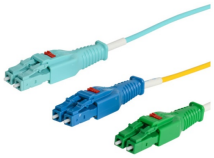
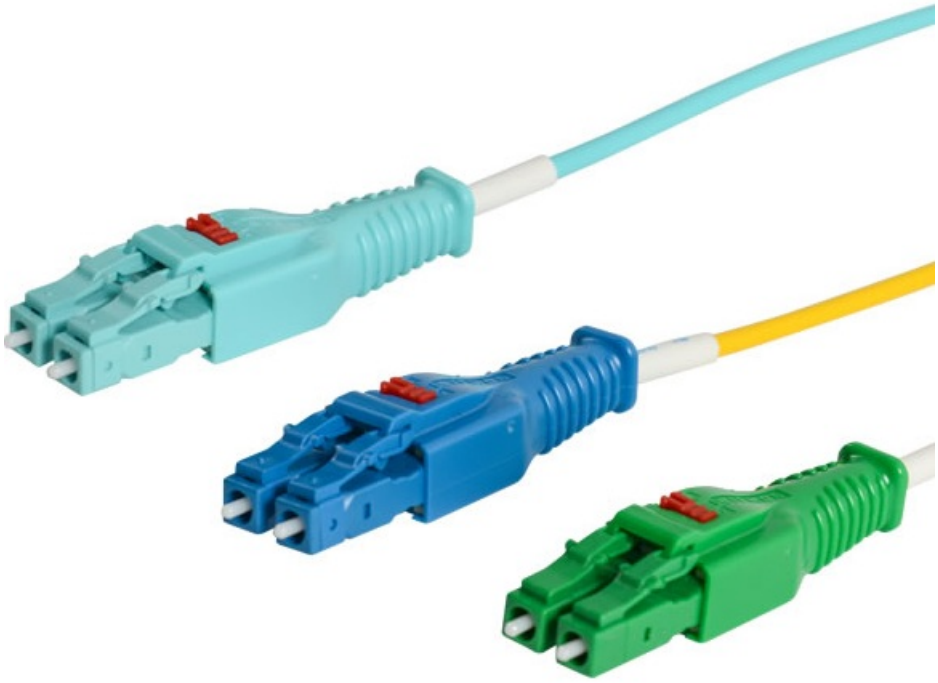


Siemon AUDIO VISUAL IP-based network cabling User Guide

Contents

Siemon AUDIO VISUAL IP-based network cabling



Connecting Today’s AV Systems to a Higher Standard

Over the past decade, AV systems for applications like video displays, video conferencing and digital signage have started shifting from connecting via traditional coaxial and component cables to low-voltage IP-based network cabling such as balanced twisted-pair copper and, in the case of extended lengths, optical fiber. With the growth of AV over IP-based infrastructure applications and an ever-increasing amount of HD and Ultra HD video, today’s AV systems need the right cabling infrastructure with the performance to deliver clear, high-quality video and audio signals. At the same time, they must provide superior support for remote powering applications like Power over HDBaseT (PoH) and Power over Ethernet (PoE) that now deliver enough power for video displays. As a leading global manufacturer of low-voltage copper and optical fiber cabling systems, Siemon understands that high-performance cables and connectors play an important role in ensuring AV signal quality, remote powering capability and the bandwidth to handle HD and Ultra HD video. We also understand that as the industry continues to embrace the shift to AV over IP, education surrounding network design, Ethernet/IP switching and structured cabling will be imperative to successful deployment.

Why AV over IP?

