or better) and 4K up to 230 ft (70 m)
- Multimode fiber for distances up to 1000 ft (300 m)
- Single-mode fiber for distances up to 7.5 miles (12 km)

DigitalMedia Signal Support

Video	Audio	Data
HDMI Component (YPbPr) S-video Composite RGBHV HD-SDI DVI Display Port	2-, 6-, or 8-channel PCM DTS-HD Master Audio™ codec Dolby® TrueHD codec S/PDIF 2-Channel Analog	Ethernet IR RS-232 USB HID Crestron Control

DigitalMedia Features

DigitalMedia is installer friendly and provides a flexible choice of input and output cards. It expands easily to serve the most demanding multiroom solution. Advanced troubleshooting tools can be accessed via the front panel, Crestron Toolbox™ software, and control system to identify potential problems with HDCP keys and handshaking, CEC control, video resolutions, USB, wiring, and audio format issues. DigitalMedia accommodates legacy AV systems, provides a zero-latency solution, and drives full HD content without compression or resolution loss.

Computer Compatibility: DigitalMedia handles every available HDTV format supported by HDMI and also supports the distribution of DVI and RGB computer signals. It is also fully compatible with computer signals up to 2560x1600 @ 60 Hz and 4Kx2K @ 30 Hz.

USB HID Switch: DigitalMedia centralizes more than just television receivers and Blu-ray™ changers. It also centralizes other HD sources like media servers and computers. Built-in USB HID signal routing allows USB HID compatible keyboards and mice to be connected at each display location, extending their signals to the centralized equipment via USB HID ports provided on select switcher input cards.

EDID Format Management: When using varied AV sources, there can be a multitude of confusing video and audio formats to keep track of, and not every device in the system supports all of the same formats. DigitalMedia eliminates such conflicts by managing the EDID that modern digital devices use to communicate their capabilities. Using Crestron Toolbox software, the format and resolution capabilities of each device can be assessed which allows the installer to configure EDID signals appropriately for the most desirable and predictable behavior. For more information on EDID, refer to “EDID Design” on page 52.

QuickSwitch HD Technology: Many content providers are using HDCP. HDCP is a copy-protection scheme designed to protect content against unauthorized copying and requires the source device to authenticate every display and signal processor through an HDMI connection before delivering an output signal. This process occurs every time any HDMI signal is switched, causing a complete loss of signal for up to 15 seconds whenever a new source or display is selected anywhere in the house. Crestron QuickSwitch HD technology eliminates this issue by maintaining a constant HDCP connection with each HDMI device in the system. By eliminating the need to reauthenticate each time a different source or display is selected, QuickSwitch HD achieves very fast switching of HDMI signals.

HDCP Key Management: HDCP uses keys to manage the handshaking that occurs between any two devices. Every HDMI source device supports a limited number of downstream devices as determined by the number of HDCP keys available. The number of HDCP keys is rarely advertised or specified by the manufacturer or service provider; therefore, without warning, the source simply stops outputting a signal when connected to too many displays or processors. DigitalMedia handles all key management, providing fully encrypted data to any number of displays simultaneously.

Auto-Locking® Technology: Crestron Auto-Locking technology enables superfast signal switching by instantaneously configuring every device in the signal path, including DM transmitters, DM receivers, and scalers, as soon as the signal hits the first device. When the devices are switching between sources or TV channels, Auto-Locking significantly reduces the time it takes each device to sense the new signal and configure itself to handle the changes, virtually eliminating any noticeable gap while switching.

CEC Signal Management: The primary objective of every Crestron system is to precisely enable the control desired for a seamless user experience. To ensure this outcome, DM switchers intercept the CEC signals that many HDMI devices automatically generate, preventing any unwanted commands from being executed. Through proper CEC management, DigitalMedia can control each device.

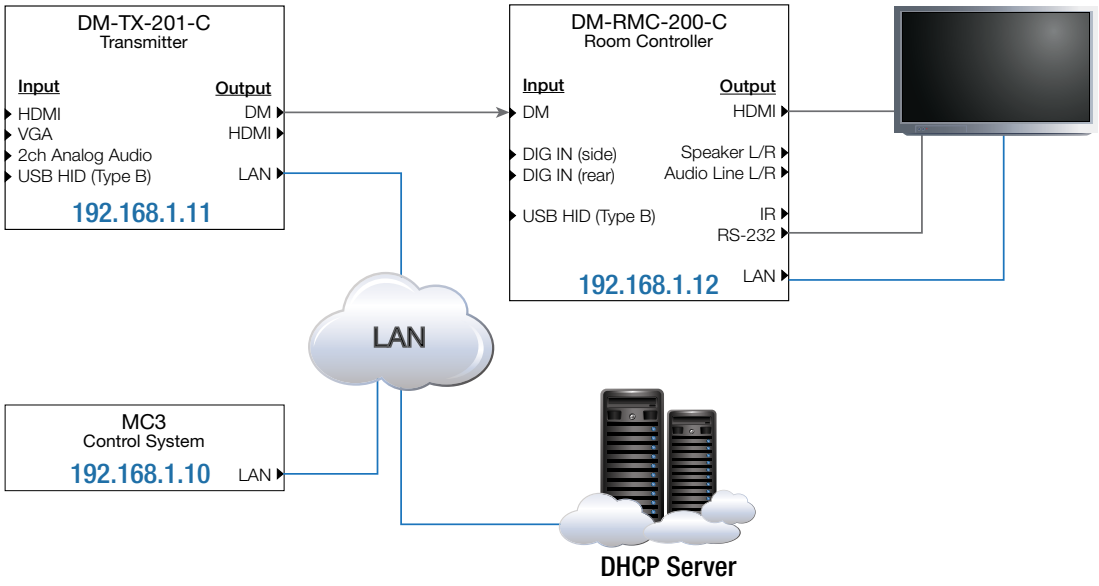
Ethernet Integration

DigitalMedia provides an Ethernet transport method in addition to HDMI, control, and USB HID transport. DM carries 10/100 Ethernet to each room controller and transmitter, supporting streaming media for multimedia devices or providing LAN connectivity for any room device that requires Ethernet or Internet access. Its Gigabit Ethernet connection to the external LAN helps maximize bandwidth for each network port.

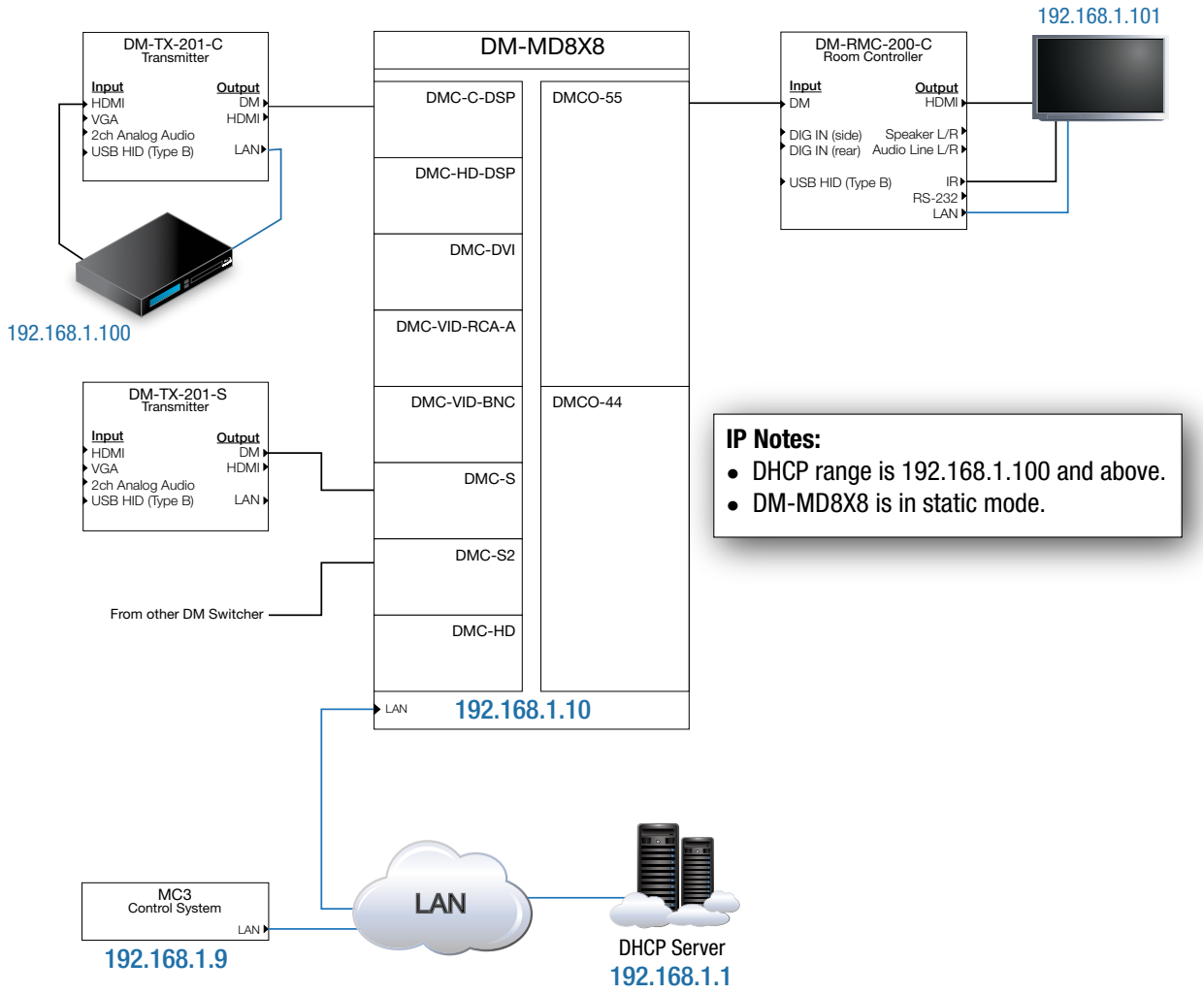
All DM products are Ethernet devices. Ethernet is transported via every DM connection. When using a DM switcher at the core of the system, the Ethernet uplink occurs at the switcher. Ethernet is distributed to the transmitter(s) or room controller(s) via the integrated 10/100 Ethernet switch contained in the switcher, making separate LAN connections unnecessary.

Private Network Mode (PNM) simplifies deployment and configuration by moving all DM endpoints to a private LAN, leaving only a single IP address to be assigned on the public network. For more information on PNM, refer to “Appendix A: DigitalMedia Network Considerations” on page 55.

Point-to-Point Systems



Switcher Based Systems



DM room controllers come fully equipped with an integrated Ethernet switch. A spare courtesy Ethernet port is connected to a DM switcher. This port can be used for connecting other Ethernet devices. When a device (other than a DM device) is connected to a DM courtesy port, the Ethernet connection is passed transparently through the DM network as though that device is connected directly to the public LAN.

In a point-to-point scenario, the Ethernet port can be used as an uplink to the main network. For example, if a system contains a DM-TX-200-C-2G and a DM-RMC-100-C, the DMC-RMC-100-C must serve as the uplink point, since the DM-TX-200-C-2G does not provide an Ethernet port. If the DM-TX-200-C-2G is replaced with a DM-TX-201-C or DM-TX-401-C, the Ethernet uplink can occur at either the transmitter or the room controller since both of these devices have an available Ethernet port.

NOTE: In point-to-point systems, only one of the devices should connect to the main network. In systems with switchers, the switcher should be the only device connected to the network. Refer to "Appendix B: DM Cable Plant Certification" on page 60.

NOTE: With PNM enabled, these endpoint courtesy ports must never be connected to the public LAN to which the DM switcher is connected.

HD-DTDS Specification and DM Certified Training

Crestron provides the definitive design, installation, and commissioning specification to guarantee the reliable performance of DigitalMedia systems. The specification establishes an industry standard, and the DM Certification program ensures that AV professionals are fully educated and adhere to the standard. The HD Digital Transport and Distribution System (HD-DTDS) specification and corresponding coursework set a high benchmark for digital AV systems.

HD-DTDS Specification

The HD-DTDS specification defines the critical aspects of system design and installation to assure reliable system performance. Crestron guarantees and fully supports any DM system installation that conforms to the HD-DTDS standards. Specifiers who use this DM HD-DTDS specification guarantee their customers that the design is finalized by a DMC-E-4K, ensuring proper system installation and configuration of HDCP, video, resolution management, cabling, and cabling distance.

DM Certified Designer - 4K (DMC-D-4K

In this free online course, the fundamental differences between analog and digital systems are covered including the unique design considerations to ensure reliable system operation for a 4K distributed system. If the attendee is a DM Certified Designer (DMC-D-4K), an online refresher course must be completed in order to add DMC-D-4K certification credentials. The course concludes with an exam that must be passed to earn DMC-D-4K certification. DMC-D-4K is a prerequisite for the DMC-E-4K course.

DM Certified Technician - 4K (DMC-T-4K)

This is a hands-on class for AV professionals who install systems or need a deeper understanding of installation requirements. Attendees are trained on all copper and fiber termination options available for DM systems and cable plant certification. Upon course completion, the attendee is able to install and test the performance capabilities of a DM system. The course concludes with a practical exam that must be passed to earn DMC-T-4K certification. A nonwaivable $300 course fee is required.

DM Certified Engineer - 4K (DMC-E-4K

This rigorous three-day program includes DMC-D and DMC-T Certification, and details every aspect of system installation and commissioning. Only a DMC-E-4K is qualified to fully execute and support a DM project. A DMC-E-4K demonstrates proficiency in system setup, diagnostics, testing, and reporting. Only Crestron dealers with a DMC-E-4K on staff can bid on projects designed using the HD-DTDS. If the attendee is a DM Certified Designer (DMC-D-4K), a free online refresher course must be completed in order to add DMC-E-4K certification credentials. A nonwaivable $1,000 course fee is required.

Courses fill up fast, so reserve a seat today. There is a limit of two people per company per class.

For more information, refer to the HD-DTDS Specification and DM Certified Training on the Crestron website.

Crestron 4K Certification Program

To ensure that installations run smoothly, Crestron has introduced a 4K Certification program. Under this program, manufacturers submit their 4K sources and displays to Crestron. Crestron ensures that the 4K sources and displays do the following:

- Deliver true 10 Gbit/s data rates to get the signal to its destination
- Interface with DigitalMedia to handle cable lengths found in integrated AV systems
- Work with other 4K products in a DigitalMedia system

Crestron 4K Certification guarantees that certified sources and displays meet the demands of a 4K distributed system. Crestron engineers in the DigitalMedia lab rigorously test 4K products to ensure they work in a matrix-switched environment. Only those that do are awarded the Crestron 4K Certified logo.

NOTE: For more information on 4K, refer to the 4K White Paper on the Crestron website.

Infrastructure Choices

Because of modular input and output cards, DM systems are able to offer several different ways of transporting signals: H.264 Ethernet streaming, DigitalMedia 8G+® fiber (DigitalMedia over a single CAT5e or better UTP or STP), and DigitalMedia 8G™ fiber (DigitalMedia over a single strand of multimode fiber).

NOTE: DM 8G® and DM 8G+® products are recommended for new installations.

Comparing Copper and Fiber Transports

DigitalMedia uses twisted pair and fiber cabling to transport its signals.

Copper and Fiber Benefits

Cable Type	Copper	Fiber
Maximum Distance	Up to 330 ft (100 m)	Up to 1000 ft (300 m) with multimode fiber Up to 7.5 miles (12 km) with single-mode fiber
Benefits	• Familiar • Readily available • Inexpensive • Preexisting infrastructure	• Long transmission distance • Not susceptible to EMI • Armored jacket available • Extremely high bandwidth • Easy to terminate

DigitalMedia Transport Technology Types

Technology	Maximum Distance	Cabling	Notes
DM Ultra Cable	Up to 330 ft (100 m)	CAT7a	-
DM 8G+	Up to 330 ft (100 m)	Single CAT5-type	Only up to 70 m for 4K
DM 8G Fiber	Up to 1000 ft (300 m)	Single strand of multimode fiber	-
DM 8G Single-Mode Fiber	Up to 7.5 miles (12 km)	Single strand of single-mode fiber	Compatible only with single-mode fiber S2 hardware (not compatible with other DM 8G fiber products)

Copper Infrastructure

When the term “copper” is used in a DigitalMedia context, it refers to twisted pair cable. With DM, choose the cable based on the application.

DM 8G+ Performance over Copper

DM 8G+ transmits high-resolution digital signals over unshielded CAT5e UTP with minimal errors. DM 8G+ technology maintains signal integrity over UTP without using compression, making it easy to upgrade existing QM, PVID, and other analog distribution systems while delivering the highest quality HD video and audio, along with Ethernet, USB HID, and control. For the best results, Crestron recommends using shielded DM 8G cable.

All DM 8G+ products are based on HDBaseT® technology, and all products are certified by the HDBaseT Alliance. This ensures the highest levels of reliability and performance and guarantees compatibility between DM 8G+ products and third-party HDBaseT devices, such as HDBaseT displays.

Shielded Infrastructure

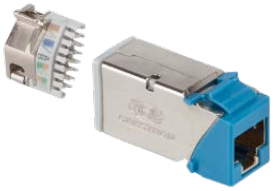
To maintain the wire shield throughout the entire cable run, be sure to use fully shielded components. The wire shield is rendered practically useless if it is not carried through the connector. Crestron DM-CONN, DM-8G-CONN, DM-8G-CONN-WG, DM-RPP-K24, and DM-CBL-ULTRA-PC are fully shielded for use with DigitalMedia. In addition, if using patch points, be sure to carry the shield through all connecting points. These include wall plates, patch panels, and patch cables.

DM-CONN

DM-8G-CONN

DM-8G-CONN-WG

DM-CONN-ULTRA-RECP

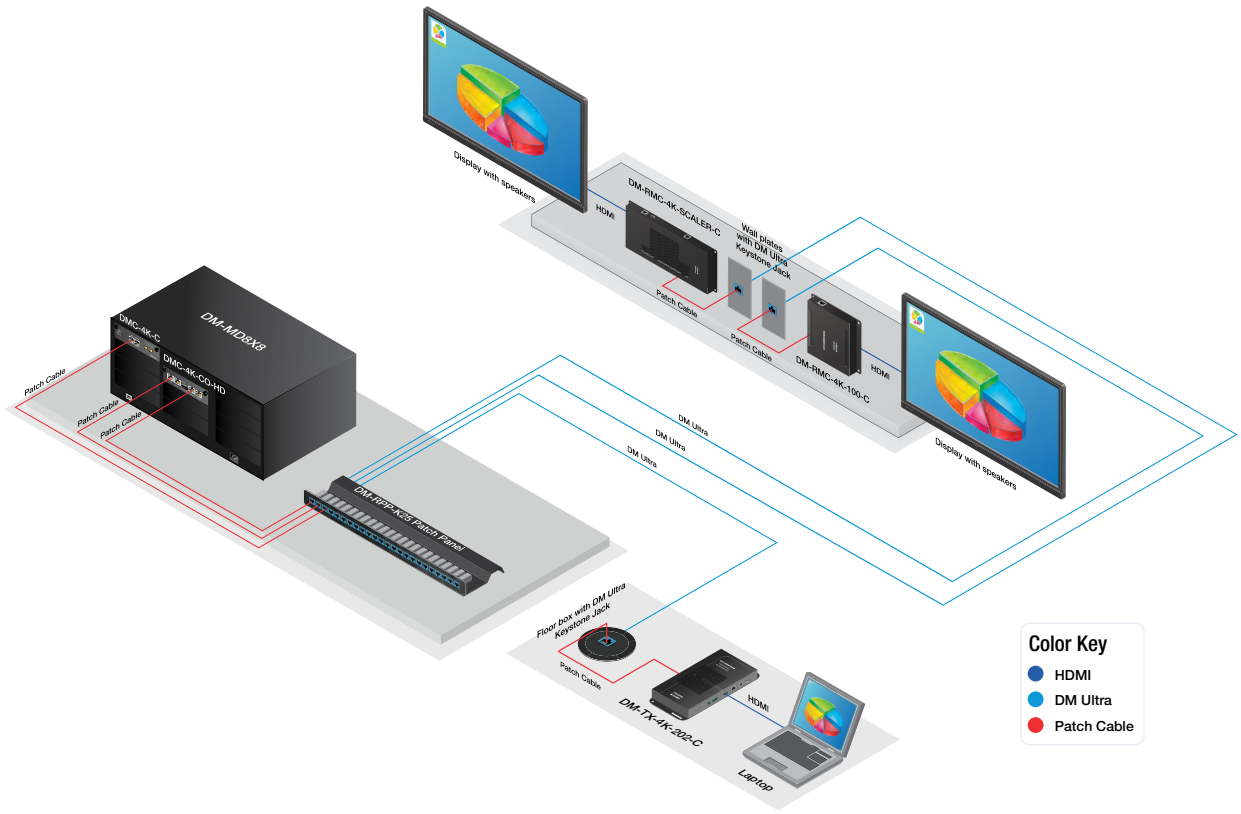


Copper Terminations and Patching

Crestron strongly recommends using telecommunications industry-standard structured cabling best practices as defined by EIA/TIA 568 and ISO/IEC 11801. The long permalink cable that runs between devices should be terminated with female receptacles (or jacks). Factory-terminated and certified patch cables should be used to connect devices to the permalink cable run. This cabling method increases system reliability and allows for cable installations to be certified according to industry-standard test procedures.

According to these practices, permalink cable runs may be up to 90 m (295 ft), and patch cables up to 5 m may be used on each side, for an overall channel length of 100 m. Be sure to take into consideration all cable bend radii as defined by the cable manufacturer.

Patching Guidelines



Crestron has a complete line of structured cabling accessories to support these best practices, as follows:

- DM-CONN-ULTRA-RECP DigitalMedia Ultra Keystone RJ45 Jack
- DM-RPP-K24 DigitalMedia 24-port Keystone Patch Panel
- DM-CBL-ULTRA-PC DigitalMedia Ultra Patch Cable

The above accessories are compatible with both DM Ultra and DM 8G cabling.

NOTE: While still officially supported, field-terminated male connections and the use of male-to-male couplers are no longer the recommended best practice.

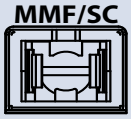
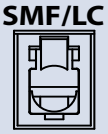
Cable Types

The table below shows the maximum cable lengths by cable type.

Resolution	DigitalMedia Ultra Cable (DM-CBL-ULTRA)	DigitalMedia 8G Cable (DM-CBL-8G)	CAT5e (or better) UTP or STP
1080p60 Full HD	330 ft (100 m)	330 ft (100 m)	330 ft (100 m)
1920X1200 WUXGA	330 ft (100 m)	330 ft (100 m)	330 ft (100 m)
1600X1200 UXGA	330 ft (100 m)	330 ft (100 m)	330 ft (100 m)
2048X1080 2K DCI	330 ft (100 m)	330 ft (100 m)	330 ft (100 m)
2560X1440 WQHD	330 ft (100 m)	230 ft (70 m)	165 ft (50 m)
2560X1600 WQXGA	330 ft (100 m)	230 ft (70 m)	165 ft (50 m)
3840X2160 Ultra HD	330 ft (100 m)	230 ft (70 m)	165 ft (50 m)
4096X2160 4K DCI	330 ft (100 m)	230 ft (70 m)	165 ft (50 m)

Fiber Infrastructure

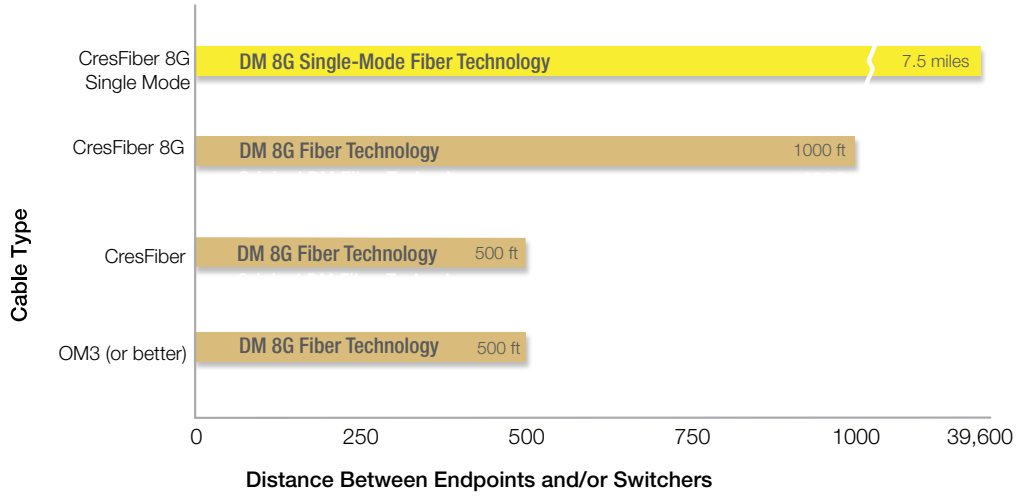
DM 8G Fiber Comparison - 8G Single-Mode vs. 8G Multimode

DM Type	DM 8G Fiber Technology	DM 8G Single-Mode Fiber Technology
Connector Details		
Example Cable		
Fiber Description	Single strand (simplex) of multimode fiber	Single strand (simplex) of single-mode fiber
Cable Requirements		
Crestron Fiber	CresFiber® 8G cable and CresFiber* cable	CresFiber 8G-SM
Third-Party Fiber	OM3*	OS1 or better
Connector Requirements	One SC 50 µm connector per end	One LC connector per end
Maximum Distance	1000 ft (300 m)*	7.5 miles (12 km)
Benefits	• One termination per end • Inexpensive fiber solution • Can use existing infrastructure	• Extremely long distance transmission • One termination per end • Can use existing infrastructure
Notes	• Requires 1 strand of multimode fiber, plus backups in the event of breakage • Crestron recommends pulling at least 2 strands to each location	• Requires 1 strand of single-mode fiber, plus backups in the event of breakage • Crestron recommends pulling at least 2 strands to each location

* Distance is limited to 500 ft (153 m) CresFiber and OM3 or better. CresFiber 8G ensures maximum transmission distance of 1000 ft (300 m).