Before IP technology, transmitting audio and video signals relied on dedicated cabling with varied device connections and cable types that resulted in multiple points of failure and required costly compression fittings, specialized tools and time-consuming processes. With the shift to AV over IP-based infrastructure technology, the ability to control devices, send audio and video, and even power devices using IP-based network cabling offers the following benefits:

- **Cost-Effectiveness:** Delivers significant savings in materials, labor and maintenance due to one cable used for audio, video, power and control, eliminating the need for AC power runs to devices
- **Increased Functionality:** Enables all AV devices to be integrated over a single platform, supports the use of network encryption, allows for centralized control of an AV system from any location and offers improved flexibility and scalability
- **Improved Performance:** IP-based cables can handle much larger amounts of data, resulting in improved audio and video signals over longer distances

Part of Siemon's ConvergeIT Intelligent Building Solutions

The integration of low-voltage applications is happening as part of the intelligent building movement, and AV systems are converging over an IP-based platform along with Wi-Fi, security, PoE lighting, distributed antenna systems (DAS) and building automation systems.
Siemon's ConvergeIT Intelligent Building Solutions includes Digital Building Architecture that supports the design, installation and administration of integrated systems and Digital Building Delivery that ensure a robust, scalable standards-compliant infrastructure, from construction planning through implementation and delivery.
This AV application and product guide is just one in a series for all the low-voltage applications that fall under Siemon's Digital Building Architecture and Digital Building Delivery. These guides are specifically developed to help our customers optimize the design, performance and administration of converged applications, while best fitting their technology roadmap and budget and ensuring return on investment.

Understanding Your Choices

With the shift to AV over IP-based infrastructures, there is a need to understand options and key considerations to make an informed choice that meets both your customers' needs and budgets.

HDBaseT
Introduced in 2010, HDBaseT supports what has been dubbed "5Play"—the transmission of ultra-high definition 4K video and audio along with 100 Mb/s Ethernet (100Base-T), USB 2.0, bidirectional control signals and 100 Watts (W) of power (PoH) over a single twisted-pair cable to 100 meters (m) using standard RJ45 network connectivity. This reliable and proven application is an ideal choice for customers who already deploy HDBaseT and are looking to upgrade or expand. HDBaseT is not a true AV overIP systems as it uses a different packetization protocol (T-packets) and HDBaseT equipment.

Note: HDBaseT-IP is currently under development and will include support for Ethernet/IP. The HDBaseT Alliance is also working on an uncompressed 4K solution that will require higher bandwidth.

	HDBaseT	**AV over IP**		**Dante Audio**
		Vendor Specific	**SDVoE**	
Signal	4K Video	≥ 4K Video	4K Video	Digital Audio
Ethernet	100BASE-T (100 Mb/s)	≥ 1000BASE-T (1 Gb/s)	10GBASE-T (10 Gb/s)*	≥ 1000BASE-T (1 Gb/s)
Power	Up to 100W with PoH	Up to 90W with PoE	Up to 90W with PoE	Up to 90W with PoE
Infrastructure	≥ Category 5e/Class D	≥ Category 5e/Class D	≥ Category 6A/ Class EA	≥ Category 5e/Class D
Distance	100m (Cat 6A), 40m (Cat 6), 10m (Cat 5e)	100m	100m	100m
Transmission	Separate network	Coexists with LAN	Coexists with LAN	Coexists with LAN
Packets	T-Packets	TCP/IP	TCP/IP	TCP/IP
Equipment	HDBaseT Transmitter HDBaseT Matrix Switch HDBaseT Receiver	Vendor Encoder Ethernet Switch Vendor Decoder	SDVoE Encoder Ethernet switch SDVoE Decoder	Dante Controller Ethernet Switch Dante-enabled Device