The table below illustrates the maximum distance a DM fiber signal can run between endpoints and switchers at any resolution. Because of the abundant bandwidth of fiber, video resolution does not affect transmission distance. An endpoint refers to any device, other than a switcher, to which DM terminates from a transmitter or receiver.

Maximum DM Transmission Distance Fiber



NOTE: CresFiber (CRESFIBER) is no longer available and has been replaced by CresFiber 8G (CRESFIBER8G).

Fiber Cable Options for DM Fiber Technology

Cable Model and Type	DM 8G Fiber Multimode	DM 8G Single-Mode Fiber
CresFiber 8G	1000 ft (305 m) max distance	-
CresFiber	500 ft (153 m) max distance	-
OM3/OM4 (or better)	500 ft (153 m) max distance	-
CresFiber 8G Single Mode	-	7.5 miles (12 km) max distance
G.652.D (or better) Single Mode	-	7.5 miles (12 km) max distance

DM 3D Facts

- Most DM devices are ready to send and receive 3D video.
- 3D does not require bandwidth beyond that of a 1080p signal.
- Consult individual spec sheets for detailed compatibility with 3D.

DM 8G fiber can be patched through a panel, wall plate, or similar point. The following guidelines must be followed.

- Any number of patch points may be used as long as the entire fiber loss does not exceed 4 dB.
- Any type of fiber connector may be used in patches as long as the fiber that terminates to the DM device uses SC connectors (for DM 8G fiber) or LC connectors (for DM 8G single-mode fiber).
- For information on how to test for optical loss, refer to “Appendix B: DM Cable Plant Certification” on page 60.

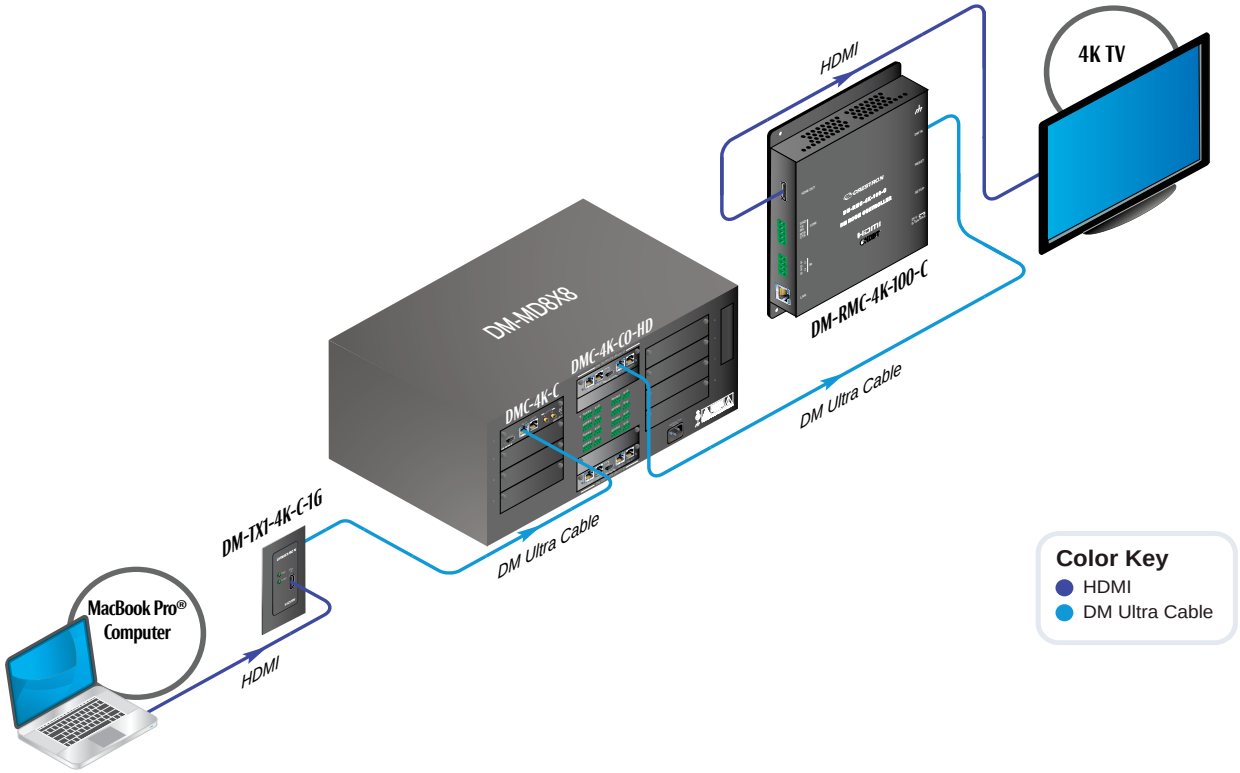
Fiber Facts

- OM3 and OM4 usually have an aqua-colored jacket.
- OM3 and OM4 have a core and cladding diameter of 50/125 µm.
- SC connectors are most common for inside-plant telecom, but recently LC connectors (only natively compatible with DM 8G single-mode products) are becoming more popular due to their smaller size.
- Intermediate patch panels and connections can use other types of connectors if necessary.

DigitalMedia and 4K

For a 4K application to work properly, each component between the source and the display must support 4K. All 1080 p and 2K signals can pass normally through 4K components. The example below shows a working 4K application.

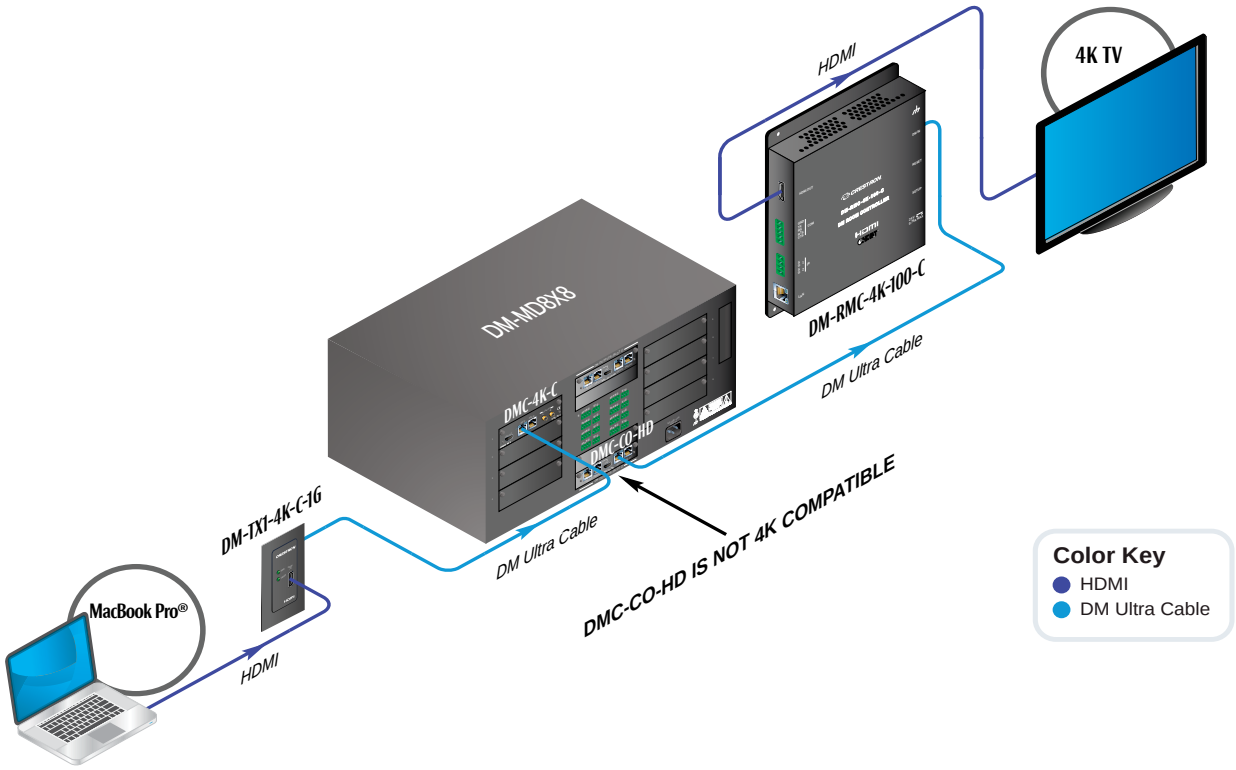
Working 4K Example



NOTE: For simplicity, patch points are not shown in the illustration above.

The illustration below shows an example of a nonworking 4K setup. The DMC-CO-HD output card, within the DM-MD8X8 switcher, is not 4K compatible and therefore cannot provide 4K signals to the display (4K TV). The source must be set to output 1080 p (or similar) to pass the signal to the display.

Nonworking 4K Example



Selecting DigitalMedia Equipment

DigitalMedia Switchers

There are four main types of DM switchers:

- Modular (card-based)
- Modular (blade-based)
- Fixed (cardless)
- DigitalMedia Presentation Systems (DMPS)

DigitalMedia Modular Switchers: Card Based

There are three DigitalMedia switcher card frames: DM-MD8X8, DM-MD16X16, and DM-MD32X32. Each switcher permits inputs to be cascaded with up to four additional switchers, increasing the number of available outputs in the system while maintaining HDCP compliance. For example, using five DM-MD16X16 switchers in a system provides a total of 80 available outputs.

DM input and output card details are as follows:

- Input and output cards must be selected upon time of order.
- Switchers are shipped pre-loaded with custom configuration.
- For the DM-MD8X8 and DM-MD32X32 switchers, input and output cards may be added and reconfigured in the field.
- For the DM-MD16X16, only input cards may be added and reconfigured in the field; output cards must be added or configured by Crestron.

NOTES:

- For power information, refer to the “DM Transmitters by Supporting Infrastructure” on page 32.
- DisplayPort Multimode connectivity is supported via an HDMI or DVI input port using a suitable adapter or interface cable (not included).

What is RPS?

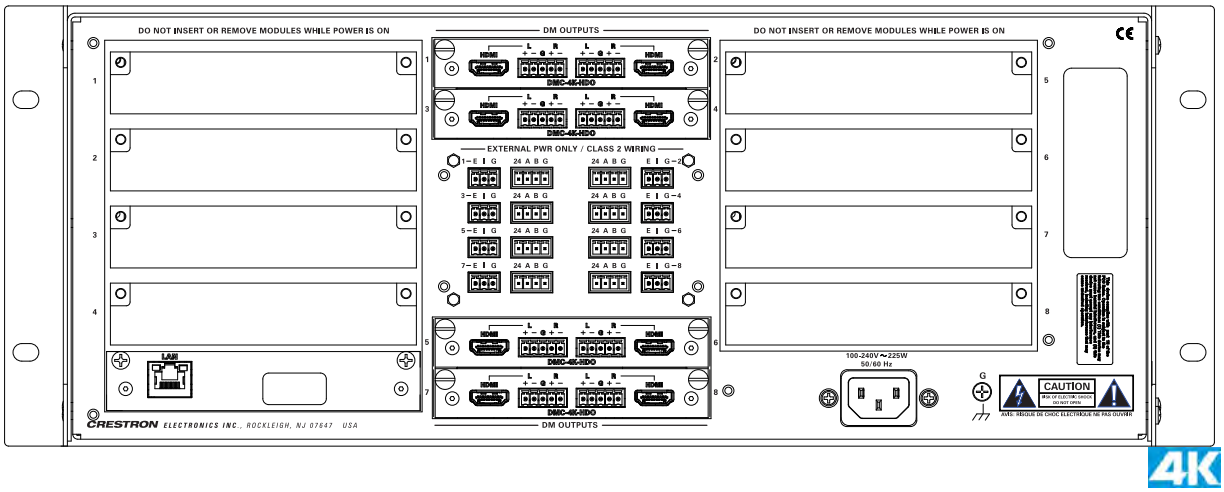
All three DigitalMedia switcher card frames are available with a redundant power supply, denoted by -RPS at the end of the model name. With the RPS option, the unit continues to operate as normal if one of the power supplies fails. The DM-MD8X8-RPS, DM-MD16X16-RPS, and DM-MD32X32-RPS have an MTBF (Mean Time Between Failures) of one million hours.

NOTE: RPS models do not provide DMNet™ power internally. Instead, DMNet power must be provided by external power supplies such as CNPWS-75 and C2N-SPWS300. DM 8G+ and DM 8G Fiber endpoints do not require DMNet power.

DM-MD8X8 and DM-MD8X8-RPS

- Eight input card slots (field upgradable) for up to eight AV sources
- Eight DM room outputs and/or HDMI outputs for up to 40 outputs using multiple chassis
- Four DMC output cards (field upgradable)
- Full audio and USB breakaway
- DM-MD8X8-RPS has internal redundant power supply for utmost reliability (MTBF of 1,000,000 hours)
- 4K ready

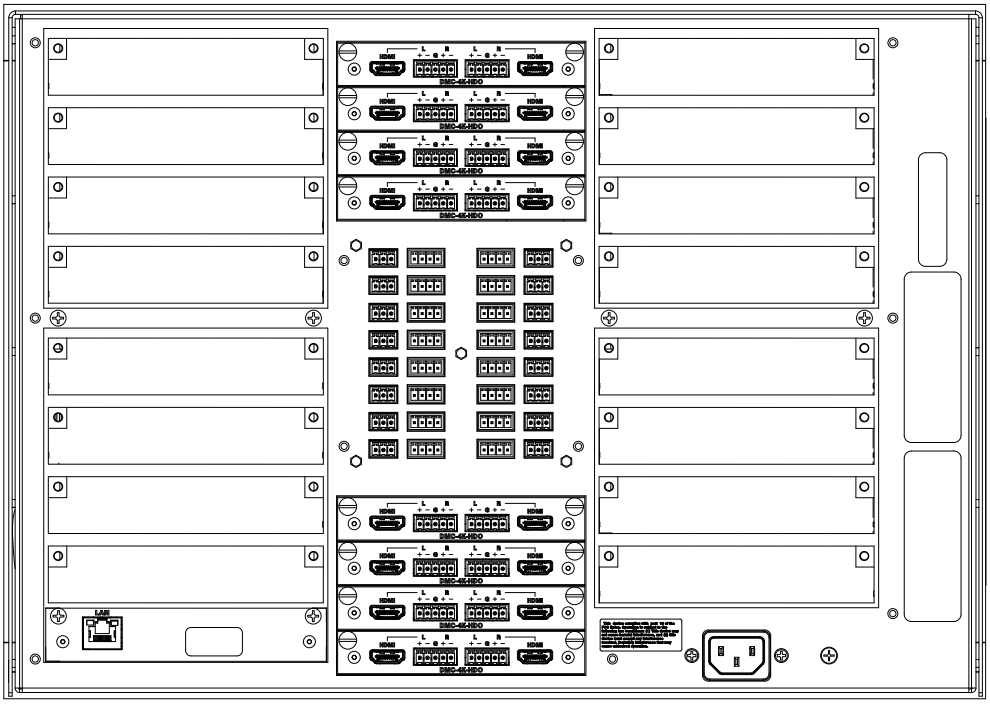
DM-MD8X8-RPS



DM-MD16X16 and DM-MD16X16-RPS

- 16 input card slots (field upgradable) for up to 16 AV sources
- 16 DM room outputs and/or HDMI outputs for up to 80 outputs using multiple chassis
- Eight DMC output cards (field upgradable)
- Full audio and USB breakaway
- DM-MD16X16-RPS has internal redundant power supply for utmost reliability (MTBF of 1,000,000 hours)
- 4K ready

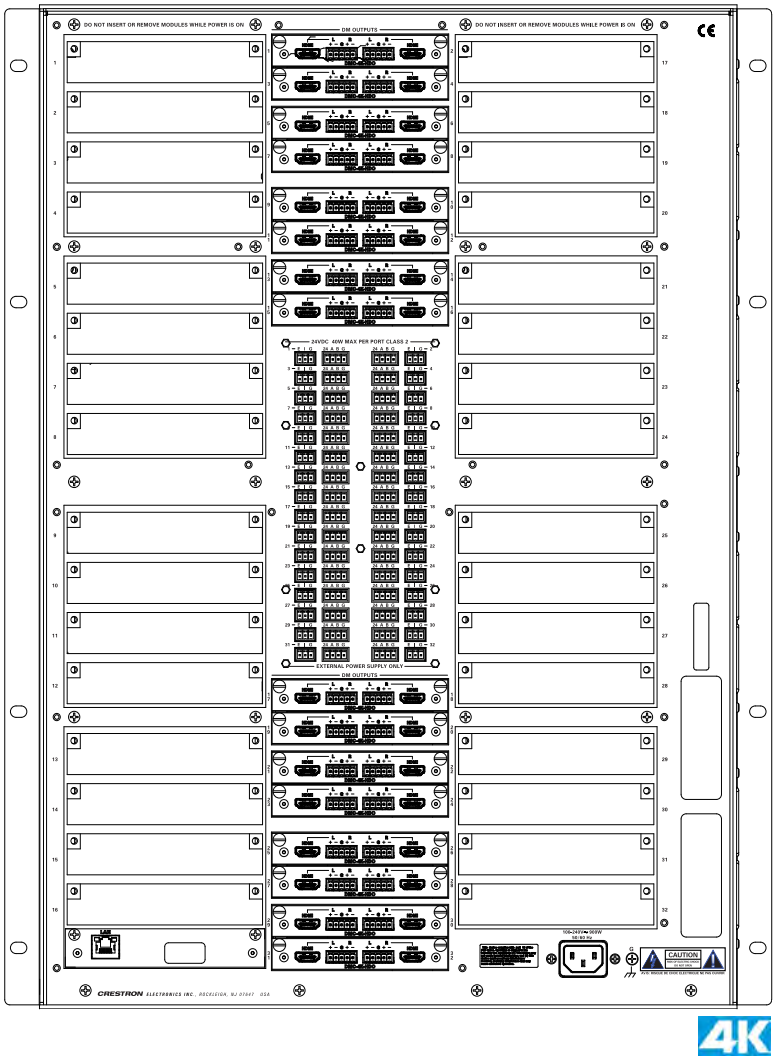
DM-MD16X16-RPS



DM-MD32X32 and DM-MD32X32-RPS

- 32 input card slots (field upgradable) for up to 32 AV sources
- 32 DM room outputs and/or HDMI outputs for up to 160 outputs using multiple chassis
- 16 DMC output cards (field upgradable)
- Full audio and USB breakaway
- 14-space 19-inch rack-mountable
- DM-MD32X32-RPS has three power supplies (two required for operation) for utmost reliability (MTBF of 1 million hours)
- 4K ready

DM-MD32X32-RPS



DigitalMedia Switcher Input Cards: Local Sources

All input cards provide an HDMI loop output for switcher expansion.

DMC-4K-HD

The DMC-4K-HD includes 4K HDMI input, RCA analog audio output (which breaks out the embedded HDMI audio to feed a multiroom audio distribution system), and USB HID port (which passes a remote mouse or keyboard signal to the source device).

Additional models are shown below.

Model	Description	Notes
DMC-4K-HD DMC-4K-DSP	HDMI Input with 4K Support	Includes USB HID
DMC-VID-RCA-D	RCA Analog Video Input Card with SPDIF Audio	YPbPr, Y/C, composite
DMC-VID-RCA-A	RCA Analog Video Input Card with Analog Audio	YPbPr, Y/C, composite
DMC-VID-BNC	BNC Analog Video Input Card	YPbPr, Y/C, composite, balanced audio
DMC-VID4	Quad Video Input Card	Composite video, for viewing security cameras
DMC-DVI	DVI/RGB Input Card	Analog and digital video input, analog audio, supports USB-HID
DMC-SDI	SDI Input Card	Supports SD-SDI, HD-SDI, and 3G-SDI
DMC-VGA	VGA or Analog Video Input Card	YPbPr, Y/C, composite

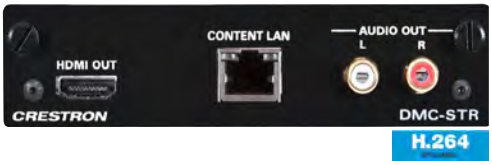
For a complete input card list, refer to www.crestron.com/digitalmedia.

DigitalMedia Switcher Input Cards: Remote Sources

DMC-4K-C-DSP

The DMC-4K-C-DSP 4K DM signal is received from a DM 8G transmitter via DM 8G STP or UTP. The built-in DSP processing enables simultaneous multichannel 7.1 surround sound and 2-channel stereo signals.

DMC-STR



The DMC-STR is an input card for a DigitalMedia switcher, providing one streaming input. The streaming input receives a single H.264 video stream over an IP network from another DM switcher, an IP camera, a streaming server, or a Capture HD® system.

Additional models are shown below.

Model	Description	Notes
DMC-4K-C DMC-4K-C-DSP DMC-4K-C-HDCP2 DMC-4K-C-DSP-HDCP2	DM 8G+ Input Card with 4K	Compatible with DM-TX-201-C, DM-TX-200-C-2G, DM-TX-401-C, DM-TX-4K-100-C-1G, DM-TX-4K-202, and DM-TX-4K-302 For applications requiring support for higher resolutions up to 4K
DMC-C DMC-C-DSP	DM 8G+ Input Card with Optional Down-Mixing	Compatible with DM-TX-201-C, DM-TX-200-C-2G, and DM-TX-401-C For use with surround sound sources
DMC-S DMC-S-DSP	DM 8G Fiber Input Card with Optional Down-Mixing	DSP version adds DSP for 7.1-channel down-mixing
DMC-S2 DMC-S2-DSP	DM 8G Single-Mode Fiber Input Card with Down-Mixing	DSP version adds DSP for 7.1-channel down-mixing
DMC-STR	H.264 Streaming Input Card	Up to 25 Mbps RTSP Stream Decoder

For a complete input card list, refer to www.crestron.com/digitalmedia.

DigitalMedia Switcher Output Cards

The DMCO series is a family of output cards for Crestron DigitalMedia matrix switchers. A complete selection of cards is offered to allow numerous combinations of DigitalMedia, HDBaseT, HDMI, H.264 streaming, and analog audio outputs on a single switcher chassis.

- The DM-MD8X8 can hold four DMC output cards. The DM-MD8X8 holds up to two outputs per card for a total of eight possible outputs.
- The DM-MD16X16 can hold eight DMC output cards. The DM-MD16X16 holds up to two outputs per card, for a total of 16 possible outputs.
- The DM-MD32X32 holds up to sixteen DMC output cards, with up to two outputs per card, for a total of 32 possible outputs.

The available DM output cards are shown below:

DMC-4K-CO-HD

2-Channel HDBaseT Certified 4K DigitalMedia 8G+ Output Card for DM Switchers

DMC-4K-HDO

2-Channel 4K Scaling HDMI Output Card for DM Switchers

DMC-HDO

2-Channel HDMI Output Card for DM Switchers

DMC-SO-HD

2-Channel DigitalMedia 8G Fiber Output Card for DM Switchers

DMC-S20-HD

2-Channel DigitalMedia 8G Single-Mode Fiber Output Card for DM Switchers

DMC-STRO

Streaming Output Card for DM Switchers

A DM Switcher Configuration Tool is available to assist with configuring the DM switcher.

NOTE: The DMC-4K-CO-HD-HDCP2 is the updated version of the DMC-4K-CO-HD. The DMC-4K-CO-HD-HDCP2 supports HDCP 2.2.

DigitalMedia Modular Switchers: Blade Based

The DM-MD64X64 and DM-MD128X128 feature Crestron blade architecture with high-density and high-reliability features such as the following:

- Hot-swappable power supplies, I/O blades, and fan tray
- Field-replaceable CPU and front panel
- Maximum reliability and uptime
- Designed as core building or campus-wide router

DM-MD64X64

- 8 input blade slots (hot-swappable)
- 8 output blade slots (hot-swappable)
- Up to 64 outputs
- Full USB breakaway
- 14-space 19-inch rack-mountable
- Two power supplies (one required for operation) for utmost reliability

DM-MD128X128

- 16 input blade slots (hot-swappable)
- 16 output blade slots (hot-swappable)
- Up to 128 outputs
- Full USB breakaway USB HID Switch
- 24-space 19-inch rack-mountable
- Two power supplies (one required for operation) for utmost reliability

DigitalMedia Switcher Input Blades

Each input blade provides eight DM or HDMI input channels to the DM-MD 64X64 backplane switch.

DMB-I-S

The DMB-I-S includes eight DM 8G Fiber inputs, each of which receives a DM signal from a DM 8G Fiber transmitter or another DM switcher. For a complete input card list, refer to the Crestron website.

Additional models are shown below.

Model	Description	Notes
DMB-4K-I-HD	HDMI Input x 8 with 4K Support	Includes Analog Audio Input x 8 4K
DMB-I-S	DigitalMedia 8G Fiber Input x 8	Compatible with DM-TX-201-S and DM-TX-401-S
DMB-I-S2	DigitalMedia 8G Single-Mode Fiber Input x 8	Compatible with DM-TX-201-S2 and DM-TX-401-S2
DMB-4K-I-C	DigitalMedia 8G+ Input x 8	4K

DigitalMedia Switcher Output Blades

DMB-O-S

The DMB-O-S includes 8 DM 8G Fiber outputs, each of which transmits a DM signal to a DM 8G Fiber receiver or another DM switcher. For a complete output card list, refer to the Crestron website.

Additional models are shown below.

Model	Description	Notes
DMB-4K-O-HD-Scaler	HDMI Output x 8 with 4K Support	Includes Analog Audio Output x 8 4K
DMB-O-S	DigitalMedia 8G Fiber Output x 8	Works with DM-RMC-100-S, DM-RMC-150-S, DM-RMS-SCALER-S, and DM-RMC-200-S
DMB-O-S2	DigitalMedia 8G Single-Mode Fiber Output x 8	Works with DM-RMC-200-S2 4K
DMB-4K-O-C	DigitalMedia 8G + Output x 8	

DigitalMedia Fixed Switchers

Crestron DM fixed switchers provide a simple and cost-effective solution for distributing multiple high-definition AV sources to up to six rooms. DM switchers are intended to be used in smaller applications that do not require expansion. The DM fixed switchers are available in 6x4 and 6x6 matrices.

- DM-MD6X4 capabilities: 6 HDMI inputs, 3 DM 8G+ out, and 1 HDMI output
- DM-MD6X6 capabilities: 6 HDMI inputs, 5 DM 8G+ out, and 1 HDMI output

DM-MD6X4

DM-MD6X6

About USB-HID

USB HID is a USB device class used for simple human-interface devices such as mice and keyboards. USB HID features a standard communications interface that allows devices to communicate without special drivers. Although communication flows both ways, the important command flow of keyboard strokes, mouse output, etc. goes from the device to the host. The square type B connector on the DM input cards is considered a host port because it connects to the host, and the DM room controller has a rectangular type A device port to connect to USB HID devices. For more information on the USB devices supported by DigitalMedia, refer to the Crestron True Blue Online Help Answer ID 5007.

DigitalMedia 4K Fixed Switchers

The HD-MD8X1-4K and DM-MD8X1-4K-C are ultra high-definition scaling presentation switchers with advanced features that are best suited for huddle rooms, conference rooms, and classrooms. Both switchers are preloaded with DMPS3 .AV Framework™ software that does all the programming for you, enabling control of a single display device, integration with AirMedia® presentation gateway, and centralized monitoring through Crestron Fusion® software.

Without requiring a separate control system or any programming, the HD-MD8X1-4K and DM-MD8X1-4K-C are easily configurable for a variety of media presentation applications and are compatible with a touch screen, iPad® device, or computer for setup and control.

- HD-MD8X1-4K capabilities: 4 VGA inputs and 4 HDMI outputs
- DM-MD8X1-4K-C capabilities: 4 VGA inputs, 4 HDMI outputs, 1 DM output, and 1 Mic input

HD-MD8X1-4K (Front and Back)

DM-MD8X1-4K-C (Front and Back)

For application examples using DM switchers, refer to “Appendix C: Application Diagrams” on page 63.

For more information on the HD-MD8X1-4K and DM-MD8X1-4K-C switchers, refer to the Software Features of the DM-MD8X1-4K-C and HD-MD8X1-4K Operations Guide (Doc 7772) on the Crestron website.

DMPS Presentation Systems

The DMPS is a powerful 3-Series® control processor that provides a complete, high-definition presentation control and signal routing solution for boardrooms, lecture halls, and video conference rooms. More than a new AV control processor, the Crestron 3-Series is an integrated building management platform capable of unifying the various technologies within a commercial building to operate as a single, intelligent system rather than in silos as separate systems. DMPS models include the DMPS3-4K-150-C, DMPS3-200-C, DMPS3-300-C, and DMPS-300-C-AEC. The DMPS-300-C-AEC is an enhanced version of the DMPS featuring full-bandwidth acoustic echo cancellation.

- **DMPS3-4K-150-C:** 4 HDMI inputs, 4 VGA inputs, 1 HDMI output, and 1 powered DM output
- **DMPS3-200-C:** 5 HDMI inputs, 3 VGA inputs, 1 HDMI output, 1 powered DM input, and 1 powered DM output (not shown)
- **DMPS3-300-C:** 5 HDMI inputs, 3 VGA inputs, 2 HDMI outputs, 2 powered DM inputs, and 2 powered DM outputs
- **DMPS-300-C-AEC:** 5 HDMI inputs, 3 VGA inputs, 2 HDMI outputs, 2 powered DM inputs, and 2 powered DM outputs

DMPS3-4K-150-C (Front and Back)

A control surface can be easily added to the DMPS3-4K-150-C, which allows presenters to turn the system on and off, select a source, and adjust the volume using a Crestron touch screen, button panel, computer, or iPad. The complete system configuration is enabled right from the device so that the installer can quickly select the control surface, specify the display device, and assign user-friendly names and icons to the inputs and output. The preloaded DMPS3 .AV Framework software enables customized presentation control without programming.

An instant switching system can be created by connecting up to four Crestron Connect It™ (TT-100 cable caddies. The source selection buttons and feedback work as soon as the USB cables are connected. Meeting or class participants simply connect their laptops with the Crestron Connect It device at the table or lectern, and then press the **Show Me** button to immediately display their content. The DMPS3-4K-150-C can control any Crestron Connected® display or projector via Ethernet, any flat panel with HDMI CEC, and many popular displays via RS-232. (view list of supported models.

For more information on .AV Framework, refer to the .AV Framework™ Software for DMPS3 Operations Guide (Doc. 7887) on the Crestron website.

DMPS3-300-C (Front and Back)

The DMPS3-300-C integrates the control system, multimedia matrix switcher, mic mixer, audio DSP, amplifier, and DigitalMedia distribution center all into a single 3-space rackmount package. The DMPS3-300-C affords substantial signal-routing flexibility and high-performance signal processing without the need for separate components. The preloaded DMPS3 .AV Framework software enables customized configuration and control without programming.

DMPS3-300-C-AEC (Front and Back)

The DMPS3-300-C-AEC provides a complete presentation control and signal-routing solution with built-in audio conferencing for boardrooms and classrooms. Integrating the control system, multimedia matrix switcher, mic mixer, audio DSP, amplifier, and DigitalMedia distribution center all into a single 3-space rackmount package, the DMPS3-300-C-AEC affords substantial signal routing flexibility and high-performance signal processing without the need for separate components. Its built-in audio conferencing interface and full-bandwidth acoustic echo cancellation allow for high-quality, full-duplex voice conferencing via a SIP or POTS phone line, and seamless integration with up to two external video conferencing codecs.

DigitalMedia Room Controllers

Room controllers provide the connection between the DM signal and output devices such as a television. The table below lists the features for each model. All room controllers feature a low profile design and can be installed behind flat panel displays and above ceiling mounted projectors.

DMC-RMC-4K-SCALER-C

The DMC-RMC-4K-SCALER-C provides a controller and interface for an HD or 4K display device as part of a complete DigitalMedia System. It includes a built-in 4K/60 scaler and analog audio output. It easily connects to the DM 8G+ output of a DM Switcher or Transmitter via CAT5e, DM 8G, or DM Ultra Cable. This controller is compatible with HDBaseT and includes IR, RS-232, Ethernet, and relay control ports.

DigitalMedia Room Controller Feature Comparison Chart

Model	DM-RMC-SCALER-C	DM-RMC-200-C	DM-RMC-100-S	DM-RMC-150-S	DM-RMC-SCALER-S (-S2)	DM-RMC-200-S (-S2)	DM-RMC-4K-100-C	DM-RMC-4K-100-C-1G	DM-RMC-4K-SCALER-C
DM Communication	DM 8G+	DM 8G+	DM 8G Fiber	DM 8G Fiber	DM 8G Fiber (-S) DM 8G Single-Mode Fiber (-S2)	DM 8G Fiber (-S) DM 8G Single-Mode Fiber (-S2)	DM 8G+ 4K	DM 8G+ 4K	DM 8G+ 4K
Video Output Types	HDMI or DVI	HDMI or DVI	HDMI or DVI	HDMI or DVI	HDMI or DVI	HDMI or DVI	HDMI or DVI	HDMI or DVI	HDMI or DVI
Video Scaler	2K	2K	-	-	2K	2K	-	-	4K/60 Hz
Audio Output Types	HDMI	HDMI, Analog Stereo	HDMI	HDMI, Analog Stereo	HDMI	HDMI, Analog Stereo	HDMI	HDMI	HDMI, Analog Stereo
Stereo Amplifier	-	30 W	-	-	-	30 W	-	-	-
IR Ports	2	2	2	2	2	2	2	1	2
COM Ports	1	1	1	1	1	1	1	1	1
Ethernet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-	Yes
Power Supply	Included	Included	Included	Included	Included	Included	Included	Included	Included
USB Port	Yes	Yes	-	Yes	Yes	Yes	-	-	-
Relays	-	2	-	2	-	2	-	-	2
Contact Sensing Input	-	1	-	1	-	1	-	-	-
Mounting	2-Gang Wall Box	2-Gang Wall Box	Surface Mount	Surface Mount	2-Gang Wall Box	2-Gang Wall Box	Surface Mount	1-Gang Wall Box and Surface Mount	Surface Mount
Power Over DM	-	-	-	-	-	-	Yes	Yes	Yes

For a complete listing of the DM Room Controller and Receiver models, refer to the Crestron website.

DigitalMedia HD Streaming Receiver and Room Controller

DM-RMC-100-STR

H.264

The DM-RMC-100-STR is a compact H.264 streaming decoder that is designed to receive high-definition AV signals over an IP network. This unit is a perfect complement to any DigitalMedia switcher with streaming output and can also be used to add streaming input capability to other switchers and devices.

DigitalMedia HD Streaming Transmitter and Receiver

DM-TXRX-100-STR

H.264

The DM-TXRX-100-STR is a compact H.264 streaming encoder and decoder designed to enable the distribution of high-definition AV signals over an IP network. This unit is configurable as either a transmitter or receiver and is a perfect complement to a DigitalMedia switcher with one or more streaming inputs or outputs. The DM-TXRX-100-STR can also be used to add streaming capability to other switchers and devices.

DigitalMedia Transmitters

DM transmitters provide the ability to add remote sources to the switcher system via CAT5e, DM cable, or fiber. DM transmitters are typically used in conjunction with modular DM switchers and DMPS models, but they also work in point-to-point systems with DM room controllers and receivers.

DM-TX-201-C (Front and Back)

- Built-in 2x1 AV switcher with auto-switching and analog audio-breakaway
- Connects to DigitalMedia switcher or receiver via CAT5e or better cable
- HDMI and RGB/component video inputs
- USB type B HID device port
- Low-profile, surface-mount design
- Local HDMI monitor output

DM-TX-201-S (Front and Back)

- Built-in 2x1 AV switcher with auto-switching and analog audio-breakaway
- Connects to a DM switcher or receiver over one multimode fiber strand
- HDMI and RGB/component video inputs
- USB HID device port for connection to a computer
- Low-profile, surface-mount design
- Local HDMI monitor output

DM-TX-201-S2

- DigitalMedia 8G single-mode fiber transmitter and multimedia interface
- Built-in 2x1 AV switcher with auto-switching and analog audio-breakaway
- HDMI and RGB/component video inputs
- Provides HDMI and RGB/component video inputs
- USB type “B” HID device port
- USB HID device port for connection to a computer
- Low-profile, surface-mount design
- Local HDMI monitor output

DM-TX-200-C-2G

- DigitalMedia 8G+ transmitter and multimedia interface
- Provides HDMI and RGB/component video inputs
- Built-in 2x1 AV switcher with auto-switching and analog audio-breakaway
- Connects to a DM switcher or receiver over one CAT5e or Crestron DM 8G cable
- Supports HDBaseT Alliance specifications

DM-TX-4K-202-C

- 4K DigitalMedia 8G+ transmitter and multimedia interface
- Built-in 2x1 AV switcher with auto-switching
- QuickSwitch HD technology for fast, reliable switching
- Connects to a DM switcher or receiver over a single CAT type twisted pair cable
- HDBaseT Certified and enables direct connection to other HDBaseT certified equipment

DM-TX-4K-302-C

- 4K DigitalMedia 8G+ transmitter and multimedia interface
- Built-in 3x1 AV switcher with auto-switching and analog audio-breakaway
- Connects to a DM switcher or receiver over a single CAT type twisted pair cable
- HDBaseT Certified and enables direct connection to other HDBaseT certified equipment

DM Transmitters by Supporting Infrastructure

Transmitters	DM 8G+	DM 8G Fiber	DM 8G SMF
1-Gang Wall Box HDMI Transmitter	DM-TX1-4K-C-1G DM-TX-4K-100-C-1G		
2x1 VGA and HDMI Transmitter	DM-TX-201-C	DM-TX-201-S	DM-TX-201-S2
2-Gang Wall Box VGA and HDMI Transmitter	DM-TX-200-C-2G		
4x1 VGA, HDMI, DisplayPort, and Composite Transmitter	DM-TX-401-C	DM-TX-401-S	DM-TX-401-S2
4K Transmitter	DM-TX-4K-202-C DM-TX-4K-302-C		

For application examples utilizing DM transmitters, refer to “Appendix C: Application Diagrams” on page 63.

HDMI Solutions

The following HDMI solutions are compatible with DigitalMedia products. For more information on HDMI, refer to “Appendix D: In-Depth Look at HDMI” on page 76.

HDMI Switchers

QuickSwitch HD switchers from Crestron enable high-performance HDMI signal selection with new features designed by Crestron to deliver trouble-free, low-latency switching of all DVD and Blu-ray Disc® players, HDTV receivers, media servers, game consoles, multimedia computers, surround processors, and high-definition displays. The HD-MD4X1-4K-E and HD-MD4X2-4K-E models feature four HDMI inputs and a single HDMI output to feed a video display or processor. The HD-MD6X2-4K-E offers six HDMI inputs and two independent HDMI outputs.

HD-MD4X1-4K-E

HD-MD4X2-4K-E

HD-MD6X2-4K-E (Front and Back)

The list below shows some of the features of the HDMI switchers:

- For stand-alone use, or as part of a fully integrated Crestron system
- Fully operable using front panel controls, a Web browser, or a Crestron control system
- Simplified setup through the front panel OLED display or Web browser
- Single-space, 19 in rack-mountable design
- Universal 100-240 V external power pack included
- QuickSwitch HD technology manages HDCP keys for fast, reliable switching
- Comprehensive built-in EDID configuration tools
- DVI and DisplayPort Multimode compatible
- Handles Dolby TrueHD, DTS-HD Master Audio, and uncompressed 7.1 linear PCM audio
- High-speed Ethernet LAN connection

HDMI Over Fiber Extenders

Crestron HDMI over Fiber Transmitters and Receivers deliver straightforward, cost-effective digital AV signal extension for use in the home, classroom, or corporate boardroom. The extenders enable wire runs up to 1000 ft (300 m) using just a single multimode fiber cable (for MM OPTICAL fiber wiring, use CRESFIBER-SINGLE-SC or other quality simplex multimode fiber optic cable).

- Extends uncompressed digital video, audio, and control signals 1000 ft (300 m) over a single multimode fiber
- Supports 7.1 lossless audio up to 48 kHz
- Compatible with DVI and DisplayPort Multimode
- Handles resolutions up to 1920 x 1200 and 1080p60
- Passes EDID, CEC, and HDCP
- Universal IR repeater up to 192 kHz
- Bidirectional RS-232 extender up to 115 kBd
- No programming or configuration needed
- TX3/RX3 adds analog audio, USB-HID, and Ethernet extending

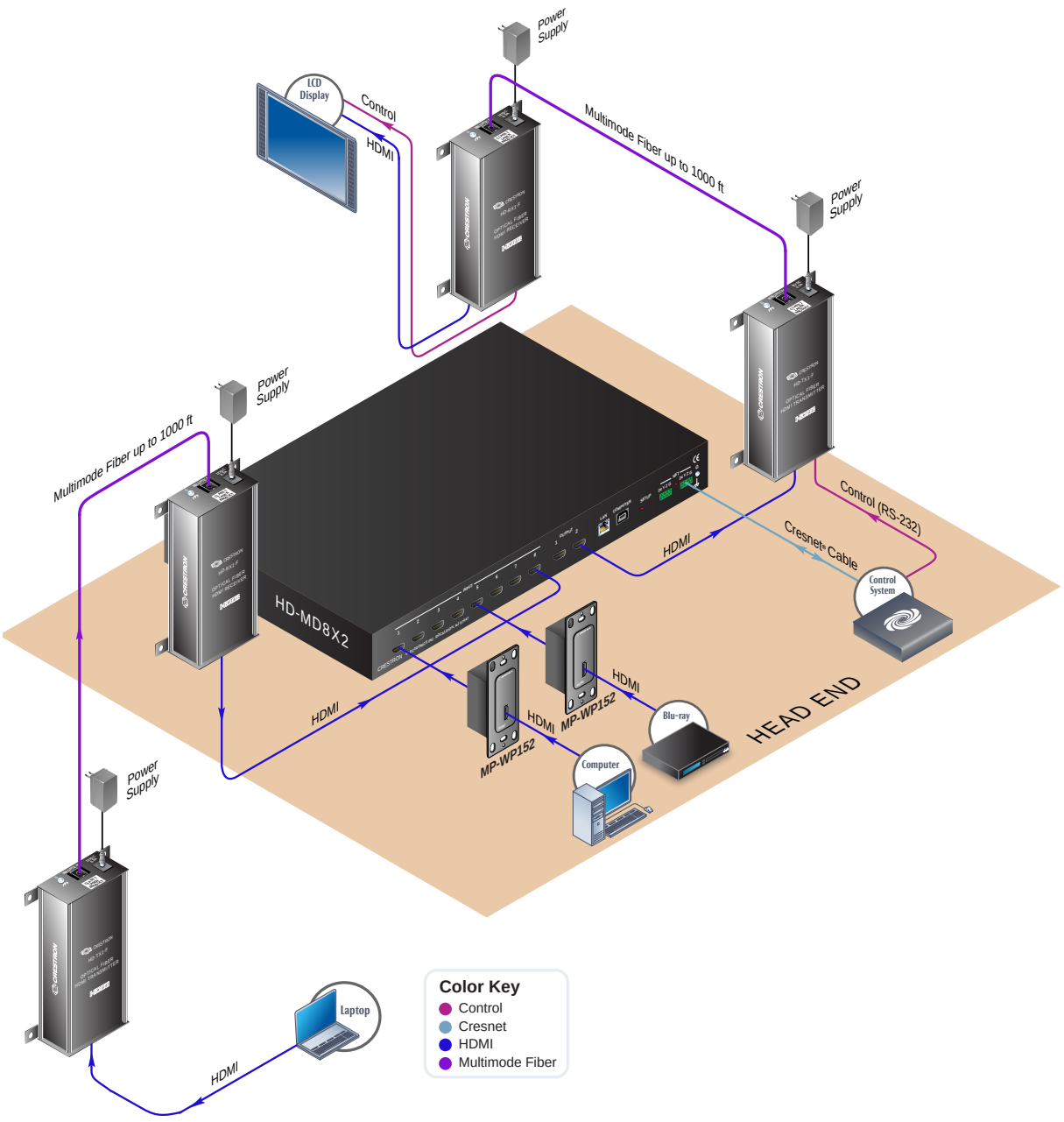
HD-RX1-F (Front and Back)

HD-TX1-F (Front and Back)

HD-RX3-F (Front and Back)

HD-TX3-F (Front and Back)

HD-TX1-F and HD-RX1-F Application



HDMI Over Copper Extenders

HD-EXT3-C

The Crestron HDMI over HDBaseT Extender (HD-EXT3-C) delivers professional-grade digital HD AV signal extension for use in the home, classroom, auditorium, or corporate boardroom. Without special setup or configur tion, the HD-EXT3-C enables the transmission of high-definition digital video and audio, plus RS-232 and IR control.

- HDBaseT Certified 4K Ultra HD signal extende
- Extends uncompressed digital video, audio, and control signals over a single CAT type twisted pair cable
- Supports cable lengths up to 330 ft (100 m) for all resolutions up to 4K and Ultra HD using DM Ultra cable
- Supports cable lengths up to 330 ft (100 m) for 1080p, WUXGA, and 2K using DM 8G cable or CAT5e
- Supports cable lengths up to 230 ft (70 m) for 4K and UHD using DM 8G cable, or 165 ft (50 m) using CAT5e
- Compatible with HDMI, DVI, and DisplayPort Multimode sources
- Compatible with HDMI and DVI display devices
- Supports Dolby TrueHD, DTS-HD, and uncompressed 7.1 linear PCM audio
- HDCP compliant and passes CEC and EDID
- Includes universal IR repeater up to 455 kHz

HD-EXT4-C

The Crestron HDMI over HDBaseT Extender (HD-EXT4-C) delivers professional-grade digital HD AV signal extension for use in the home, classroom, auditorium, or corporate boardroom. Without special setup, the HD-EXT4-C enables the transmission of high-definition digital video and audio.

- Handles 4K Ultra HD video resolutions
- Supports HDBaseT Alliance certified specifications
- Compatible with HDMI, DVI, and DisplayPort Multimode sources
- Compatible with HDMI and DVI display devices
- Handles Full HD 1080p video and 3D
- Works reliably without any programming or configuration
- Passes CEC, EDID, and HDCP
- Includes universal IR repeater up to 455 kHz

HD Video Scalers

HD-SCALER-HD-E

The HD-SCALER-HD-E is a simple, cost-effective video scaler designed to enable an HD, SD, or computer display device to handle virtually any input resolution up to Full HD 1080p or WUXGA. Its low-profile, surface-mountable design and set-and-forget simplicity allow the HD-SCALER-HD-E to be installed discreetly in the back of an equipment rack, behind a flat panel display, or above a ceiling projector. This scaler also includes stereo analog audio input and audio output for easy embedding to or extracting from HDMI.

HD-SCALER-VGA-E

The HD-SCALER-VGA-E is a simple, cost-effective video scaler designed to enable an HD, SD, or computer display device to handle analog VGA, RGB, and component video signals with input resolutions up to Full HD 1080p or WUXGA. Its low-profile, surface-mountable design and set-and-forget simplicity allow the HD-SCALER-VGA-E to be installed discreetly in the back of an equipment rack, behind a flat panel display, or above a ceiling projector. This scaler also includes stereo analog audio input and audio output for easy embedding to or extracting from HDMI.

HDMI Distribution Amplifiers

HD-DA-2

The HD-DA-2 is a compact wall or rack mountable 1-to-2 HDMI distribution amplifier. With the HD-DA-2, the audio portion of an HDMI signal can be added or extracted easily. The HD-DA-2 can split an HDMI signal into video for the display and audio for the surround sound processor. The audio is available in both SPDIF (coaxial) and analog forms. The HD-DA-2 does the reverse, merging SPDIF (coaxial or optical) audio with an HDMI video signal into two HDMI outputs. In addition, the HD-DA-2 splits one HDMI input into two HDMI outputs.

- Provides a one-in, two-out HDMI signal splitter
- Supports 7.1-linear PCM or high-bitrate encoded audio
- Includes front panel input signal and HDCP status indicators
- Enables extracting analog and SPDIF audio signals from the HDMI source
- Enables embedding SPDIF audio (coax or optical) onto the HDMI outputs
- Creates an HDMI signal from separate video and audio (SPDIF) sources

HD-DA-2-QUAD

The HD-DA-2-QUAD provides four independent 1-to-2 HDMI distribution amplifiers in a single rack-space unit. EDID and HDCP management is built-in to the device. Common uses are to split four HDMI sources or to expand the outputs of an HD-MD8X2.

- Provides four independent HDMI splitters
- Enables audio loop-thru for DVPHD inputs
- Handles 3D, and 7.1 linear PCM or high-bitrate encoded audio
- Passes EDID, CEC, and HDCP
- Compatible with DVI and DisplayPort Multimode
- Single-space 19-inch rack-mountableManages HDCP digital rights management for connected devices
- Performs automatic AV signal format management via EDID
- Includes external power supply
- No programming or control system required

HD-DA-2-QUAD (Front and Back)

HDMI Cables

CBL-HD-LOCK

This premium HDMI cable provides a perfect connection for HD devices. The Perfect Path® high speed HDMI cable with a PerfectLock™ locking connector keeps the cable securely locked when plugged into any Type A receptacle, but it is easily disengaged by pulling the connector body.

- High-speed HDMI certified
- PerfectLock connector with 25 lb (34 kg) retention
- CL2/FT4 rated for in-wall use
- Supports 3D, 4K, and audio return channel
- Available in a variety of lengths

CBL-HD

High-quality, high-speed HDMI digital AV interface cables for connecting high-definition multimedia devices such as DVD and Blu-ray Disc players, cable and satellite HDTV receivers, high-def video displays and projectors, surround sound processors, game consoles, and multimedia computers.

- High-speed Category 2 HDMI cable
- Supports 1080p60 HDTV with 16-bit color depth
- Handles computer resolutions up to WQXGA
- Supports SACD, DVD-Audio, Dolby TrueHD, and DTS-HD Master Audio
- 24 karat gold-plated 19-pin Type A connectors and high-flex CL3-rated jacket
- Available in a variety of lengths

Ultra Cables, 8G Cables, and Accessories

DM-CBL-ULTRA-NP and DM-CBL-ULTRA-P

The DM-CBL-ULTRA cable is a high-bandwidth CAT7a shielded twisted pair (S/FTP) cable. This cable is engineered to deliver optimum performance for 10 GB data networking and 4K ultra high-definition AV signal distribution applications. The DM-CBL-ULTRA is available in plenum-rated or riser-rated.