Note: Includes a 1 Gb/s Ethernet channel for communication

Vendor Specific AV over IP

These systems take advantage of the scalability and flexibility provided by Ethernet/IP networks versus matrix switches via compression of AV signals. This includes the Society of Motion Picture and Television Engineers (SMPTE) 2110 standard that defines the uncompressed transmission of HD video over IP, JPEG-2000 lightly compressed video and high-efficiency H.264 and H.265 video compression.
Another AV over IP system is Dante AV that integrates audio and video over IP for interoperability with existing Dante-enabled audio over IP solutions, supporting one video channel (JPEG-2000) and eight uncompressed Dante audio channels over a 1 Gb/s IP network. Using encoders and decoders, other AV over IP manufacturers such as Crestron, Extron, DigitaLinx and MuxLab use compression techniques such as H.264 and JPEG-2000 to ensure image quality is minimally compromised. While compression supports operation over 1 Gb/s networks, higher speed (2.5 Gb/s, 5 Gb/s and 10Gb/s) networks do not require the same level of compression enabling the use of lower cost encoders and decoders.
Despite these systems operating over Ethernet/IP networks, interoperability between manufacturers of transmitters/encoders and receivers/decoders has remained an issue in the AV industry for years.

SDVoE

Introduced in 2017, Software Defined Video over Ethernet (SDVoE) supports 4K video, audio, control and 1 Gb/s Ethernet. Like AV over IP, SDVoE leverages existing network switches and encryption, offering added value for those needing to broadcast signals wherever the network can reach. While SDVoE is considered an AV over IP system, it utilizes 10Gb/s Ethernet and a purpose-built encoding scheme to transmit AV control signals between SDVoE transmitters (encoders) and receivers (decoders) at both ends of the channel. SDVoE devices are interoperable between manufacturers.

Dante Audio

Digital Audio Network Through Ethernet (Dante) designed by Audinate is the most popular system for transmitting digital audio signals over IP-based Ethernet networks. Deployed up to 100 meters over twisted-pair copper cabling or longer distances using fiber, Dante utilizes controller software to transmit digital unicast or multicast audio to Dante-enabled end devices such as amplifiers and speakers by encapsulating the signals within IP packets for transmission across standard Ethernet networks.

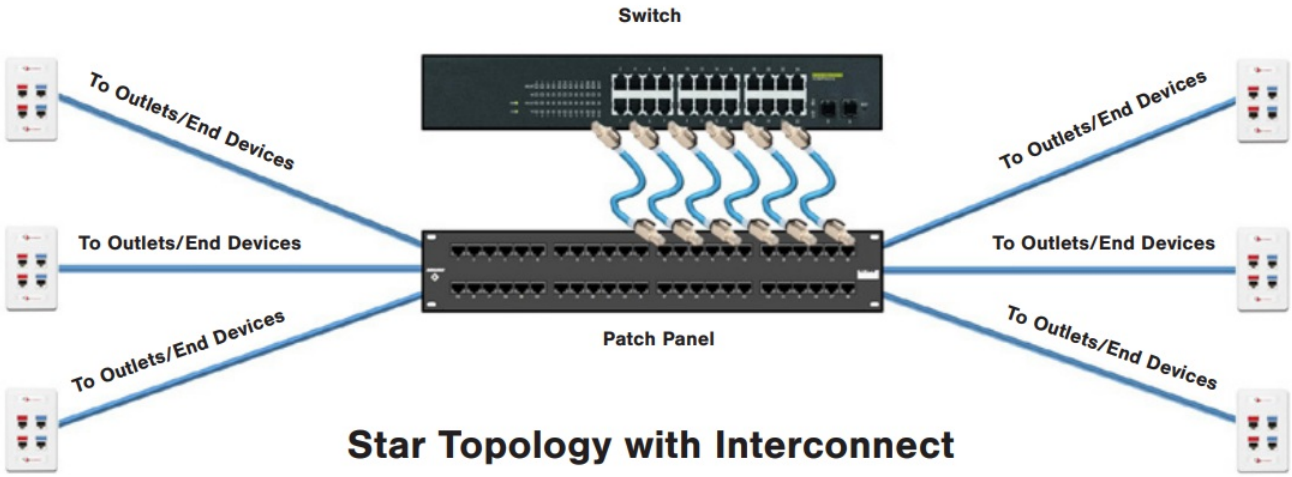
AV over IP is Everywhere
AV over IP deployments touch a wide range of environments, scenarios and business – anyone needing to transmit audio and visual signals for the purpose of informing, promoting, collaborating, entertaining and educating.