- Exceeds HDMI specifications requiring less than one pixel error per billion
- Every spool individually tested and certified
- Measurement markings on outer jacket
- Available in type CMR-rated for riser and other non-plenum installation or CMP-rated for plenum installation

DM-CBL-8G-NP and DM-CBL-8G-P

Crestron DigitalMedia 8G cable is a 350 MHz-certified twisted-pair cable with overall foil shield (F/UTP) that is engineered to deliver optimum performance for use in data networking and high-definition AV signal distribution applications. The DM-CBL-8G is available in plenum-rated or riser-rated.

- Manufactured and tested to exceed CAT5e specific tions and qualified for use wherever high-quality shielded CAT5e is required
- Ensures Crestron guaranteed performance for DigitalMedia 8G+ and Sonnex® Link
- Highly recommended for use with HDBaseT
- Spools individually tested and certifie
- Available in type CMR-rated for riser and other non-plenum installation or CMP-rated for plenum installation

Patch Cable, Patch Panel, and Receptacle

DM-CBL-ULTRA-PC

The DM-CBL-ULTRA-PC is a shielded CAT6a patch cable designed for use with all Crestron DigitalMedia 8G+, DM 8G+ products, as well as HDBaseT and 10GBase-T Ethernet. Using the DM-CBL-ULTRA-PC in combination with other Crestron DM Ultra structured cabling products ensures the highest performance and reliability for distributing Ethernet data and uncompressed 4K/60 video.

- Unique PCB-based RJ45 plug design
- 360 degree shield coverage
- Low-profile snag-resistant boot design with robust strain and bend relief
- Cantilevered latch for enhanced accessibility
- High-performance CAT7 S/FTP stranded cable
- Alien crosstalk preventive construction

DM-RPP-K24

The DigitalMedia 24-Port Keystone Patch Panel (DM-RPP-K24) provides an enterprise-grade network routing solution that is designed in accordance with EIA/TIA specifications for use as part of a complete DM, HDBaseT, or Ethernet infrastructure.

- Shielded CAT6a RJ45 jacks sold separately
- Designed for 10GBase-T Ethernet, Crestron DM 8G+, and HDBaseT
- Compatible with Crestron DM 8G and DM Ultra cable
- Field-terminable
- Individual rear cable tie points
- Versatile ground lug placement
- Single-space 19 in rack-mountable

DM-CONN-ULTRA-RECP

The DM-CONN-ULTRA-RECP is a shielded CAT6a RJ45 jack designed for use with the Crestron DigitalMedia 24-Port Keystone Patch Panel (DM-RPP-K24) or any keystone wall plate. It fits in a standard keystone module opening and can be field-terminated in as little as 60 seconds using the tool provided.

- Exceeding Category 6A performance requirements
- Ultra-fast and reliable termination
- Enhanced 360 degree shielding
- Accommodating multiple cable diameters
- Compatible with Crestron DM 8G and DM Ultra cable
- Sold in packs of 20 or 50 with termination tool included

DigitalMedia 4K/60 Fiber Distribution System

The Crestron DigitalMedia 4K/60 fiber distribution system provides 4K/60 video at fiber distances. The system includes 4K fiber transmitters and receivers that use SFP+ (Small Form-factor Pluggable Plus) transceiver modules. The modules support multimode and single-mode fiber.

The transmitters and receivers are available as stand-alone endpoints (DMF-TX-4K-SFP and DMF-RMC-4K-SFP) and as cards (DMCF-TX-4K-SFP and DMCF-RX-4K-SFP). An eight-card slot chassis (DMF-CI-8) is designed to accommodate and power the DMCF series cards.

The DigitalMedia 4K/60 fiber system provides the following features and benefits:

- Full DM 4K/60 signal support
- IT industry-standard fiber support
- Single solution adds fiber across product lines
- Flexibility to adapt to changes in fiber type without hardware swap
- End-to-end HDCP2 support

For more information on the DM 4K/60 fiber distribution system, refer to the DMF and DMCF Series: DigitalMedia 4K/60 Fiber Distribution System Reference Guide (Doc 7948) on the Crestron website.

DigitalMedia 4K/60 Fiber Products

The main components of a 4K/60 fiber distribution system are as follows:

- Fiber transmitter (DMF-TX-4K-SFP stand-alone endpoint or DMCF-TX-4K-SFP card)
- Fiber receiver (DMF-RMC-4K-SFP stand-alone endpoint or DMCF-RX-4K-SFP card)
- Fiber card chassis (DMF-CI-8)
- SFP+ transceiver module (SFP-10G-SR, SFP-10G-BX-U, or SFP-10G-BX-D for new installations and SFP-10G-S-U or SFP-10G-S-D for existing CresFiber 8G installations)

Fiber Transmitters

The fiber transmitter is available in two physical configurations: the DMF-TX-4K-SFP stand-alone endpoint and the DMCF-TX-4K-SFP card.

DMF-TX-4K-SFP Transmitter

The DMF-TX-4K-SFP is a fiber-based transmitter used with a companion receiver (DMF-RMC-4K-SFP or DMCF-RX-4K-SFP) to support point-to-point signal extension, and may also be used to add 4K fiber input capability to a DigitalMedia switcher.

The DMF-TX-4K-SFP includes two HDMI inputs for the connection of HD and 4K sources. Switching between the HDMI inputs can be performed automatically using autoswitching mode, manually using the onboard INPUT SEL (select) button, or programming via a Crestron control system. The local HDMI output allows the selected video and audio input signals to be fed to a local display or monitor.

NOTE: The DMF-TX-4K-SFP is sold as part of a kit that includes one SFP+ transceiver module.

DMF-TX-4K-SFP (Front)

For more detailed information, refer to the DMF-TX-4K-SFP page on the Crestron website.

DMCF-TX-4K-SFP Transmitter Card

The DMCF-TX-4K-SFP is a fiber-based transmitter card designed to function as part of a Crestron 4K video signal extender solution. It is used with a companion receiver (DMF-RMC-4K-SFP or DMCF-RX-4K-SFP) to support point-to-point signal extension, and may also be used to add 4K fiber input capability to a DigitalMedia switcher

The DMCF-TX-4K-SFP installs in any slot of a DMF-CI-8 card chassis. The DM OUT port allows for the insertion of an appropriate SFP+ transceiver module to enable compatibility with multimode or single-mode fiber. It also features two HDMI inputs, one analog audio input, a local HDMI output, and a gigabit Ethernet LAN port. The DMCF-TX-4K-SFP occupies one card slot of the DMF-CI-8 and requires a DMF or DMCF series receiver.

DMCF-TX-4K-SFP (Front)

For more detailed information, refer to the DMCF-TX-4K-SFP page on the Crestron website.

Fiber Receivers

The fiber receiver is available in two physical configurations: the DMF-RMC-4K-SFP stand-alone endpoint and the DMCF-RX-4K-SFP card.

DMF-RMC-4K-SFP Receiver

The DMF-RMC-4K-SFP enables uncompressed 4K/60 video signal extension over a fiber-optic cable. It is used with a companion transmitter (DMF-TX-4K-SFP or DMCF-TX-4K-SFP) to support point-to-point signal extension and may also be used to add 4K fiber input capability to a DigitalMedia switcher.

The DMF-RMC-4K-SFP includes one HDMI input for the connection of any HD or 4K source. Switching between the DM and HDMI inputs can be performed automatically using autoswitching mode, manually using the onboard INPUT SEL (select) button, or programming via a Crestron control system.

NOTE: The DMF-TX-4K-SFP is sold as part of a kit that includes one SFP+ transceiver module.

DMF-RMC-4K-SFP (Front)

For more detailed information, refer to the DMF-RMC-4K-SFP page on the Crestron website.

DMCF-RX-4K-SFP Receiver Card

The DMCF-RX-4K-SFP is a fiber-based receiver card designed to function as part of a Crestron 4K video signal extender solution. It is used with a companion transmitter (DMF-TX-4K-SFP or DMCF-TX-4K-SFP) to support point-to-point signal extension, and may also be used to add 4K fiber input capability to a DigitalMedia switcher.

The DMCF-RX-4K-SFP installs in any slot of a DMF-CI-8 card chassis. The DM IN port allows for the insertion of an appropriate SFP+ transceiver module to enable compatibility with multimode or single-mode fiber. The unit also features a built-in 4K/60 scaler, HDMI and analog audio outputs, a local HDMI input, and a gigabit Ethernet LAN port.

NOTE: The DMCF-RMC-4K-SFP is sold as part of a kit that includes one SFP+ transceiver module.

DMCF-RX-4K-SFP (Front)

For more detailed information, refer to the DMCF-RX-4K-SFP page on the Crestron website.

Fiber Card Chassis

DMF-CI-8 Chassis

The DMF-CI-8 is a 2-space rack-mountable chassis designed to house up to eight Crestron DMCF series cards. With one or more cards installed, the DMF-CI-8 functions as a high-performance, fiber-based signal extender capable of handling up to eight separate uncompressed 4K video signals. Transmitter and receiver cards are available and can be installed in any of the eight card slots. Interchangeable SFP+ transceiver modules are utilized by each card to support multimode and single-mode fiber types. Stand-alone transmitters and receivers are also available for installation at remote locations.

The DMF-CI-8 provides a means for adding 4K fiber inputs and outputs to a Crestron DigitalMedia switcher. Each card connects to an HDMI input or output on the switcher, and to the local Ethernet network, allowing seamless routing of AV and control signals. The DMF-CI-8 chassis does not switch; it is only a power supply.

DMF-CI-8 (Front)

The rear of the DMF-CI-8 accepts the DMCF series cards. The transmitter and receiver cards can occupy any card slot of the DMF-CI-8, and any combination of cards can be installed. The example below shows the rear of the DMF-CI-8 with a fully occupied chassis containing four DMCF-RX-4K-SFP cards in slots 1–4 and four DMCF-TX-4K-SFP cards in slots 5–8.

DMF-CI-8 (Rear View with DMCF Cards Installed)

For more detailed information, refer to the DMF-CI-8 page on the Crestron website.

Transceiver Module

SFP-10G

Crestron SFP-10G series SFP+ Transceiver Modules are designed for use with DMF Series DigitalMedia SFP+ 4K Fiber Transmitters and Receivers and DMCF Series DigitalMedia SFP+ 4K Fiber Transmitter and Receiver Cards. A choice of modules is offered to support multimode or single-mode fiber types.

The SFP-10G transceiver modules are normally sold as part of a packaged kit containing one SFP+ transceiver module and one DMF or DMCF device. They are also available individually to allow for replacement in the field. SFP+ modules provide fiber flexibility. The modules separate optics from the electronics.

NOTE: The fiber interface provided by the SFP+ transceiver module is not compatible with Crestron DM fiber (-F type, DM 8G fiber (-S type, or DM 8G SM fiber (-S2 type devices.

SFP+ Transceiver Module (Dual LC Connectors Shown)

SFP+ Transceiver Module Installation into SFP+ Cage (DMF-TX-4K-SFP Shown)

For more detailed information, refer to the SFP-10G page on the Crestron website.

4K/60 Fiber Distribution System Application Examples

This section includes application examples of several different 4K/60 fiber distribution systems.

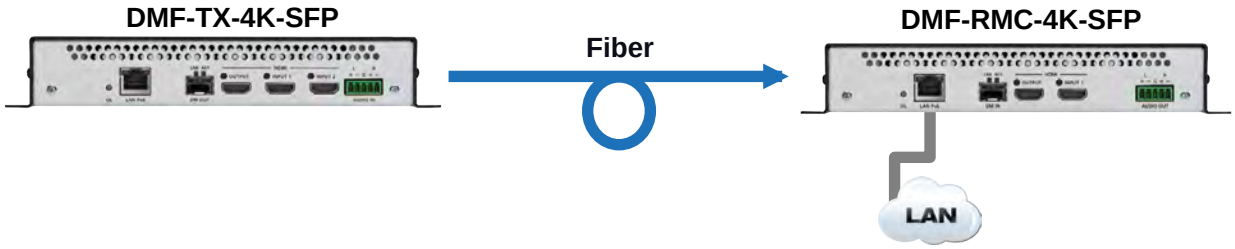
Long-Distance Point-to-Point Fiber Run

The example below shows a fiber connection between a DMF-TX-4K-SFP transmitter and a DMF-RMC-4K-SFP receiver in a point-to-point application.

The 4K/60 video can be transmitted over multimode fiber for distances up to 1300 ft (400 m) or over single-mode fiber for distances up to 6.2 miles (10 km). An Ethernet LAN connection is also required to enable communication with the associated control system. The LAN connection can be made using the LAN port of either the fiber transmitter or the fiber receiver.

NOTE: The LAN ports of both the transmitter and receiver cannot be connected to the LAN simultaneously.

DMF-TX-4K-SFP and DMF-RMC-4K-SFP Point-to-Point



Integration with a DigitalMedia Switcher

The example below shows a seamless integration of the 4K/60 fiber distribution system with a DigitalMedia switcher.

NOTE: The DM-MD8X8 is shown as an example only. Any card-based DigitalMedia switcher (DM-MD8X8, DM-MD16X16, and DM-MD32X32) as well as any blade-based DigitalMedia switcher (DM-MD64X64 and DM-MD128X128) can be used.

Only single connections are shown; however, all fiber connections to the cards in the DMF-CI-8 require a companion transmitter or receiver endpoint, and every connection to the DM-MD8X8 requires an HDMI cable and a LAN cable. The information in parentheses (x4 and x8) denotes the actual number of connections that are necessary.

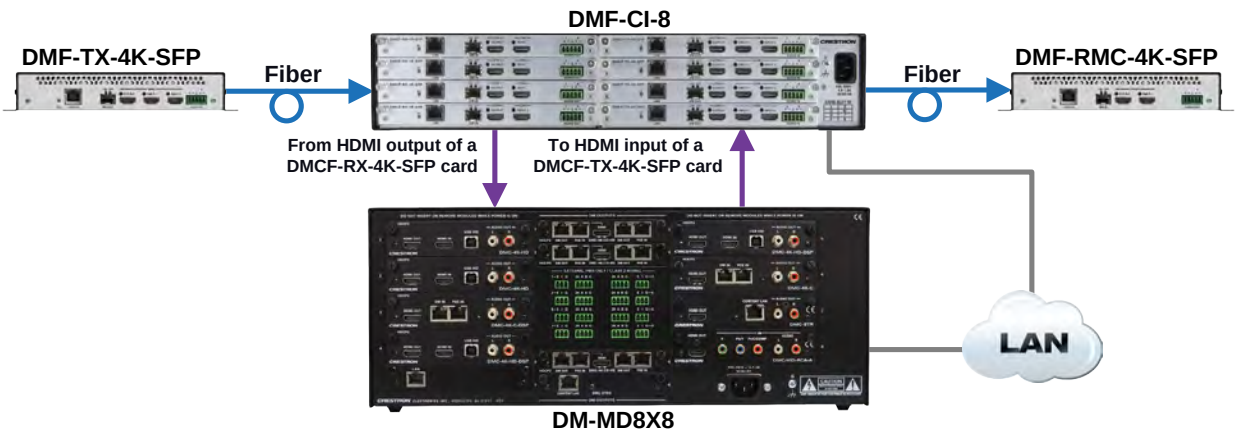
The DMF-CI-8 contains four DMCF-RX-4K-SFP cards in slots 1–4 and four DMCF-TX-4K-SFP cards in slots 5–8. Four DMF-TX-4K-SFP endpoints are required to connect to the four DMCF-RX-4K-SFP cards in the DMF-CI-8, totaling four fiber connections. The four DMCF-TX-4K-SFP cards require connections to four DMF-RMC-4K-SFP endpoints, totaling four fiber connections.

The HDMI output of each DMCF-RX-4K-SFP card in the DMF-CI-8 can connect to any available HDMI input on the switcher, adding a 4K fiber input to the switcher. The HDMI input of each DMCF-TX-4K-SFP card in the DMF-CI-8 can connect to any available HDMI output on the switcher, adding a 4K fiber output to the switcher. In the example below, a total of eight HDMI connections is required to connect the switcher to the DMCF-RX-4K-SFP and DMCF-TX-4K-SFP cards.

NOTE: When the HDMI output of a fiber receiver or an HDMI input of a fiber transmitter connects to a DigitalMedia switcher, the switcher automatically configures the IP table of the fiber transmitter according to the SIMPL program. The fiber transmitter hosts the configuration settings of the fiber receiver.

For each pair containing a transmitter and companion receiver, an Ethernet LAN connection is required to enable communication with the associated control system. Connection to the LAN can be made using the LAN port of either the fiber transmitter or the companion receiver. The LAN ports of both the transmitter and receiver cannot be connected to the LAN simultaneously. Eight LAN connections are required for the eight pairs of fiber transmitters and companion receivers that connect the DMF-CI-8 to the DigitalMedia switcher.

Logical Integration with a DigitalMedia Switcher



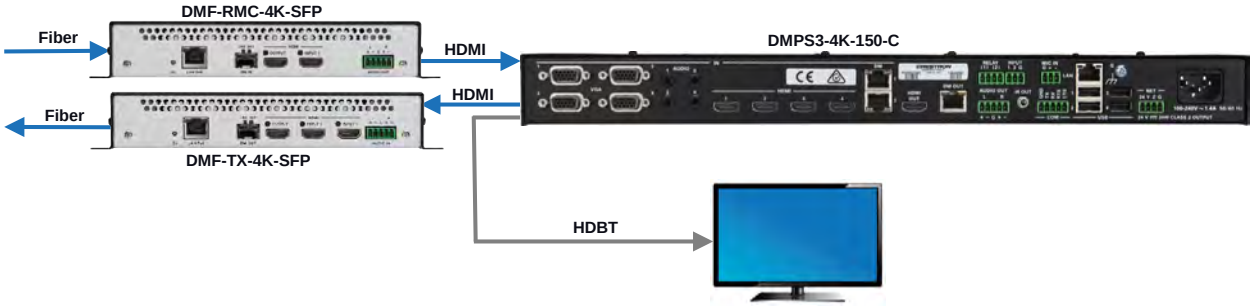
Fiber Distribution in a Single Room

The example below shows a 4K/60 fiber distribution system integrated with a DMPS3 (4K DigitalMedia presentation system) for fiber distribution in a single room.

NOTE: The DMPS3-4K-150-C is shown as an example only. Any 4K DigitalMedia presentation system (DMPS3-4K-150-C, DMPS3-4K-50, and DMPS3-4K-100-C) can be used.

The HDMI output of a DM-RMC-4K-SFP connects to an available HDMI input of the DMPS3-4K-150-C, adding a 4K fiber input to the DMPS3-4K-150-C. The HDMI input of the DMF-TX-4K-SFP connects to the HDMI output of the DMPS3-4K-150-C, adding a 4K fiber output to the DMPS3-4K-150-C.

Fiber Distribution in a Single Room



Fiber Distribution between Floors

The example below shows a fiber connection between two floors with a seamless integration of two DigitalMedia switchers, each of which is located on a different floor.

NOTE: The DM-MD8X8 is shown as an example only. Any card-based DigitalMedia switcher (DM-MD8X8, DM-MD16X16, and DM-MD32X32) as well as any blade-based DigitalMedia switcher (DM-MD64X64 and DM-MD128X128) can be used.

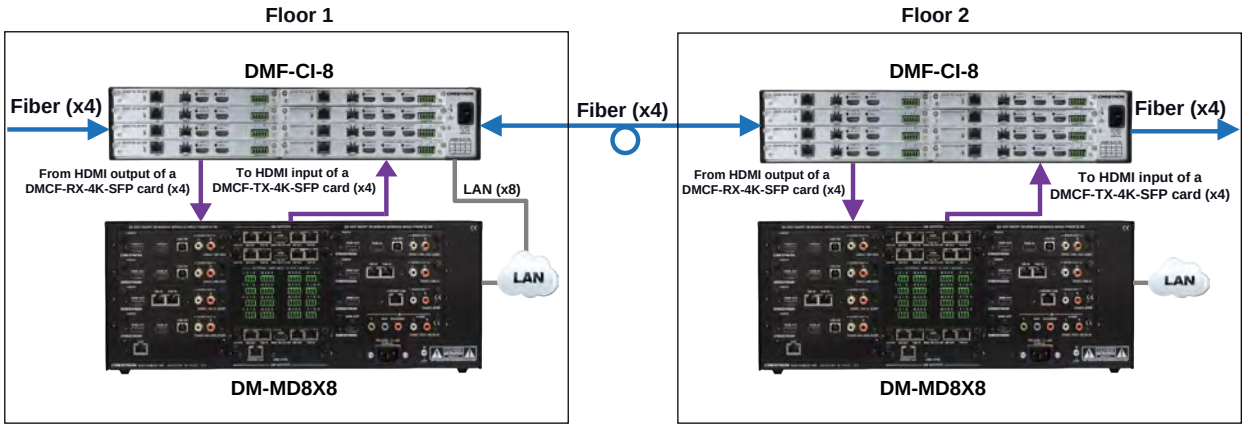
HDMI connections between a switcher, the fiber transmitters, and companion receivers add 4K fiber outputs and inputs to the switcher. The switcher automatically configures the IP table of the fiber transmitters according to the SIMPL program. The fiber transmitters host the configuration settings of the companion fiber receivers.

For each pair containing a transmitter and companion receiver, an Ethernet LAN connection is required to enable communication with the associated control system. The LAN connection can be made using the LAN port of either the fiber transmitter or companion receiver.

NOTE: The LAN ports of both the transmitter and receiver cannot be connected to the LAN simultaneously.

- On Floor 1, eight LAN connections are required for the eight pairs of fiber transmitters and companion receivers that connect the DMF-CI-8 to the DigitalMedia switcher.
- On Floor 2, only a single LAN connection from the DigitalMedia switcher to the LAN is required.

Fiber Distribution between Floors



NOTE: Refer to the DMF and DMCF Series: DigitalMedia 4K/60 Fiber Distribution System Reference Guide (Doc 7948) on the Crestron website, for detailed information on Transmitter and Receiver Kits.

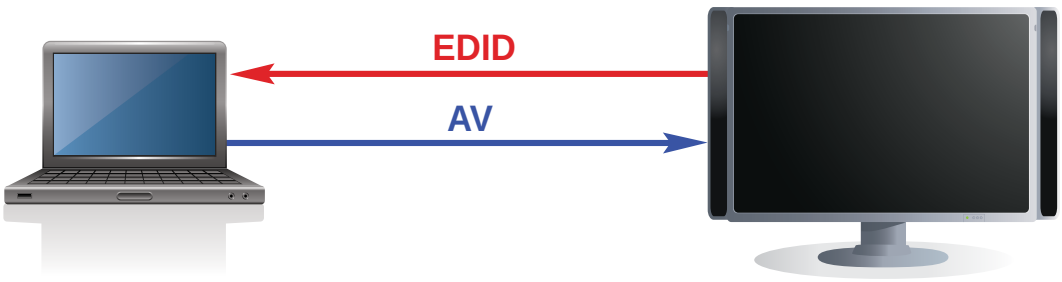
System Commissioning

Commissioning a DM system consists of the following:

- Proper Extended Display Identification Data (EDID) configuration in DMTool
- Link Quality (LQ) tests
- DM Test Report

EDID Design

EDID design is just as crucial as system hardware design. EDID is the information that tells a source what resolution to output when it is plugged in. EDID data flows in reverse from the AV information, so the display tells the source what it wants—not the other way around.



In some cases, the user can adjust the output resolution of the source, but not without a valid EDID table from the display. A PC allows the user to choose a resolution from the list provided in the display settings. That list is generated by the display and is sent to the PC.

DigitalMedia distributes EDID to all the sources that are attached. This EDID table should be manually set by the system commissioner and considered a part of a complete system design. While automatic mode guarantees that something appears on the screen, it cannot guarantee the customer is seeing what they actually want.

DMTool software (available in Crestron Toolbox) allows the user to manually configure the EDID table, while complying to all the rules of EDID. There are only so many entries that can exist in an EDID table, which means every resolution cannot be listed. Signal type (VGA, DVI, HDMI) impacts the EDID table size; HDMI signals allow for more EDID entries than DVI and VGA (keep this in mind when choosing sources).

Start off designing the EDID table by answering these two questions:

1. How does the customer expect the system to work?
   - For residential systems, the answer may be as simple as “I want 1080p video everywhere.”
   - In commercial systems, the customer may want to choose from a number of sources, including using a laptop to display on the projector.
2. What is the native resolution of each display in the system? If all displays do not share the same native resolution, is there a common resolution across all?

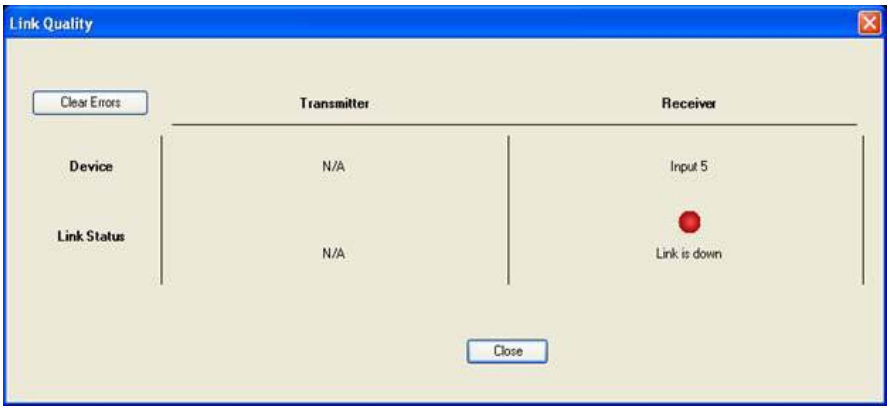
The designer must process this data and come up with an EDID table that satisfies both requirements. In many cases resolution conflicts prevent the designer from sending the highest quality video to all displays. DM receivers that feature video scalers, such as the DM-RMC-SCALER-C, can be used to ensure that each display provides the best resolution it can support. For additional information on EDID design, refer to “EDID” on page 78.

Link Quality Test

The **Link Quality** (LQ) button is available on DM 8G+ and 8G Fiber devices. Click this button to run a quick test on the status of the DM connection between the DM devices. Based on a bit-error test, one of the following states is reported:

Status Color	Status Text	Notes
Green	Link is good	No action is required
Red	Link is unstable or down	Terminations and cable should be checked

Link Quality Example



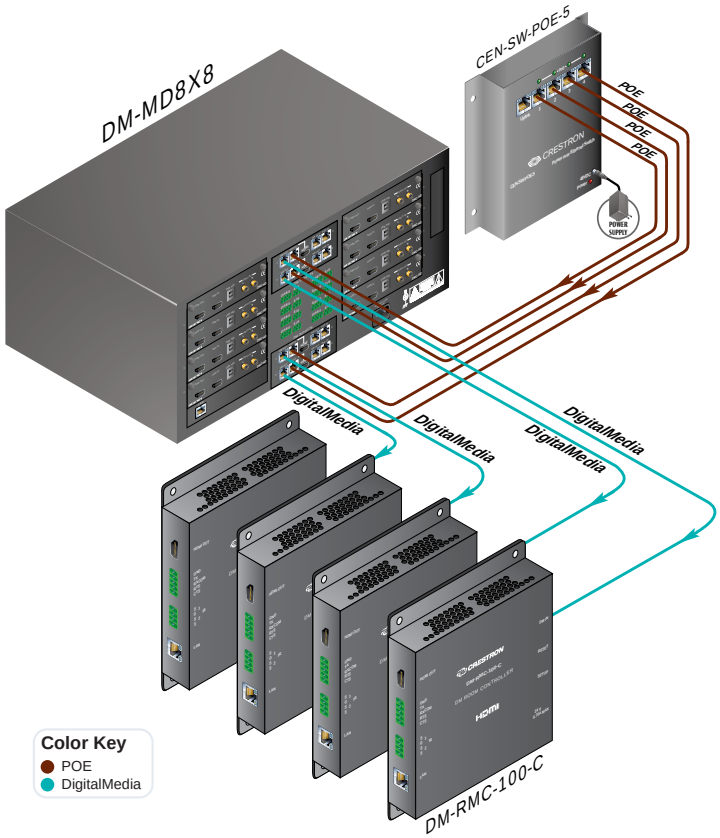
DM Test Report

The DM Test Report is the final document generated by DMTool. The report provides a comprehensive summary of the DM system, documenting inputs, outputs, EDID settings, HDCP status, and any open items or notices that may impact system performance. This report can be provided to the system designer and/or client as a final notice regarding the system's configuration and status.

DM 8G+ Power Considerations

Each fiber-based DM and DM 8G+ endpoint ships with a power supply for local powering. Some DM 8G+ devices can be powered via PoDM or PoDM+ in place of using the included power supply.

- DM 8G+ input and output cards have a POE IN port for each DM port.
- Connect a PoDM or PoDM+ power source to each POE IN input and output card (depending on the endpoint type) to provide power.
- The same CAT5e or better cable that carries video and audio also carries power to the DM endpoint.
- The PWE-4803RU, CEN-SW-POE-5, CEN-SW-POE-24, DM-PSU-8, and DM-PSU-16 supply PoDM for use with DM 8G+.
- The CEN-SW-POE-16 and DM-PSU-ULTRA-MIDSPAN supply PoDM and PoDM+ for use with DM 8G+.
- The DMPS-100-C, DMPS-200-C, DMPS-300-C, and DMPS-300-C-AEC provide PoDM via its companion power over DM supply. These products do not support PoDM+ power, they supply only PoDM.
- The DMPS3-300-C, DMPS3-300-C-AEC, and DMPS3-200-C provide PoDM via its companion power over DM supply. These products do not support PoDM+ power, they supply only PoDM.
- The DM-RMC-100-C, DM-TX-201-C, DM-TX-200-C-2G, DM-TX-401-C, DM-TX-4K-202-C, and DM-RMC-4K-100-C endpoints can be powered via PoDM.
- The DM-TX-4K-302-C, DM-RMC-4K-SCALER-C, and DM-RMC-4K-SCALER-C-DSP endpoints can be powered via PoDM+.
- The DM-TX-4K-302-C can be powered by a PoDM PSE (Class 3) if no USB device is connected to the USB HID port.



Appendix A: DigitalMedia Network Considerations

Most Crestron DigitalMedia devices are Ethernet devices. Ethernet traffic due to DigitalMedia devices is relatively low. The custom control system program that ties together the DM system dictates how much bandwidth is needed.

DigitalMedia Certified Designers and Engineers

Every Crestron DM system should be designed by a DigitalMedia Certified Designer (DMC-D) and commissioned by a DigitalMedia Certified Engineer (DMC-E).

Only Crestron certified engineers ensure that a system is properly installed and configured to Crestron standards. The information in this design guide is intended to explain basic DM IP addressing considerations. Consult the DMC-E for further questions.

DigitalMedia System Topology

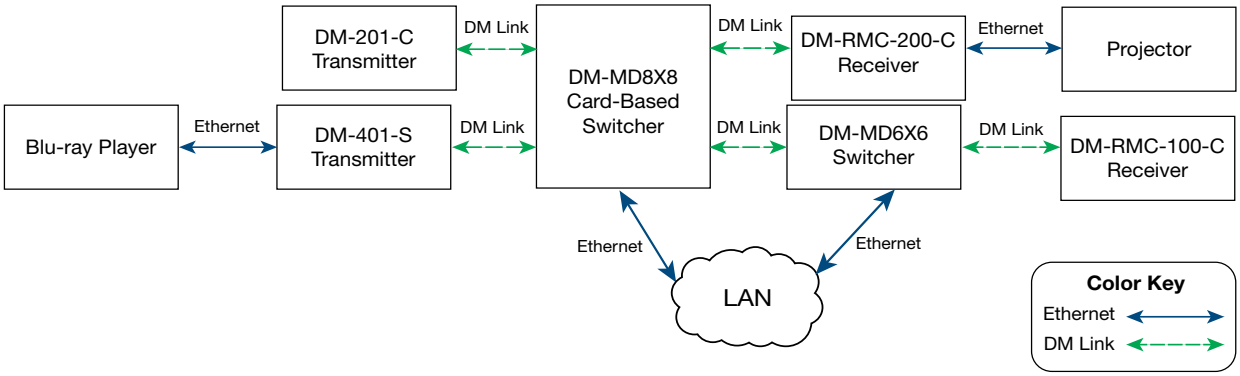
Each DM link (connection between two DM devices) carries Ethernet embedded inside; therefore, no additional wiring is needed to provide network connectivity for third party Ethernet products installed at the endpoints. Interconnected DM devices only need a single point (typically the main switcher) to be connected to the LAN in order to provide Ethernet to all devices in the system. To facilitate this, Crestron DM devices have integrated managed Ethernet switches and an exposed Ethernet port.

NOTE: Endpoints refers to any DM transmitter or receiver.

DigitalMedia Ethernet Connectivity

In the scenario below, Ethernet connectivity is provided to all DM devices and third-party devices from the single LAN connection at the DM-MD8X8. This eliminates the need to run extra wiring to each location to provide Ethernet connectivity.

DigitalMedia Ethernet Connectivity



The main Ethernet uplink to a DM system occurs at the DigitalMedia switcher.

The DM-MD6X4, DM-MD6X6, DM-MD8X8, DM-MD16X16, DM-MD32X32, and all DMPS model switchers contain 10/100/1000BaseT auto-negotiating uplink ports.

The DM-MD6X1 switcher contains 10BaseT/100BaseTX auto-negotiating uplink ports.

Private Network Mode

Prior to 2012, every DM card and endpoint in an installation required its own IP address on the corporate network. In 2012, Crestron introduced PNM to DM switchers. PNM greatly reduces the number of IP addresses required for DM installations. Crestron recommends using PNM to manage Ethernet settings for DM cards and endpoints connected to a DM switcher. Other methods are not recommended. For details on legacy modes of operation, refer to Crestron True Blue Online Help.

NOTE: PNM is not applicable to standalone installations involving directly connected DM endpoints with no associated DM switchers. In these installations, each endpoint device needs its own IP address—either configured manually or via DHCP.

PNM creates a completely private IP network for all DM cards and endpoints that are connected to the DM switcher, effectively isolating them from the building network. PNM significantly streamlines home and organizational infrastructures, conserving IP addresses, reducing costs, and simplifying system management and troubleshooting.

The only device that appears on the building network is the DM switcher. The switcher needs just one IP address, which can either be set statically or assigned via the building's DHCP server. In this mode, none of the cards or endpoints are directly reachable via the network of the building; instead, communication to these devices is managed through the main DM switcher. The devices connected to the LAN ports found on many DM endpoints remain visible to the network.

The main DM switcher CPU is the only device connected to both networks. That CPU may receive an instruction on the public network (such as from a Crestron control system) and create a new instruction for a device on the private network (DM card, blade, or endpoint). At no time does an Ethernet packet from the public network traverse to the private network, and no private Ethernet packets may traverse to the public network.

For most installations, such as in corporate or university settings, using PNM is the best practice because it does not heavily impact the network. PNM also isolates traffic that is related to DM.

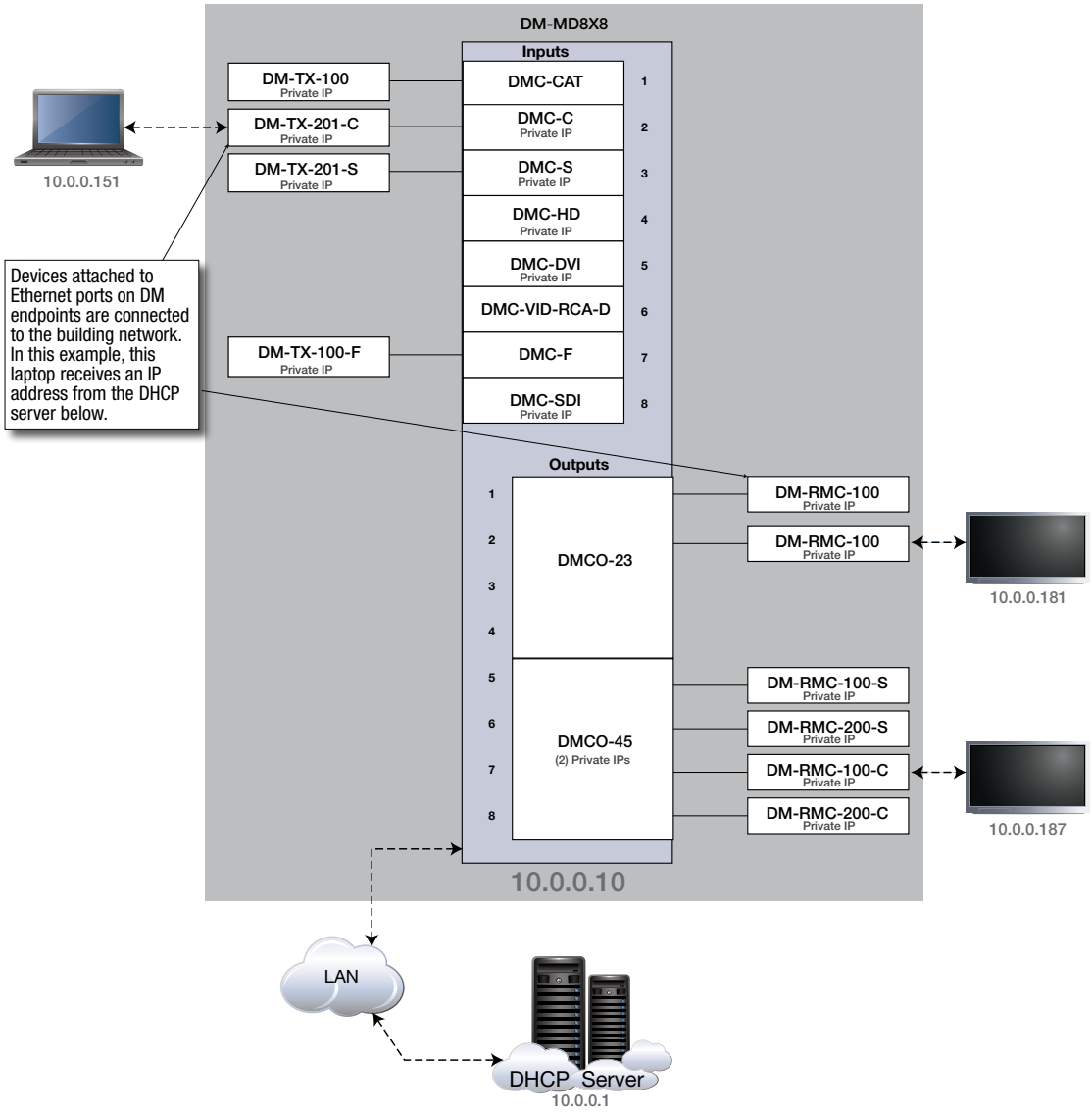
NOTES:

- PNM is enabled by default on all new units and is enabled upon system restore. PNM is only available in PUF 2.40 (firmware package update file) or later.
- DMPS units require two IP addresses. The integrated control processor requires its own IP address, and the integrated DM equipment (switcher, all endpoints) requires one more.
- If an endpoint is connected to a DM switcher, its LAN connector must not be connected to the corporate network. In this configuration, these ports are only for connection to devices such as laptops, Blu-ray players, or projectors.

Private Network Mode Configuration Options

PNM ON/OFF	Mode	Comments
PNM ON	Static	Assign one IP address to the main DM switcher
PNM ON	DHCP	Takes one IP address from the DHCP server
PNM OFF	Static and DHCP	Can be in Static or DHCP mode Requires many IP addresses This method is not recommended by Crestron for most installations

Private Network Mode with Auxiliary Devices



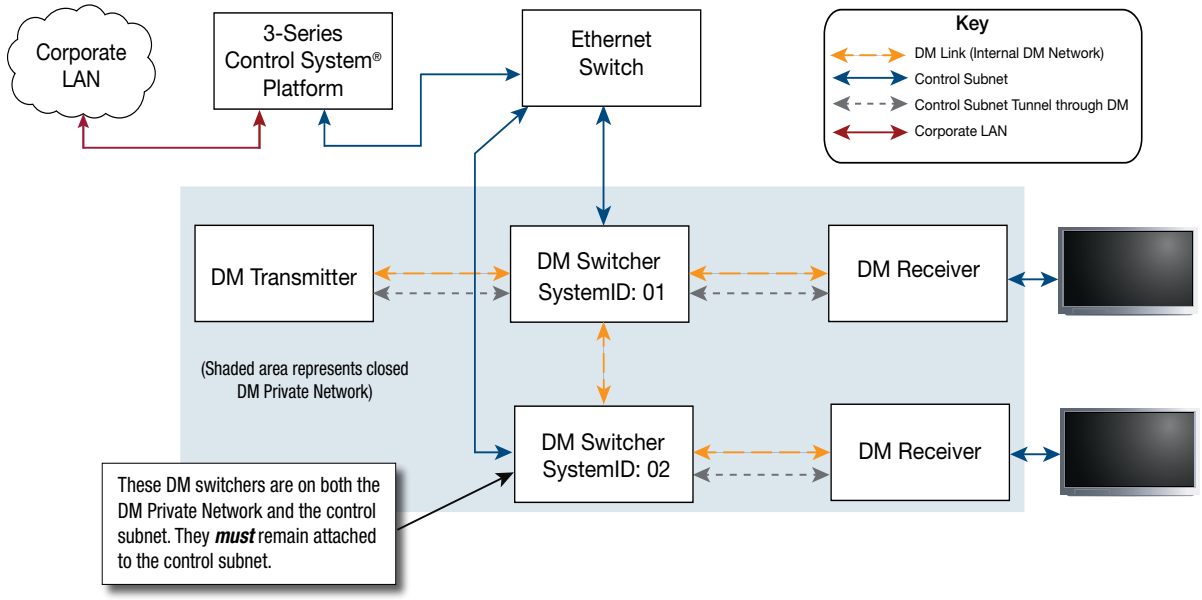
NOTES:

- DHCP-distributed IP addresses have been chosen at random to illustrate that devices attached to DM endpoints are connected to the building LAN.
- The devices enclosed by the gray box sit behind the one IP address assigned to the DM-MD8X8.

Multiple DigitalMedia Switchers Using Private Network Mode

When two or more switchers are connected by way of DM links, they are considered cascaded. Each DM switcher in a cascaded system must be configured with a unique System ID. This prevents IP conflicts among DM devices on the private network. In the illustration below, only one IP address per switcher is required from the building network.

Multiple DM Switchers Using PNM Example



NOTE: The System ID can range from 01 to 64 and must be uniquely set for each DM switcher. By default, the System ID is set to 01. The ID can be set via the front panel, the SIMPL Windows program, or the System Info tool in Crestron Toolbox. Each DM switcher must be directly connected to the corporate LAN, one DM switcher cannot receive Ethernet via another DM switcher, and each DM switcher must receive an IP address from the control subnet.

Rapid Spanning Tree Protocol (RSTP)

Since DM devices embed Ethernet in every link, a valid AV configuration can create network loops, such as routing two AV signals from one switcher to another switcher. To eliminate any network looping problems, DM products implement IEEE 802.1w RSTP. With PNM enabled, the DM switcher manages the DM Ethernet links to prevent network loops.

DM products transmit Bridge Protocol Data Units (BPDU) per the RSTP specification. With PNM enabled, BPDUs are isolated to the private network and are not visible to the corporate network. RSTP is not enabled on user-accessible LAN connectors. To prevent network loops, endpoints should not be connected to the corporate LAN in this configuration.

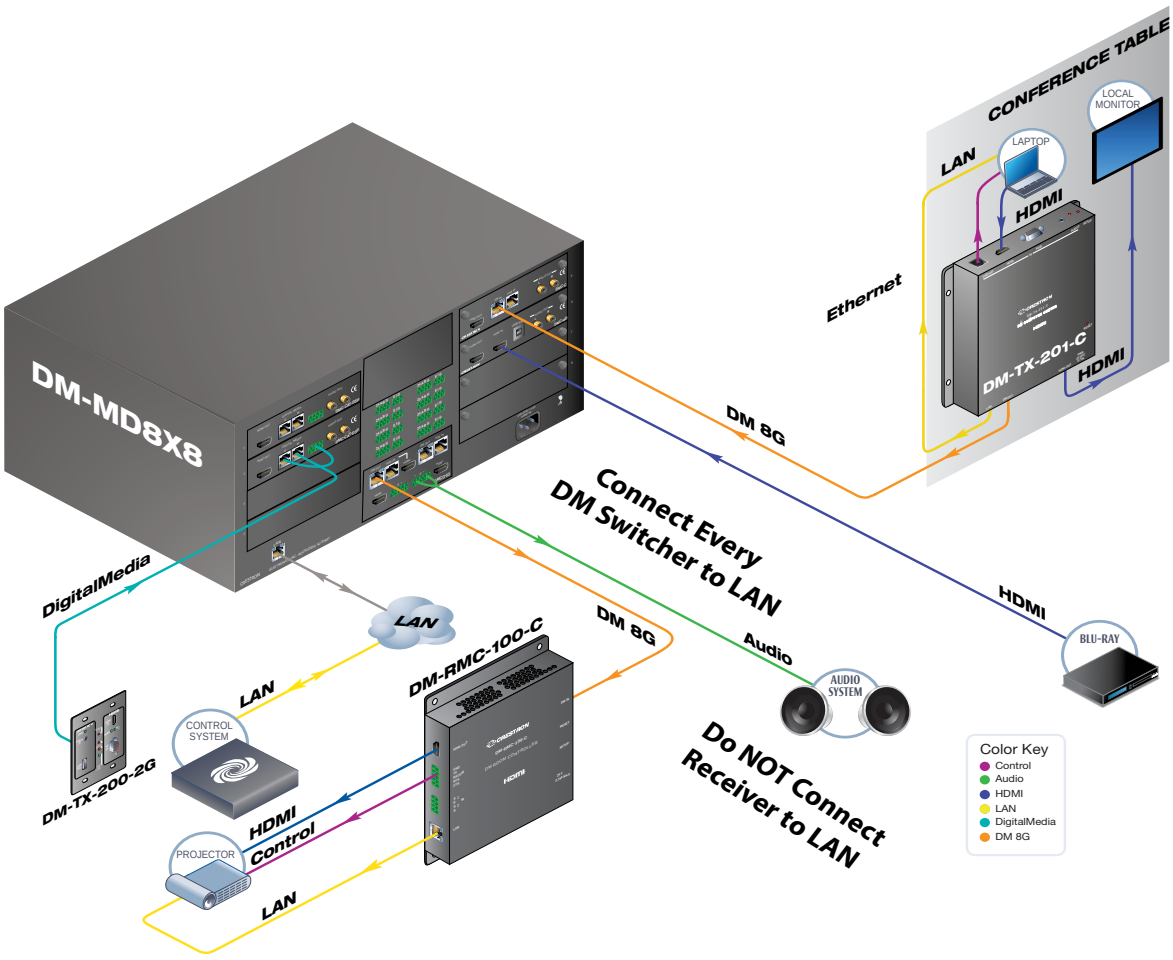
By default, every DM switcher ships with PNM and RSTP enabled. If PNM is disabled, RSTP remains enabled. If required, disable RSTP and manage Ethernet ports manually.

MSTP, which is an advanced version of RSTP, supports multiple spanning trees on multiple VLANs. DM implements RSTP—but not MSTP. If running MSTP on the network, ensure that the network port in which DM is connected only belongs to one VLAN. This is only a concern if PNM is disabled.

Managed Ethernet switches can be configured to have edge ports. No Ethernet switches can be plugged into edge ports.

- If PNM is enabled, a DM switcher is compatible with edge ports.
- If PNM is disabled, the managed Ethernet switches may consider the DM system to be an Ethernet switch and shut down the edge port.

DM Ethernet Wiring Example



NOTES:

- DM switchers should be the only devices in the DM system connected to the LAN.
- Ensure that the System ID of each DM switcher in the system is unique.
- Do not connect room controllers or transmitters to the LAN.

Appendix B: DM Cable Plant Certification

DigitalMedia infrastructure wiring should be tested before connecting DM equipment. The basic methods to certify the cable plant for DigitalMedia are outlined below. The certifications are very typical for an Ethernet style data network (most of the terminology and values are functions and vocabulary of the test equipment).

DM 8G STP Cable (DM-CBL-8G)

The cables should be certified to EIA/TIA-568 CAT5e with a certifying testing meter using the following:

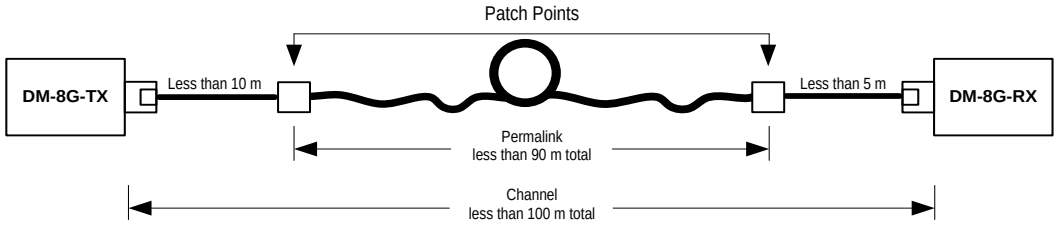
- Channel or CAT5e Permalink test
- FTP (foil twisted pair) cable with the shield test
- Nominal velocity of propagation is at 69%
- T568B wiring recommended (use T568A if that is the plant's wiring)

DM Ultra Cable (DM-CBL-ULTRA-NP and DM-CBL-ULTRA-P)

- Channel or CAT6a Permalink test
- S/FTP (shielded, foil twisted pair) cable with the shield test
- Nominal velocity of propagation is at 74% (non-plenum) and 78% (plenum)

If certifying patch points, use the Permalink test which assumes that short patch cables may be used on either end. If certifying the entire communications channel from port to port, use the Channel test (refer to the note below).

Permalink and Channel Test Example



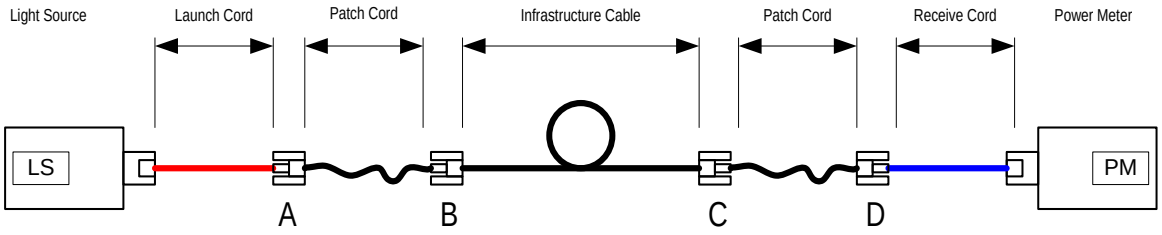
NOTE: Total patching should not exceed 10 m. Patching on the DM 8G RX side should not exceed 5 m.