- Presentation displays in conference rooms and huddle spaces
- Smart boards and interactive displays in classrooms
- Video screens in auditoriums, convention centers and arenas
- Digital signage and sound systems
- Media systems in waiting rooms, hotel rooms and other hospitality venues
- Public notification displays in airports, municipalities and operations centers
- Bring your own device (BYOD) environments for content sharing

AV over IP Means Structured Cabling

Structured cabling standards from TIA and ISO/IEC are the foundation of IP-based networks, establishing performance parameters and best practices that can reduce downtime and improve manageability.

Star Topology with Interconnect
While traditional AV deployments were point-to-point or daisy-chained, structured cabling standards governing IP-based twisted-pair systems do not permit these connections because they add complexity and limit scalability. Instead, structured cabling standards utilize a hierarchical star topology where each end device is connected to the switch via horizontal cable and patch panels in an interconnect scenario. As shown below in a star configuration with an interconnect, patching occurs directly between the matrix or Ethernet switch and a distribution patch panel, enabling easier management and moves, adds and changes.



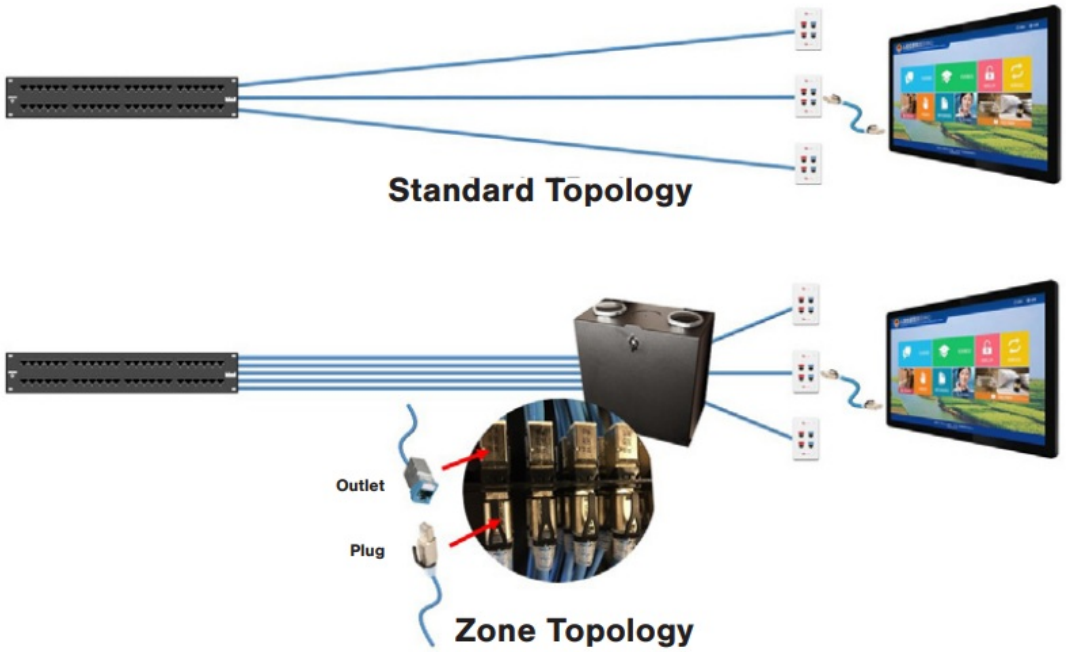
Horizontal Link Lengths
TIA and ISO/IEC industry standards limit copper horizontal channel length to 100 m, consisting of the following:

- 4-pair 100-ohm unshielded or shielded twisted-pair cabling
- 90m permanent link using solid conductor cable
- 10m of patch cords using solid or stranded conductor cable
- Maximum of 4 connectors within the channel

For environments that require longer cable runs to AV devices, such as stadiums and other larger venues, duplex multimode or singlemode fiber cabling can support much greater distances of up to 550m on multimode and up to 10km on singlemode depending on the active equipment. Extended distances may also be possible using fully-shielded category 7A cable depending on equipment/device vendor specifications.