Multimode and Single-Mode Fiber

Multimode and single-mode fiber should be tested for optical loss in accordance with their respective TIA/IEC test standards. The optical time domain reflectometer (OTDR) method of testing is strongly recommended. Each fiber end should be inspected with a 100 x to 200 x microscope and cleaned if necessary before testing.

Fiber links should always be tested end to end for optical insertion loss. The diagram below shows a typical fiber link being test and the associated test equipment. Note that patch cords and infrastructure fiber are included in the test.

Typical Fiber Link Test Example



Connector pairs B and C represent infrastructure patch panels while connector pairs A and D represent couplers. The couplers connect the fiber link being tested to the launch cord and receive cord associated with the test equipment.

Multimode fiber cable should be tested in accordance with TIA-526-14-B OFSTP-14-B Method B (One-Cord Reference Method). The European equivalent standard is IEC 61280-4-1.

Multimode fibers should be tested with 850 nm and 1300 nm wavelength sources. Due to the comparatively short lengths of multimode fiber runs and the varying fiber lengths supported by CRESFIBER8G and OM3, Crestron has simplified the acceptable loss requirement for multimode fiber. Acceptable insertion loss of each fiber link end to end is <4 dB @ 850 nm and <4 dB @ 1300 nm.

Single-mode fiber cables shall be tested in accordance with TIA-526-7 OFSTP-7 Method A.1 (one Jumper-Cable Measurement). The European equivalent standard is IEC 61280-4-2.

Single-mode fibers should be tested with 1310 nm and 1550 nm wavelength sources. Acceptable loss for each wavelength is determined by the sum of two factors:

- Number of connector pairs that are being tested. A connector pair is the pair of connectors that mate at each coupler or patch panel. The maximum allowed loss per pair is 0.75 dB.
- Total fiber length. The acceptable loss is defined in dB per kilometer and varies by wavelength.

The table below shows the acceptable insertion loss per kilometer at each wavelength for CRESFIBER8G-SM-P.

Wavelength, nm	Maximum Attenuation, dB/km
1310	0.4
1550	0.3

To calculate the maximum acceptable attenuation, add the losses allowed per connector pair to the loss allowed in the fiber. For example, a 10 km link maximum allowed fiber loss (F) is calculated as follows:

F = 0.4*10 = 4 dB @1310 nm
F = 0.3*10 = 3 dB @1550 nm

The total link loss (L) for the example above is as follows:

L = F+A+B+C+D = 4+0.75+0.75+0.75+0.75 = 7 dB @ 1310 nm
L = F+A+B+C+D = 3+0.75+0.75+0.75+0.75 = 6 dB @ 1550 nm

By comparison, the maximum allowed attenuation for a 500 m fiber link is less than half that of a 10 km link:

L = F+A+B+C+D = 0.20+0.75+0.75+0.75+0.75 = 3.2 dB @ 1310 nm
L = F+A+B+C+D = 0.15+0.75+0.75+0.75+0.75 = 3.15 dB @ 1550 nm

L = A+B+C = 0.75+0.75+3 = 4.5 dB @ 1550 nm

The equipment that is needed for testing is as follows:

- Fiber Optic Microscope (for example, SPCfiber DI-200 Fiber Optic Inspection Scope)
- Fiber Optic Cleaning Wipes (for example, wipes included with CRESFIBER-TK)
- Multimode Fiber Optic Loss Test Kit
- Single-Mode Fiber Optic Loss Test Kit (for example, CKSM-2 Contractor Series Multimode and Single-Mode Test Kit)

Why is a longer fiber cable allowed to have more loss?

An 8G receiver should accept a certain fixed amount of power loss over a fiber link regardless of length. However, these measurements are more than just a measurement of optical power losses. They are an indicator of connector termination quality and fiber integrity. Poorly terminated connectors and kinked fibers cause easy-to-measure optical power losses as well as other problematic but difficult-to-measure artifacts such as optical reflections A short, poorly terminated single-mode fiber with 7 dB of loss may output the same optical power as a much longer well-terminated fiber; however, the short fiber has reflection issues that may result in video loss or other link problems.

Testing HDMI Cables

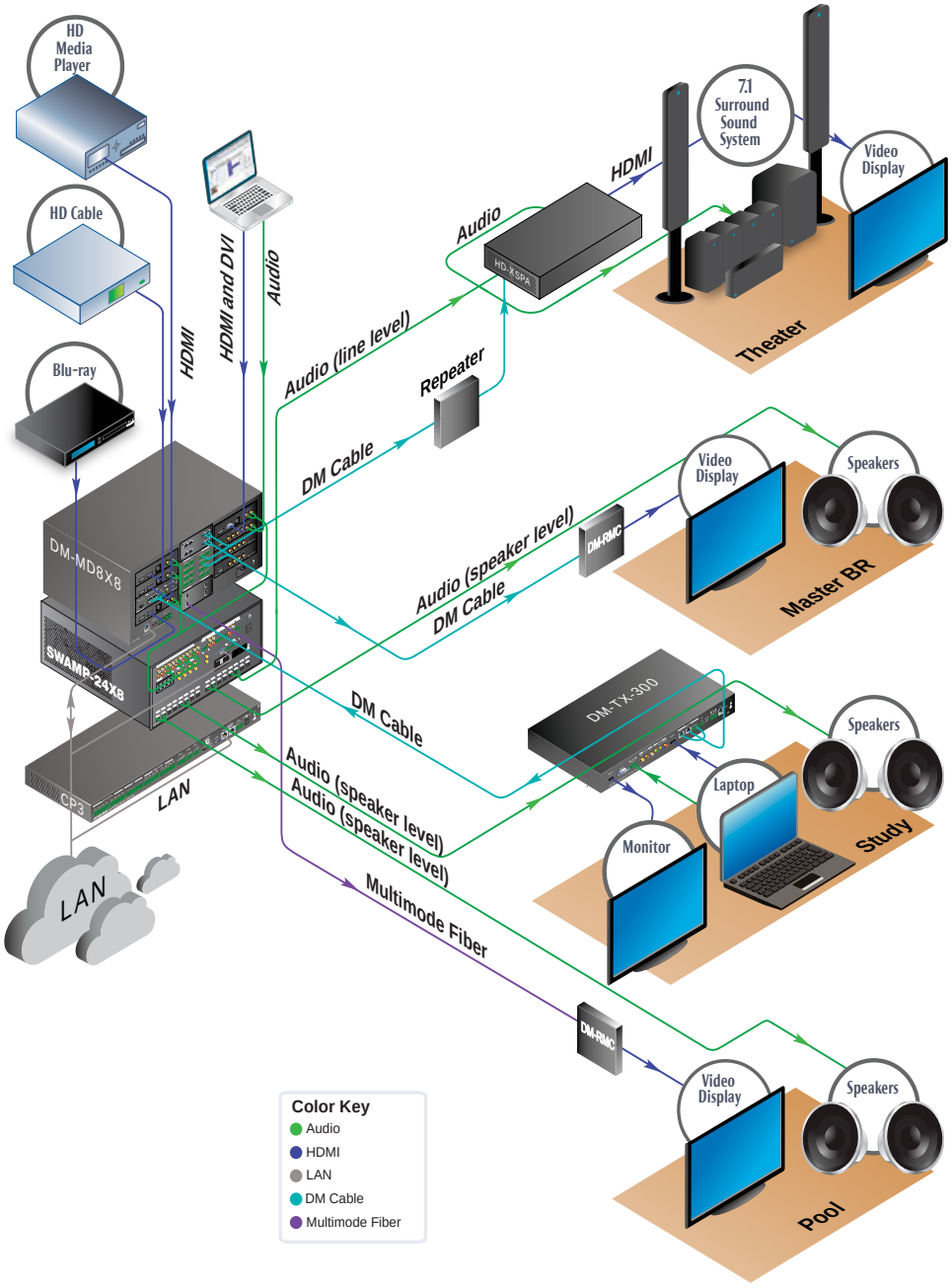
HDMI cables should be tested using a Quantum Data 780 wire test function.

Appendix C: Application Diagrams

This section provides several different DigitalMedia system applications. For additional application diagrams, refer to the Crestron DigitalMedia Page on the Crestron website.

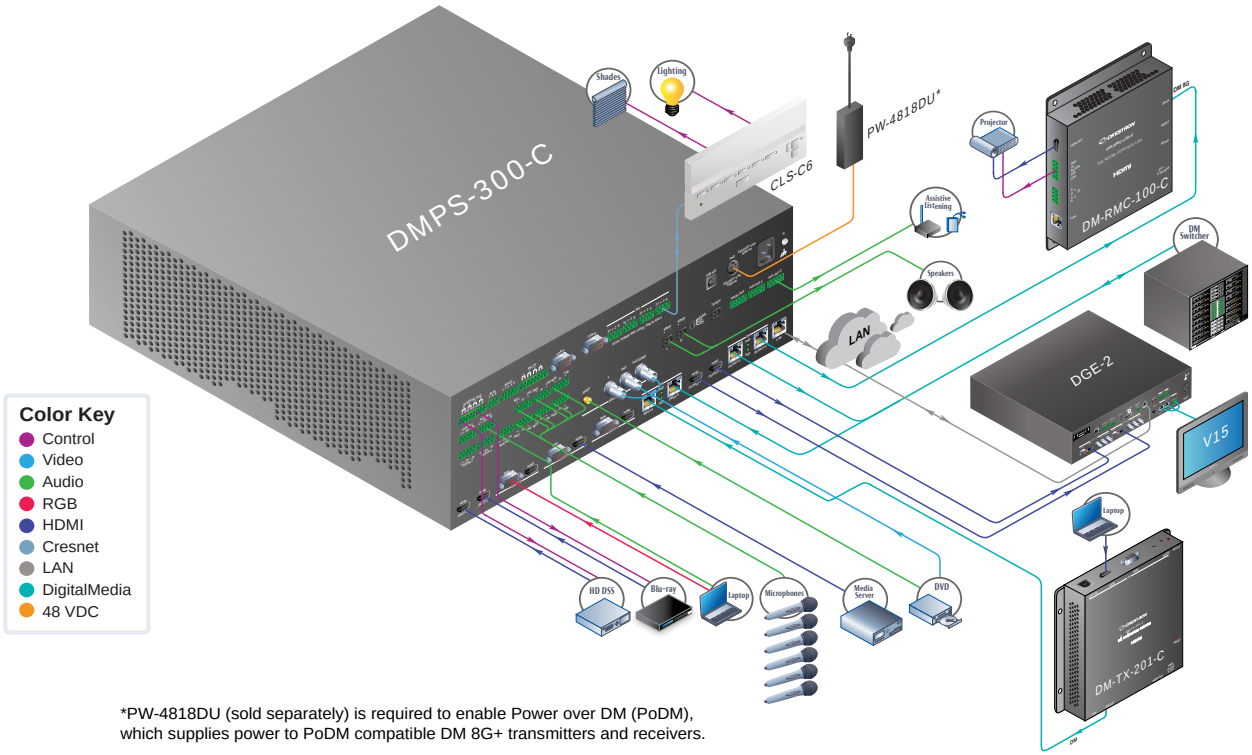
Residential Multiroom Distribution

Multiroom distribution in residential environments involves the combining of several sources and format types to different makes and resolutions of displays. Crestron DigitalMedia enables the distribution, resolutiondetermination, and HDCP management across a minimal whole home infrastructure. The example below shows multiroom distribution in a residential environment.



Commercial Video Conference Room

Video conference rooms require combining disparate media to be transmitted to a remote location and on multiple local displays simultaneously. All teleconference codes now provide an HD signal via HDMI with HDCP protection. The Crestron DigitalMedia distribution system brings together analog and digital managing resolutions and EDID to provide the highest quality signal with our exclusive low-latency QuickSwitch HD switching technology. The example below shows a commercial video conference room.

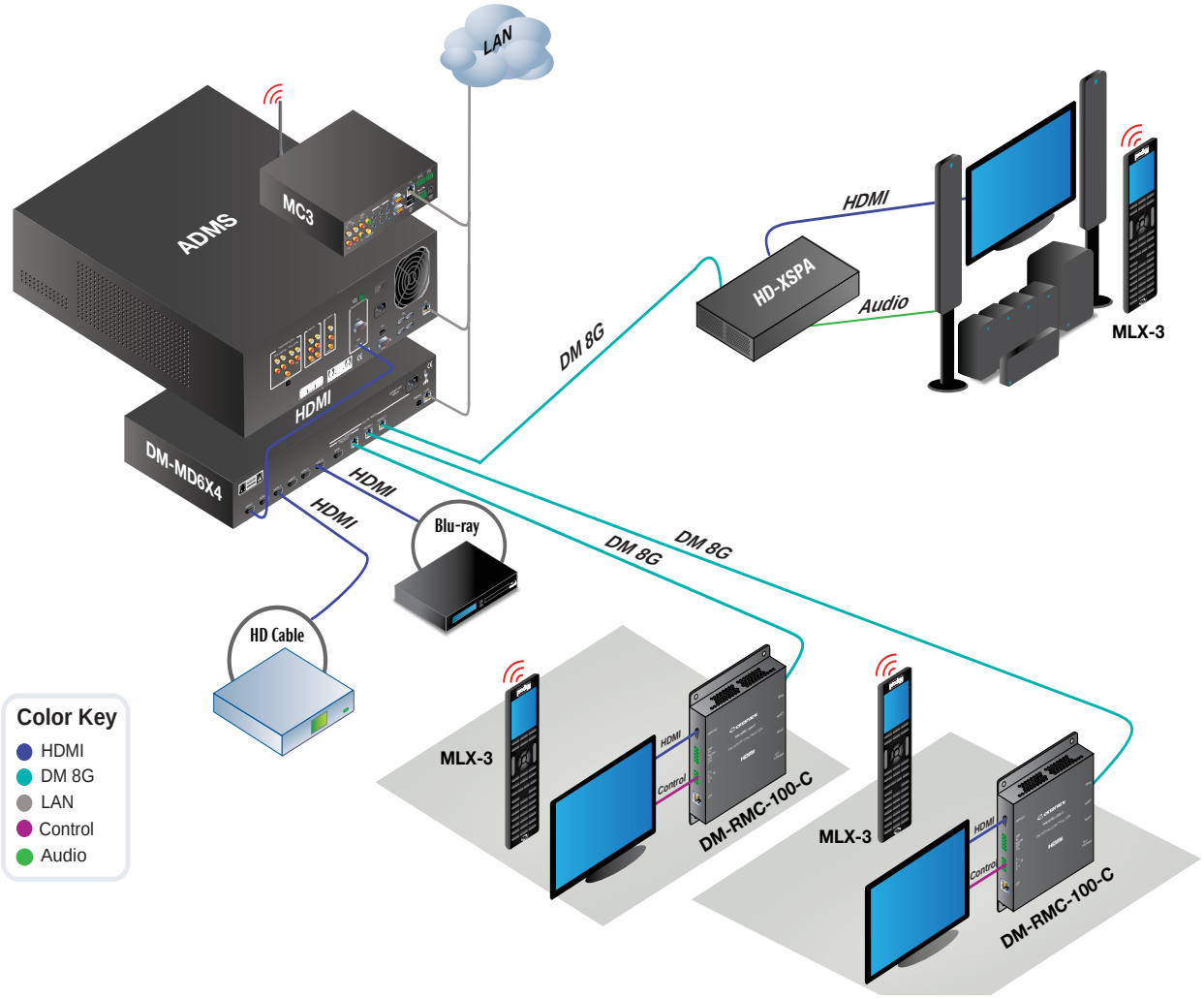


*PW-4818DU (sold separately) is required to enable Power over DM (PoDM), which supplies power to PoDM compatible DM 8G+ transmitters and receivers.

Residential DM-MD6X4 System

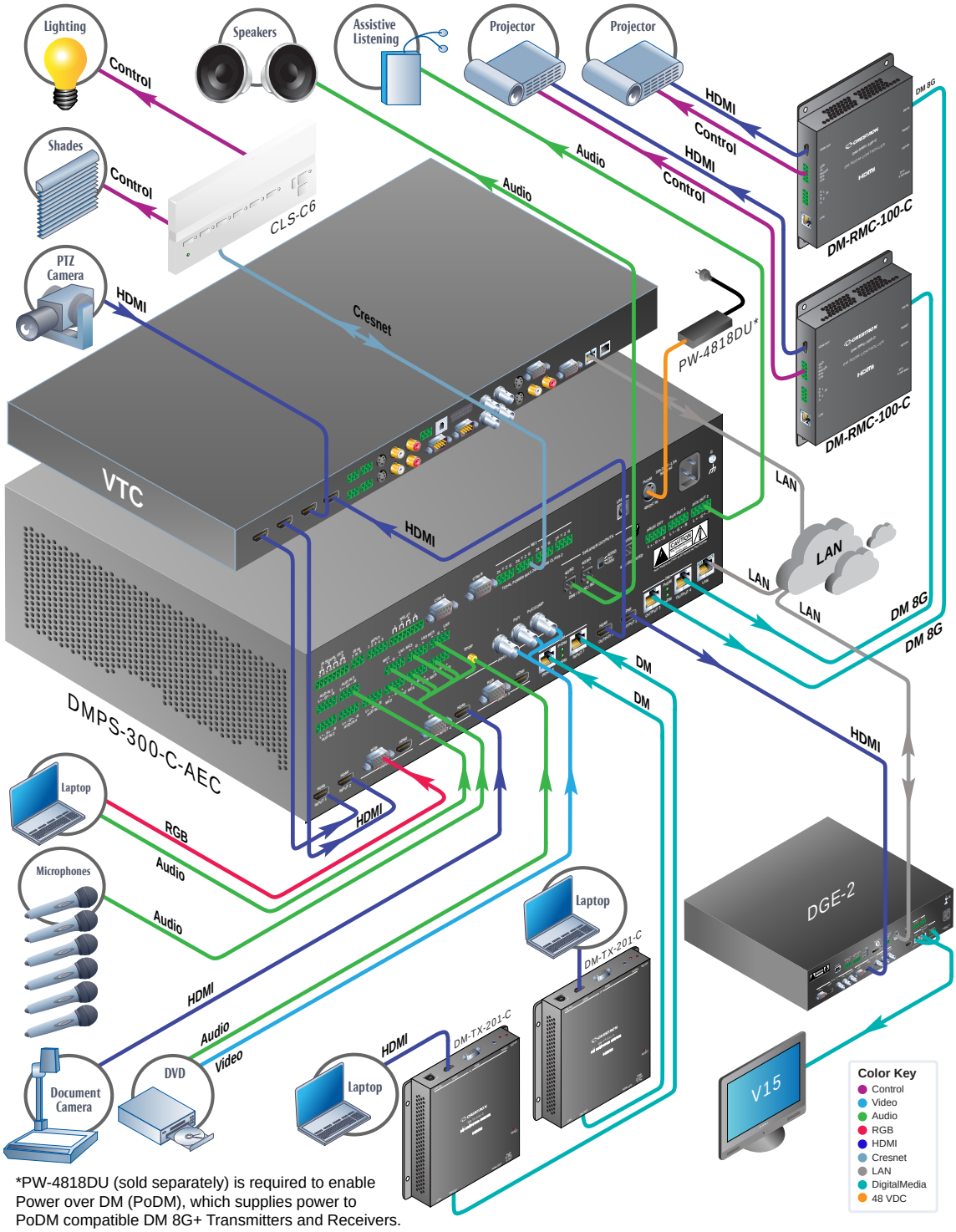
The example below shows a residential DM-MD6X4 system with the following:

- A 2U rack mount DM matrix switcher that includes three DM 8G+ outputs and one HDMI output.
- The DM-RMC-100-C provides video, audio, Ethernet, and control to each display.
- The HD-XSPA serves as a DM receiver with full surround sound processing and amplifiers.



Commercial Video Conference Room with DMPS-300-C-AEC

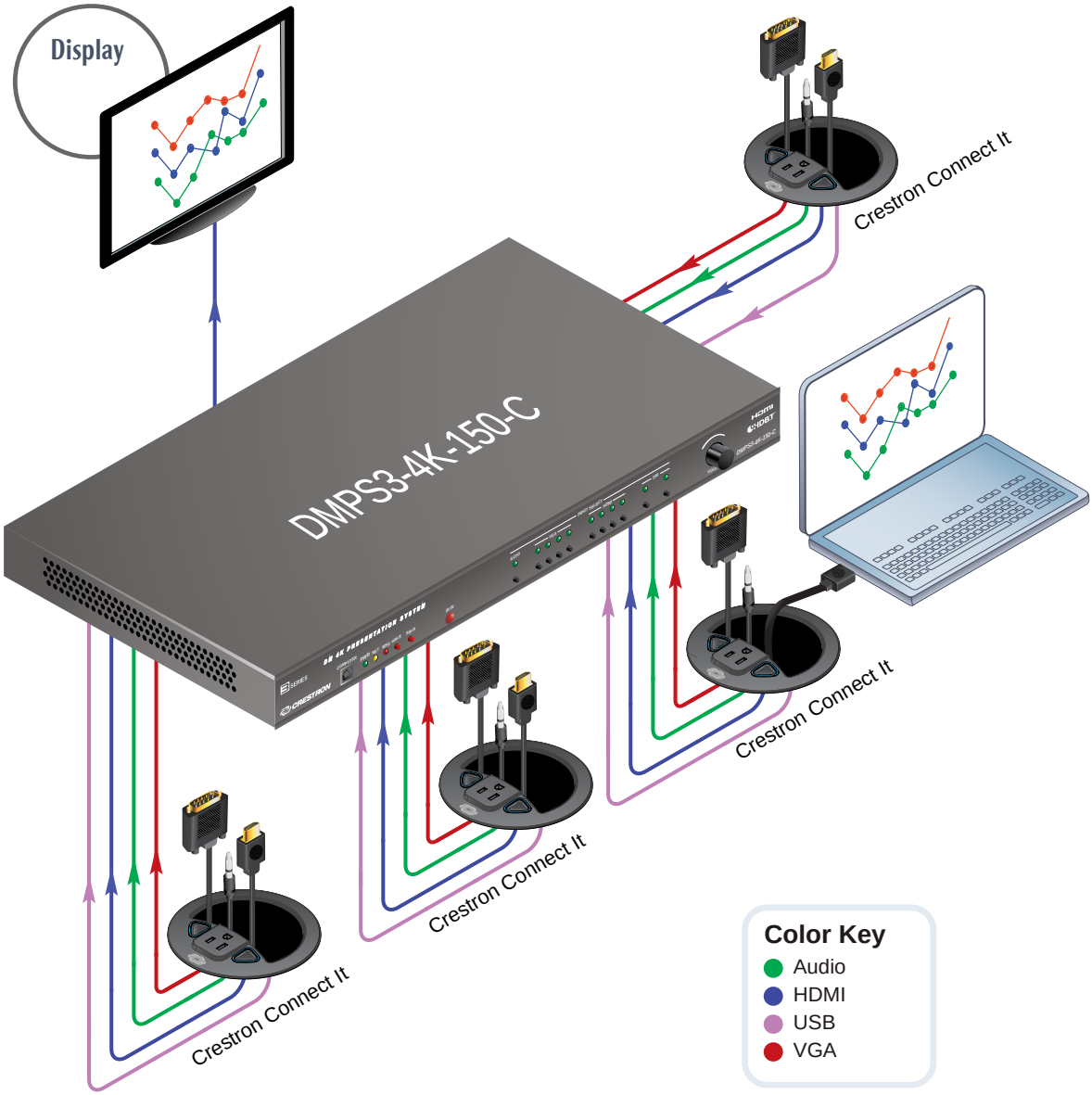
The DMPS-300-C-AEC integrates the control system, multimedia matrix switcher, mic mixer with Acoustic Echo Cancellation (AEC), audio DSP, and amplifie . The DMPS-300-C-AEC affords extensive signal routing flexibility and high-performance signal processing and can be used with both video and audio conferencing without the need for an additional mixer or processors. The example below shows a commercial video conference room using a DMPS-300-C-AEC.



*PW-4818DU (sold separately) is required to enable Power over DM (PoDM), which supplies power to PoDM compatible DM 8G+ Transmitters and Receivers.

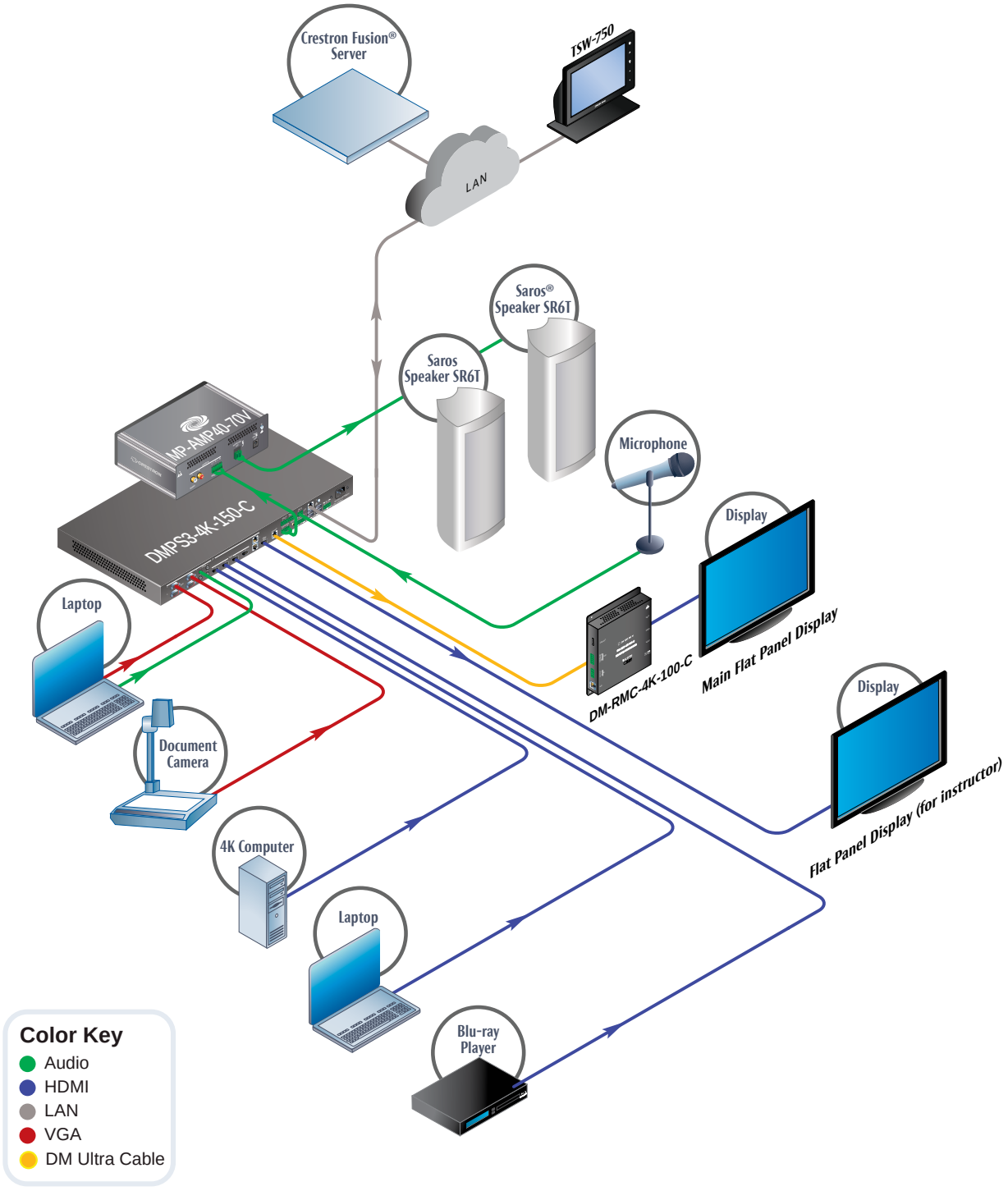
DMPS3-4K-150-C with a TT-100

The example below shows a simple huddle space with four Crestron Connect It cable caddies connected to a DMPS3-4K-150-C.



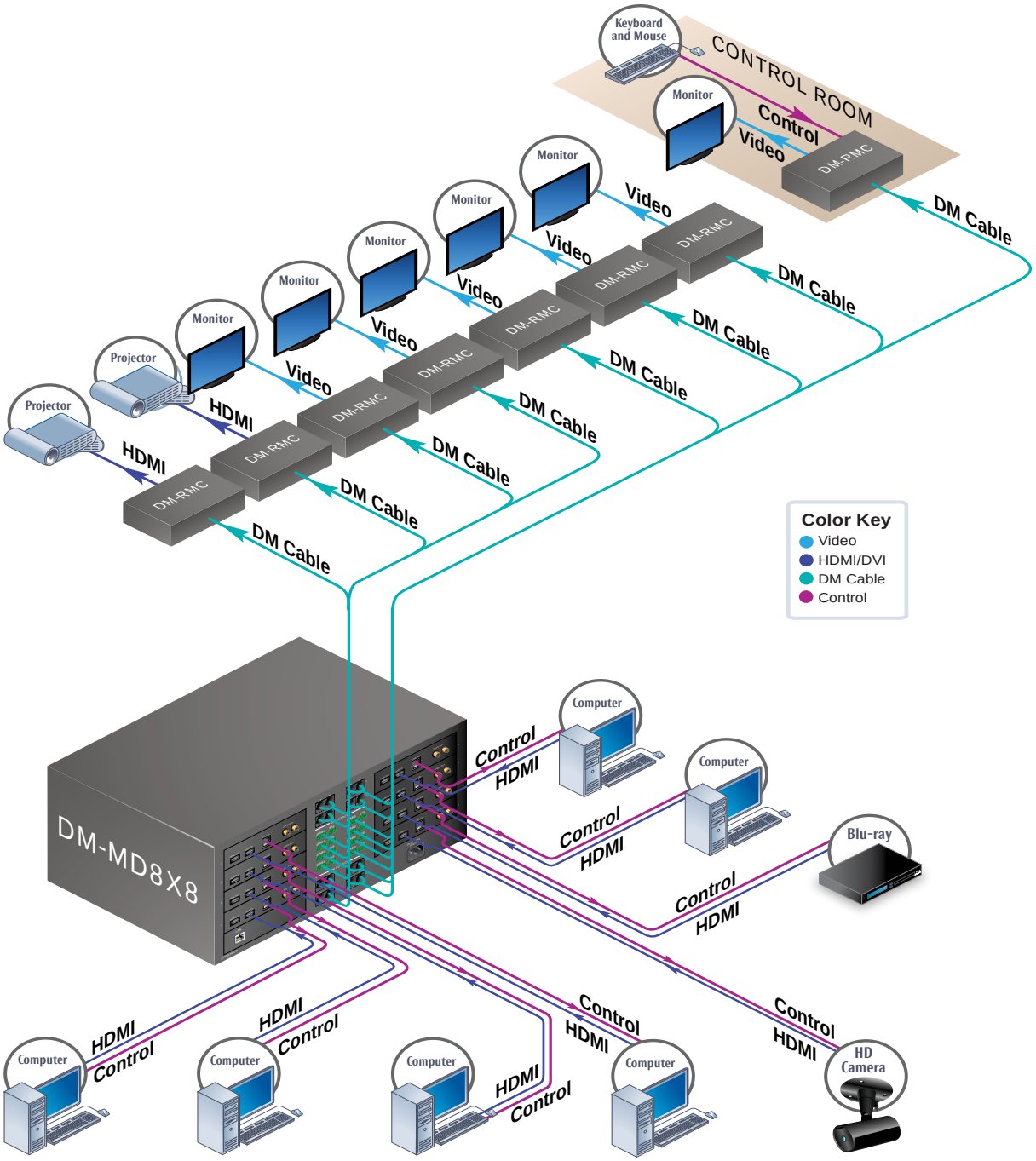
DMPS3-4K-150-C Basic Classroom

The example below shows a basic classroom system powered by a DMPS3-4K-150-C.



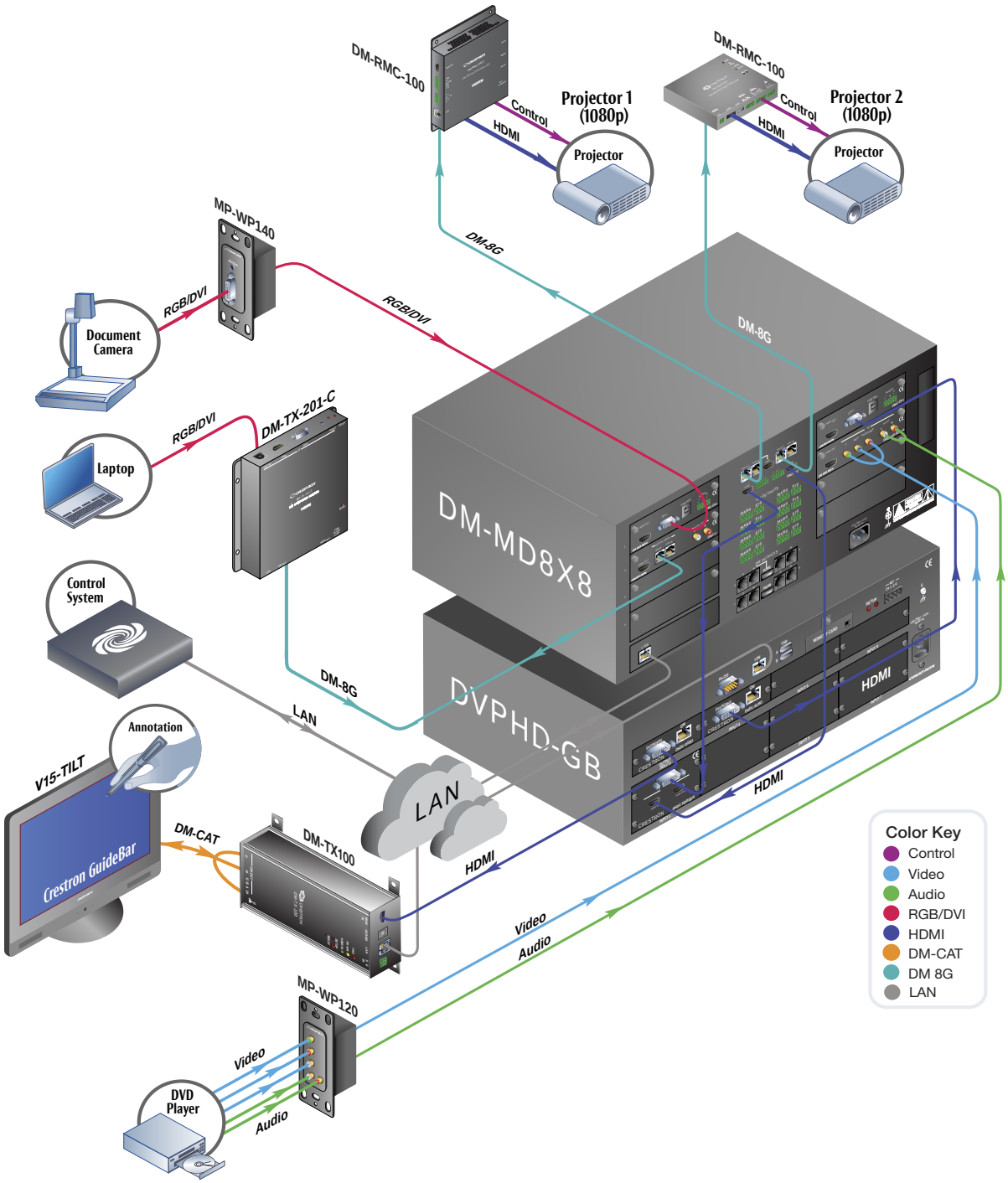
Digital Signage System

Digital out-of-home advertising and information systems require dynamic high-resolution graphics, glitch-free switching, and a straightforward topology. Crestron DigitalMedia provides the best method of content delivery in high-definition. The example below shows a digital signage system with multisource, multidisplay HDMI distribution, and long-distance capability using CresFiber. The source computer is controlled via a USB HID connection on any DM receiver.



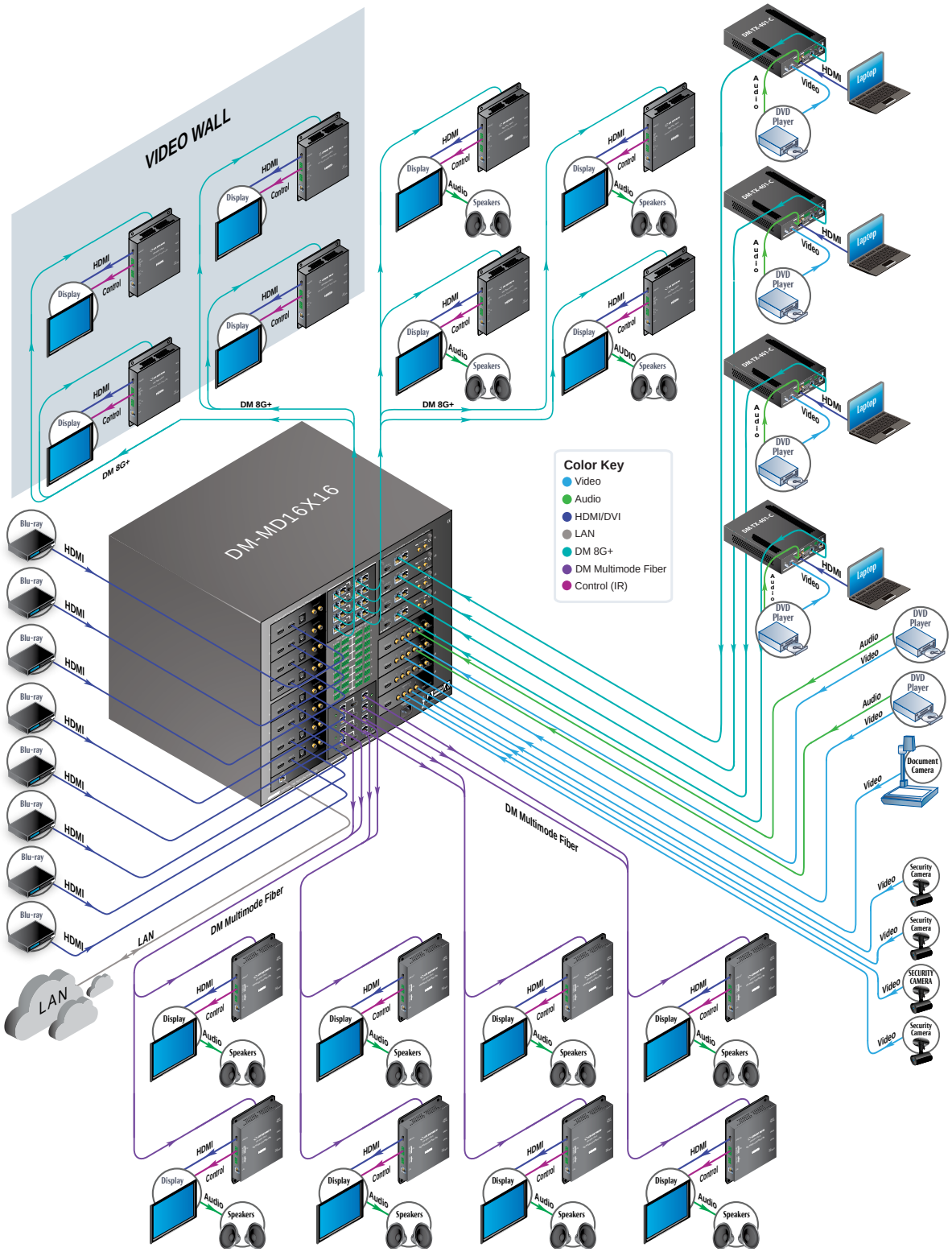
Multiwindow Processing and Annotation with DM Switching

Crestron DM, combined with the DVPHD-GB video processor, provides HD multiwindow processing, annotation, switching, and full HDCP support. The example below shows multiwindow processing and annotation using DM switching.



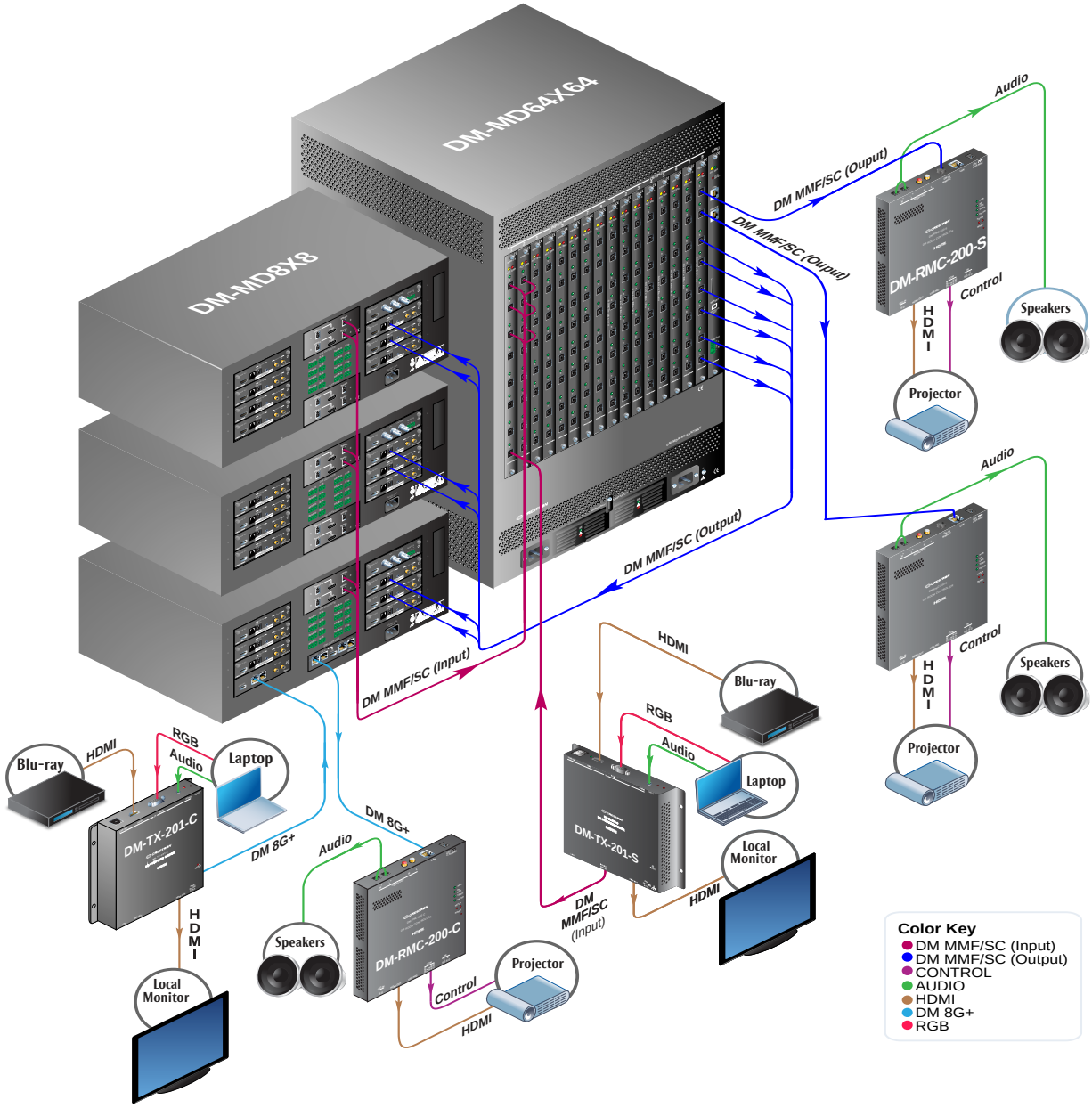
Large-Scale System Using a DM-MD16X16

The example below shows a large-scale distribution system using a DM-MD16X16 with full audio and USB breakaway and a 7-space, 19-inch rack-mountable DM-MD16X16 switcher.



Large-Scale System Using a DM-MD64X64

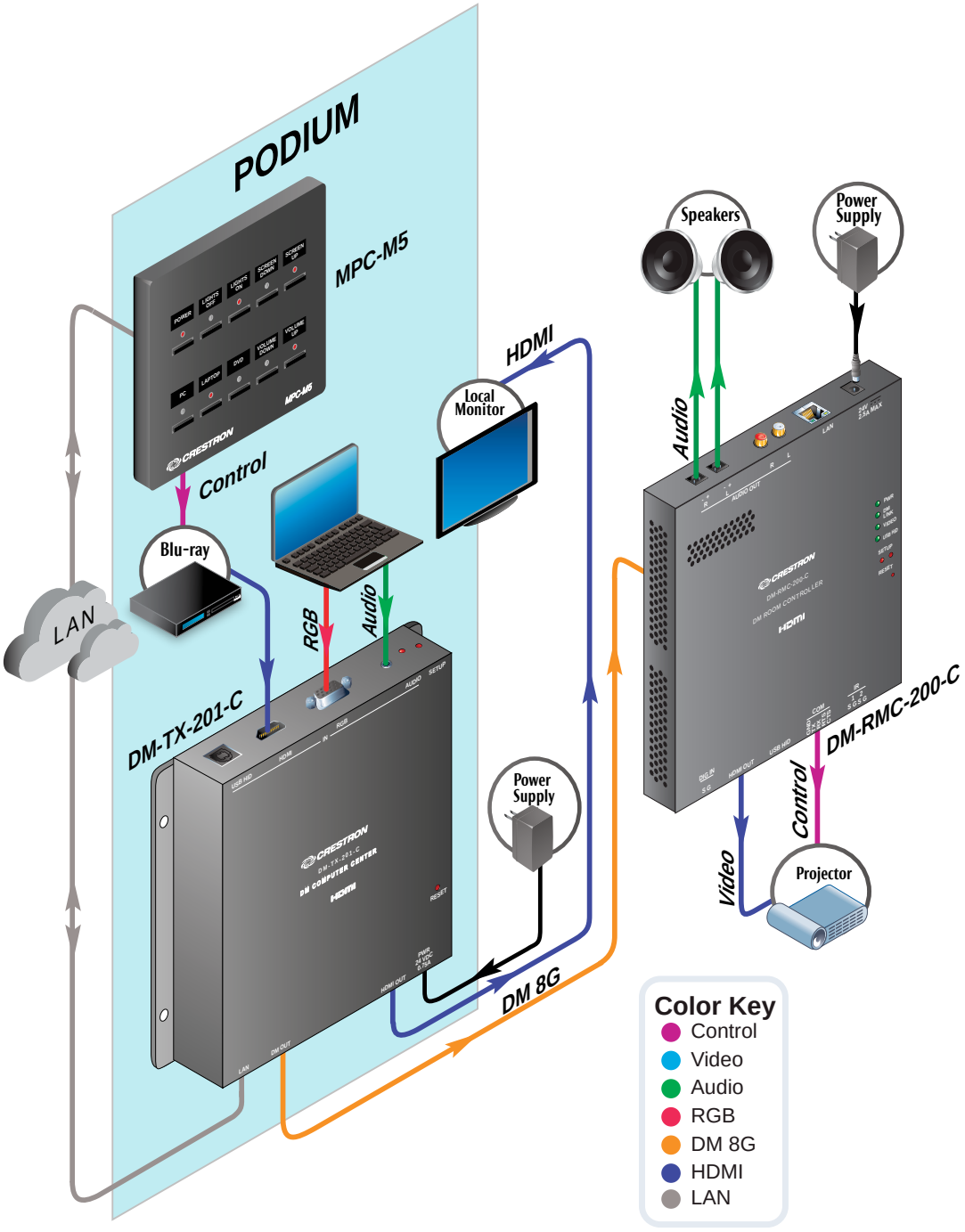
The example below shows a large-scale distribution system with a DM-MD64X64. This system requires switcher systems with the flexibility and power to manage multiple source and destination resolutions and HDCP keys.



Low-Cost Classroom Using DM 8G+

The example below shows a low-cost classroom using DM 8G+ with the following:

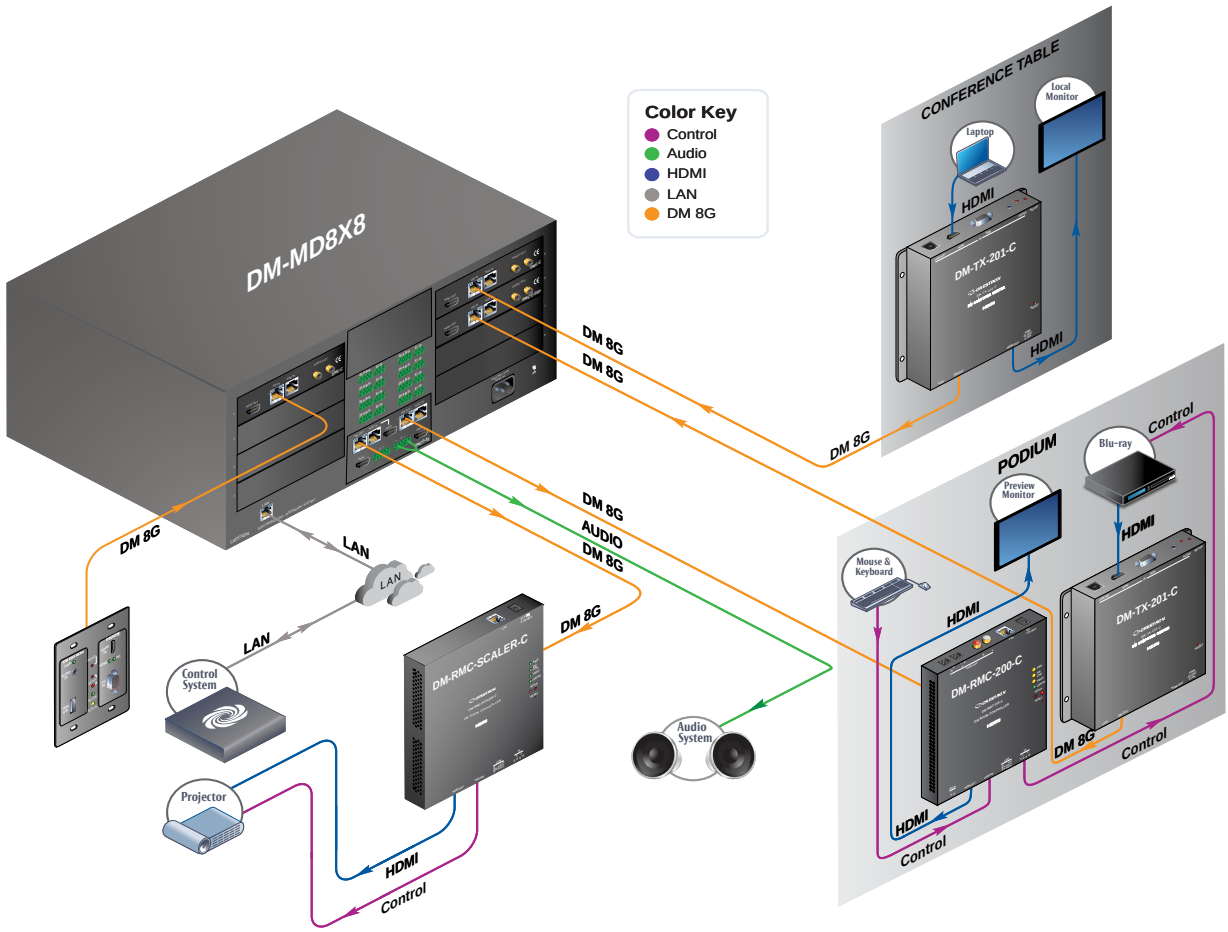
- The laptop and Blu-ray sources are located at the podium (local monitor can display either source).
- The single DM 8G+ cable runs from the podium to the room controller located by the ceiling projector.
- The projector connects via HDMI and a built-in, 30-watt amplifier powers the speakers in the room.
- The control system is connected via Ethernet.