Zone Cabling
A standards-based zone cabling topology incorporates horizontal consolidation point (HCP) or service concentration point (SCP) outlets, typically housed in a zone enclosure, that serve as intermediate connection points between the patch panels in the TR and service outlets (SO) or end devices. The benefits of zone cabling include:

- Fast, easy deployment of new devices via spare outlet capacity in the zone enclosure
- Rapid reorganization and less disruptive moves, adds and changes with changes limited to the shorter cabling link between the zone enclosure and the SO or device
- Conveniently combining outlets serving WAPs (and other intelligent building devices) within one enclosure



Testing Recommendations

While there are AV tools for testing resolution, frame rate and other video performance specifications once systems are up and running, AV over IP cabling systems should be tested to the industry standards in the same way that IP-based LAN cabling systems are tested. In fact, the HDBaseT Alliance specifically requires testing for compliance with industry standards.
Transmission testing for standards compliance using an appropriate compliant test device ensures that the cabling system will support the application and ensure signal integrity. This is especially important for advanced cabling sytems like Category 6A that operate at higher frequencies to support 10Gb/s transmission rates.

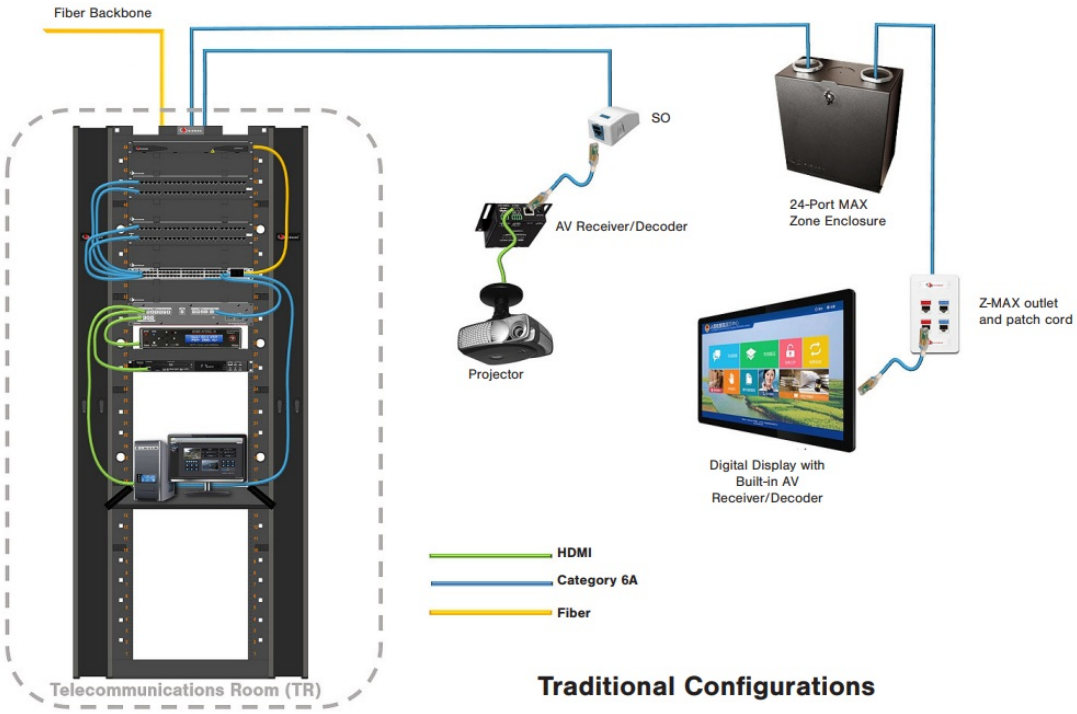