Powerful Boardroom Using DM 8G and DM CAT

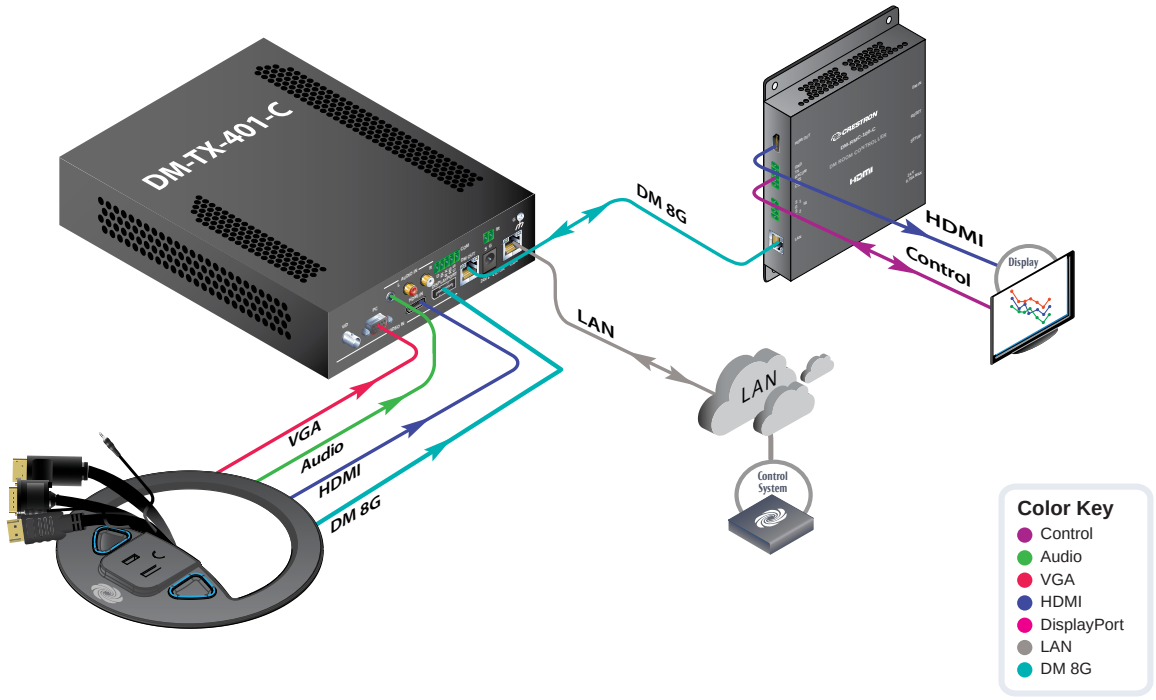
The example below shows a boardroom using DM 8G and DM CAT.

- The DM-MD8X8 connects to the control system via Ethernet and to the wall plates via DigitalMedia CAT.
- The two room controllers and two computer centers connect to the DM-MD8X8 via DigitalMedia 8G STP.
- The first room controller (DM-RMC-100-C) sends video to the projector via HDMI.
- The second room controller (DM-RMC-200-C) sends video to a monitor via HDMI, connects the USB keyboard and mouse, and controls the Blu-ray player via IR.
- The computer center (DM-TX-201-C) at the podium sends Blu-ray audio and video to the DM-MD8X8.
- The computer center (DM-TX-201-C) at the conference table sends audio and video from the laptop to the DM-MD8X8, and mirrors the laptop display on a local monitor.



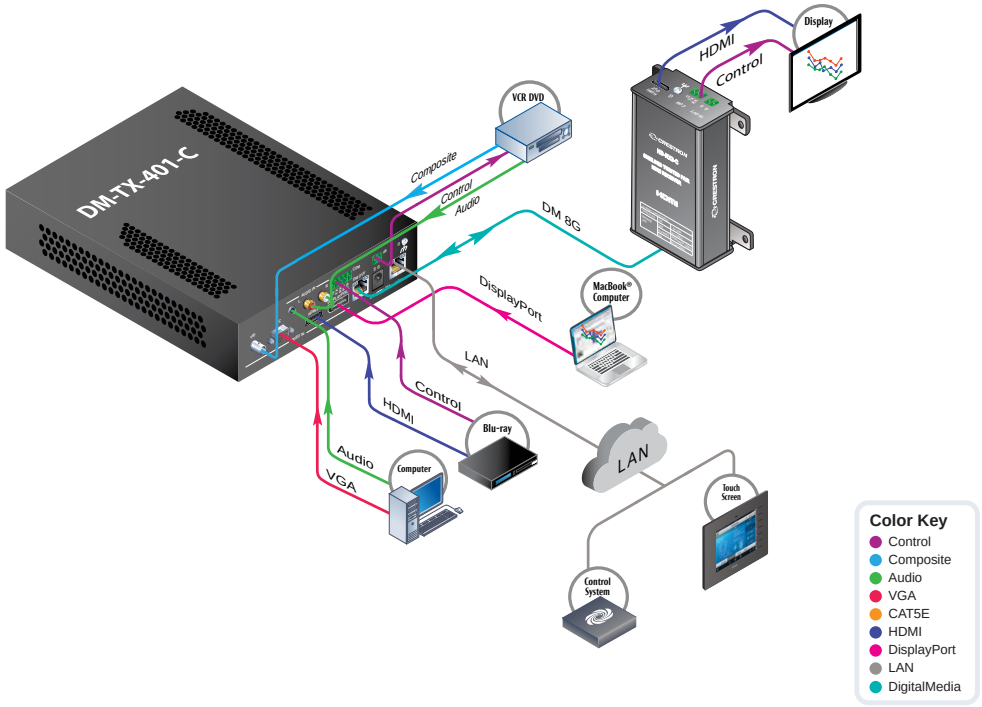
DM-TX-401-C BYOD with Crestron Connect It

The example below shows a simple, low-cost point-to-point HD AV presentation solution with BYOD source.



DM-TX-401-C with Installed Sources

The example below shows a simple, low-cost point-to-point HD AV presentation solution with installed sources.



Appendix D: In-Depth Look at HDMI

High Definition Multimedia Interface (HDMI) is an uncompressed, all digital AV interface. By delivering crystal clear, all digital audio and video via a single cable, HDMI dramatically simplifies cabling and provides consumers with the highest quality AV experience.

Consumers using HDMI devices supporting HDCP have the comfort of knowing that they have access to premium HD content now and in the future. Content providers (movie studios and television networks) are requiring that devices transmit HD video to only protected outputs that use HDCP.

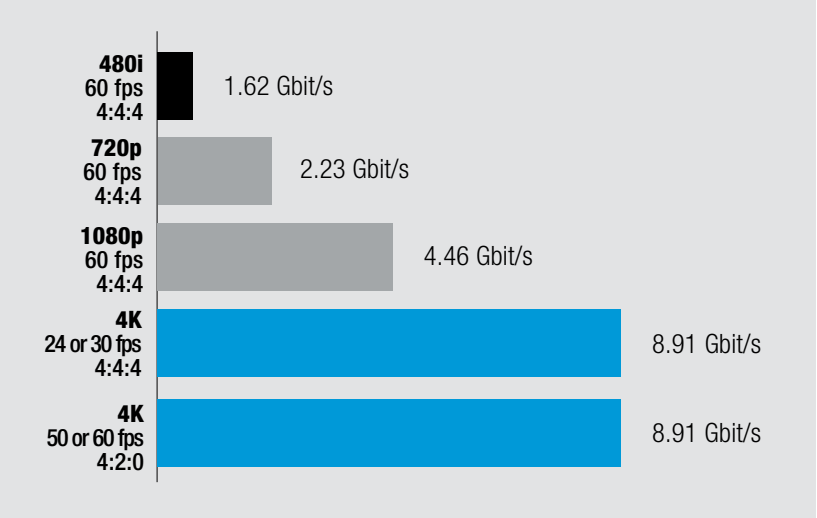
Because HDMI is a digital interface, it has lossless transmission and provides the best video quality—unlike analog video. The difference is especially noticeable in low brightness scenes and at higher resolutions, such as 1080p and 4K. Digital video is sharper than component video and eliminates the softness and ghosting found with component video. The small high-contrast details, such as text, especially show this difference.

HDMI combines video and multichannel audio in a single cable, eliminating the cost, complexity, and confusion of multiple cables currently used in AV systems. This is particularly beneficial when equipment is upgraded or added.

HDMI supports two-way communication between the video source (such as a DVD player) and the DTV, enabling new functionality such as automatic configuration. By using HDMI, devices automatically deliver the most effective formats (such as 480p vs. 720p, 16:9 vs. 4:3) eliminating the need for external intervention to identify the best resolutions and audio formats.

HDMI has one cable carrying uncompressed digital HD video and audio. There are two primary reasons for HDMI problems: bandwidth and complexity. Uncompressed HD video requires enormous digital bandwidth, which is difficult to push through copper wire. Popular features such as 4K resolution can be added. There are a number of products appearing on the market that attempt to address this issue.

Required Data Rates with HDMI Overhead



HDMI is a full-duplex digital communications interface. HDMI takes advantage of its digital nature and adds several communication mechanisms to automatically control and encrypt content. HDMI does not scale well. Since digital control is relatively new to most of the major AV distribution players, the learning curve has been very steep.

Though much more complex than analog, HDMI is not nearly as complicated as home automation, Ethernet, or any of the myriad wireless protocols. Companies with experience in these fields are in a position to implement HDMI in environments that the designers did not anticipate.

Comparing Analog and HDMI Cables

Analog Cable

- Separate audio and video cables
- Robust signals
- Field termination
- Inexpensive
- Installer friendly
- Reliable multiroom distribution
- Distance is rarely an issue
- No copy protection (DRM) support

HDMI Cable

- Single AV cable
- Delicate signals
- Cannot be field terminated
- Very expensive
- Difficult to run
- Unreliable multiroom solution
- Limited distance
- Supports copy protection

The complexity of HDMI becomes obvious when HDMI cables are compared to analog audio and video cables. Analog cables typically consist of one to three wire pairs, depending on the format, and they simply carry an audio or video signal (not both). In contrast, the HDMI cable consists of 19 wires, which carry high-speed video, audio, and other digital information. The digital audio and video data is encoded into three color channels and a clock channel. Audio is embedded inside the video data and is inserted and extracted at each end. Additional information carried by HDMI includes the following:

- The Data Display Channel (DDC) is a two-way communications interface between the source and the downstream repeater or display device. This channel was originally provided to communicate device capability information, which is encoded in EDID. HDMI devices use EDID to indicate what audio and video formats they support. The DDC interface is also used to set up and maintain HDCP encryption.
- The downstream device, or sink, indicates its presence to the source with the hot plug detect (HPD) signal, which allows each device to know when a cable has been connected and to start authentication.
- Consumer Electronics Control (CEC) is a function that provides control to multiple devices over HDMI using one remote control. A secondary device receives commands from a primary device. Although CEC wiring is required for every HDMI port, it does not mean that every HDMI port has the function enabled.

Depending on the device and manufacturer, DDC, HPD, and CEC signals interact differently. This inconsistency can negatively affect device performance. Additional control signals are associated with HDMI, but they are beyond the scope of this guide.

Topology

Every HDMI installation consists of at least one content source, like a cable box or Blu-ray player, and a TV or a projector. Most custom installations also involve at least one repeater, which is a device that accepts and retransmits HDMI content. Repeaters include simple devices such as switches and distribution amplifiers as well as more feature-rich devices such as audio and video processors.

EDID

HDMI display devices and surround sound receivers use EDID to communicate their audio and video capabilities. Embedded in the HDMI signal, EDID data is generated by a display or audio processor to inform the upstream source about its format and resolution capabilities. In response to this data, the source ordinarily configures itself to send the best video resolution and audio format that both devices can support. For example, Blu-ray players include video scalers to best match the disc's native format to the capabilities of the television or projector.

In the simplest installations, with one television and an audio processor, the EDID protocol works reasonably well. Multiroom installations can quickly become problematic when several televisions are connected to several sources through one or more HDMI switches. Neither the HDMI nor the EDID specifications offer assistance to the user.

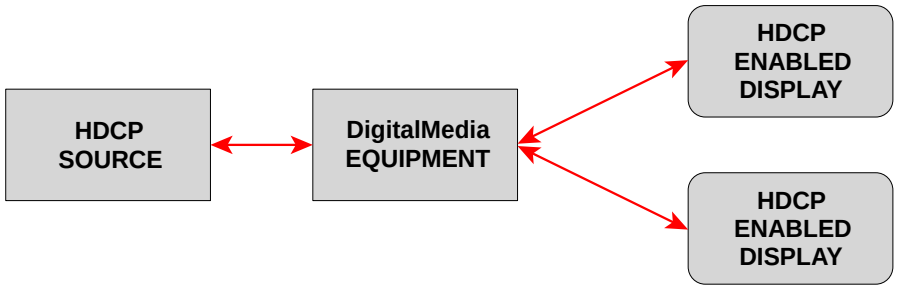
Refer to "EDID Design" on page 52 for more information on EDID design.

HDCP

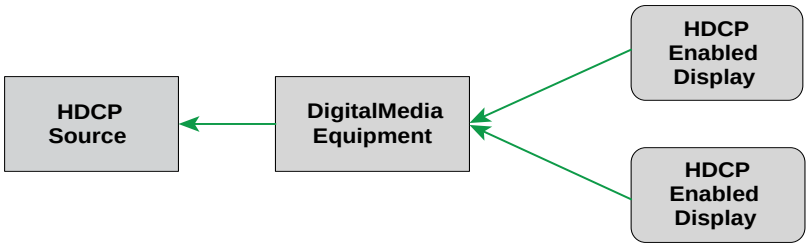
High-bandwidth Digital Content Protection (HDCP) is an encryption scheme that content providers use to protect their DVDs, Blu-ray discs, and broadcast signals against unauthorized copying. HDCP management ensures that protected content cannot be distributed via streaming. The HDCP system does the following:

- Authenticates HDCP devices to make sure they are authorized to receive the content. The authentication ensures that all devices receiving the content are licensed and authorized. Only after successful authentication will the display be able to output the audio and video streams.
- Encrypts the content to prevent interception during transmission.

HDCP Authenticates Each Device via the Source



HDCP Encrypts Each Individual Segment of an AV Transmission



Devices that retransmit HDCP content must inform the source of all the downstream connections in the system. Every HDCP device has a unique ID, known as a Key Selection Vector (KSV), which must be passed to the source. The source must then verify each device before it transmits content. It is this authentication process that causes the switch time delay in HDMI devices.

DigitalMedia solves the blank screen issue by utilizing a technology called QuickSwitch HD. QuickSwitch HD manages the keys for every HDCP-compliant device in the system, maintaining continuous authentication for each device to ensure fast, reliable routing of any source to any number of display devices. In a standard HDMI switcher, each display is authenticated dynamically when video is routed. With DigitalMedia, the authentication process takes place as displays are added. During initialization, sources are authenticated with each display through the DM system before any audio or video is routed.

Crestron's High-Definition Digital Video Processor (DVPHD) is the first multiwind w video processor of its kind that handles HDCP to work with a complete range of digital video players, cable and satellite receivers, multimedia computers, displays, and projectors. While other manufacturers ignore HDCP completely, the DVPHD actually performs advanced HDCP signal management, allowing up to eight HDCP-encrypted sources to be combined on one high-definition screen

Consumer Electronics Control

Each HDMI cable contains a communication link that enables devices connected via HDMI to talk to each other. This protocol is called Consumer Electronics Control (CEC). When a control system is in place, other devices should not issue commands. CEC is supposed to contain industry standard commands for interoperability, but inconsistent support from CE manufacturers has caused a wide variation in the functions that can actually be triggered from each device. Some examples of this functionality that Crestron has discovered are as follows:

- Multiple DVD players from the same manufacturer in the same system communicate with each other so that only one can play at a time. Every time one player is issued the play command, the player sends a pause command to the other players over CEC.
- When a Blu-ray player is turned off, it sends a power off command, turning off all displays connected to the system.

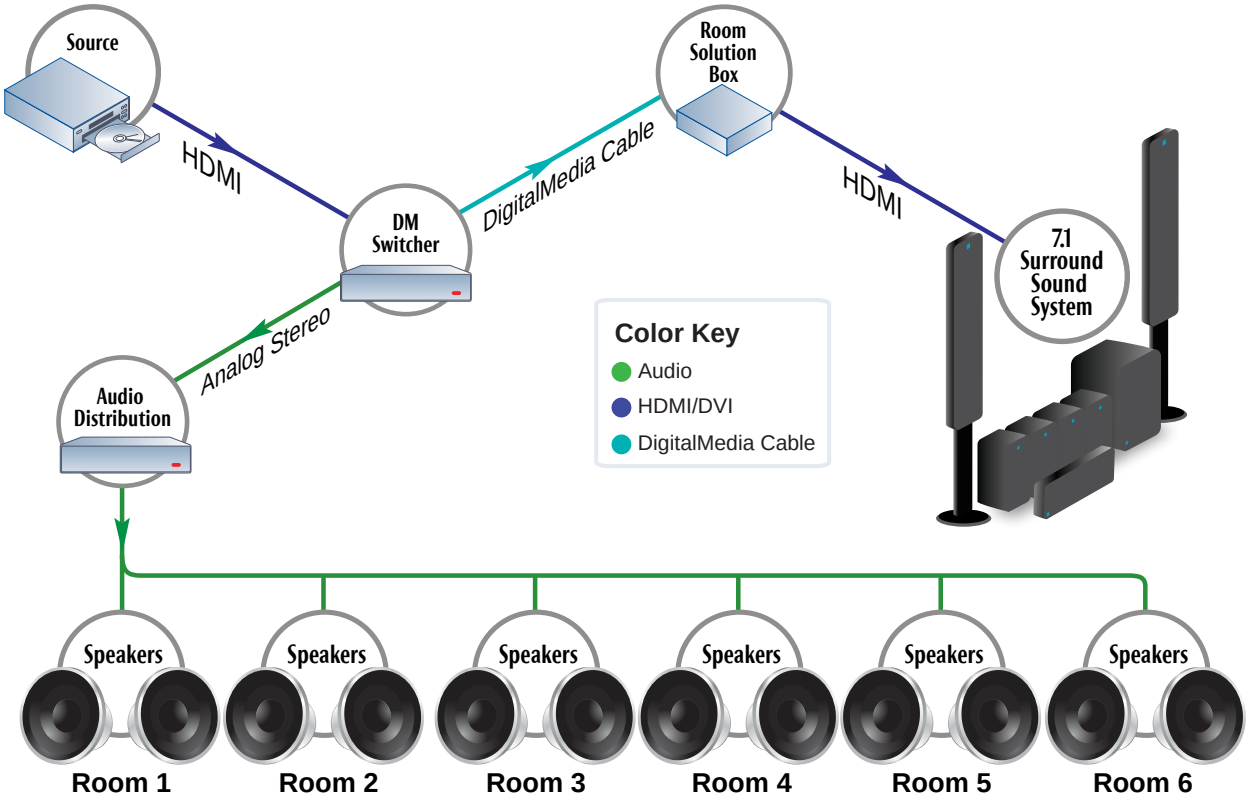
These functional commands are a major issue because they are sent behind the scenes. DigitalMedia breaks the communication path between the HDMI devices that are connected to the switch; therefore, these commands cannot be sent without approval. DigitalMedia provides a method to issue CEC commands from a control system so that the communication link can be used as an alternative to IR and RS-232 control.

Audio

HDMI provides the only transmission link for 7.1-channel HD audio. However, unlike traditional analog video sources, HDMI sources usually do not transmit multichannel and 2-channel audio at the same time. This becomes a problem for multiroom distribution in which a mixture of surround sound and stereo audio rooms are present. HDMI sources often shut off analog outputs when sending audio over HDMI.

DigitalMedia solves this problem by offering special HDMI cards that take in a multichannel audio stream and output both types of audio for distribution. These special cards are noted by a -DSP suffix.

Audio Distribution Example



Convergence

HDMI enables computers to deliver premium media content, including high-definition movies and multichannel audio formats. It is the only interface that enables direct connections to both HDTVs and digital computer monitors while upholding the DVI and HDMI standards.

HDMI is fully compatible with all DVI-enabled computers because HDMI was developed using the same technology as Digital Visual Interface (DVI), which has been the most common digital connection for computers. Because HDMI offers both audio and video over one cable and DVI only carries video, DVI and HDMI connectivity requires a separate audio cable.

DisplayPort

DisplayPort is a VESA standard for digital video connection and is similar to HDMI in functionality. The DisplayPort standard was driven by the PC industry to achieve a low-cost process for transferring video from a computer to a laptop screen and external digital video output. Both protocols support 1080p and higher resolutions, HDCP content protection, and multichannel audio. HDMI additionally supports some items not supported by DisplayPort, such as CEC Control.

Summary

Wide support from content providers and the consumer electronics marketplace makes HDMI the future of HD video transmission. There are many problems with HDMI and the problems are not just limited to cable length issues. Processing EDID and managing HDCP requires complex microcontrollers, especially when several rooms are involved. Switching systems must be easily customizable to intelligently handle HDCP and EDID.

DigitalMedia manages these various communication mechanisms and provides extensive troubleshooting information so that the installer can solve issues such as cable failure, device incompatibilities, and content protection complications.

Glossary

4K: A class of resolutions for content with the resolution of approximately 4000 x 2000 pixels.

4K Ultra HD (UHD): UHD has a resolution of 3840 pixels by 2160 lines and provides two times more horizontal and vertical resolution than the 1080p high definition television (HDTV) format.

480i: A form of standard digital television (SDTV) that assesses the quality of analog television but is not considered HDTV. It is also known as video mode. The "i" stands for interlaced and the 480 means a vertical frame resolution of 480 lines.

480p: A form of standard digital television (SDTV) comparable to VGA computer displays but it is not considered HDTV. The "p" stands for progressive scan (non-interlaced). The 480 means a vertical resolution of 480 pixel-high vertically scanning lines.

720p: This format is considered HDTV and contains 720 vertical pixels and 1280 horizontal pixels. The "p" stands for progressive. The 720p format is not inferior to 1080 it uses progressive scanning and a constant vertical resolution of 720 lines which allows it to better control motion.

1080i: This format is considered HDTV, and contains 1920 pixels x 1080 horizontal lines. The "i" stands for interlaced.

1080p: This format is considered HDTV, and contains 1920 pixels x 1080 horizontal lines. The "p" stands for progressive. A 1080p format is currently the highest HDTV resolution.

Anamorphic: The process of compressing widescreen images into a 4:3 television signal. Widescreen images that are not anamorphic are not as detailed when they are shown on a widescreen monitor.

Aspect Ratio: The ratio of width to height in a video picture or image. HDTV has a 16 X 9 ratio. A standard television aspect ratio is 4 X 3 (referring to the shape of a television or program).

Authentication: A process that verifies the user's credentials to confirm their identity for access rights.

Component Video: The parts of the video signal that consist of luminance and chrominance signals. Component video is expressed as Y R-Y B-Y or YPbPr.

DisplayPort: A digital display interface standard created by the Video Electronics Standards Association (VESA). The interface is mainly used to connect a computer to a monitor.

Down-Conversion: In digital television (DTV), the conversion from a higher resolution input signal number to a lower one input signal. For example, some DTV receivers can down-convert an HDTV 1080i signal to a 480i signal that can be shown on any TV.

Digital Rights Management (DRM): DRM refers to access control technologies that are used to restrict the usage of proprietary software, hardware, or content.

DTV: A generic term that refers to all digital television formats, such as HDTV and SDTV.

Digital Visual Interface (DVI): A video display interface created by the Digital Display Working Group (DDWG). The digital interface connects a video source to a display device.

Interlaced Scanning: A method used to display each line or row of pixels (painting) on a display screen. Two fields are used to create a frame.

Key Selection Vector (KSV): The numeric value that is used to validate that the devices are authorized to receive the content.

Progressive Scan: A method of displaying images on a monitor or HDTV. The whole picture is painted at the same time which reduces the flickering that is sometimes noticed on a television screen. Progressive scan is also known as 480p.

Standard Definition Television (SDTV): A television format that uses a resolution other than HDTV or enhanced-definition television (EDTV).

USB HID: A USB human interface device (HID) which allows devices to communicate without special drivers (for example, keyboards, controllers, and mice).

Widescreen: An image with an aspect ratio larger than 1.37:1, or a picture wider and narrower than a traditional television image. Mainly refers to televisions in the 16:9 aspect ratio.

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