AV over IP Configurations

Traditional Configuration

In a traditional LAN-style cabling configuration, horizontal cable is terminated to an SO (Z-MAX®) housed in a faceplate or surface mount box located near the AV device. Patch cords are used to connect AV devices to the SOs. The use of an SO provides a convenient end-user location to support labeling and administration of the cabling and identify channels for future use. To facilitate moves, adds and changes, a zone-style topology, where shorter links run from outlets in the zone enclosure to the SOs can also be deployed.

Plenum Space Requirements for North America

In accordance with the National Electric Code® (NFPA 70), plenum-rated components that meet UL 2043 requirements for smoke and heat release are required when located within a building's in air-handling spaces, including above drop ceilings and under raised floors.
Siemon's cable, zone enclosures, outlets, plugs, patch cords and service mount boxes all meet UL 2043 requirements for providing connectivity in the plenum space to AV devices that are ceiling mounted.



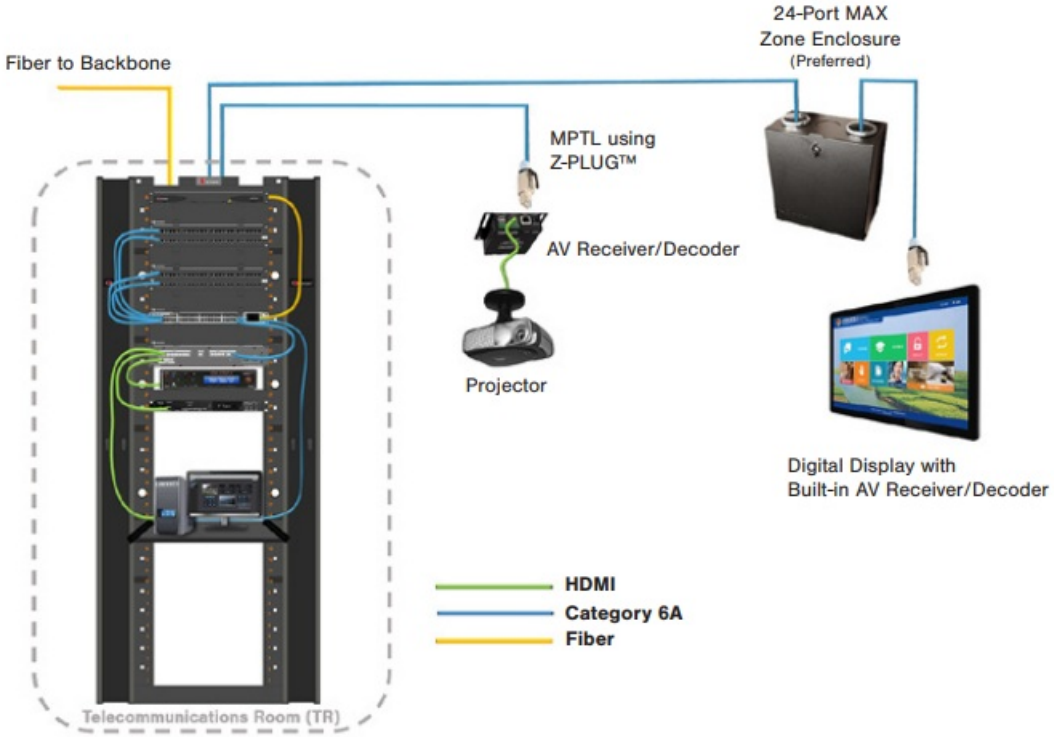
Traditional Configurations

Modular Plug Terminated Link (MPTL)

The MPTL topology is strictly limited to situations where it is necessary to eliminate both the service and SCP outlets and plug the horizontal cable directly into the end device. In an MPTL, horizontal cables from the distribution panel in the TR are terminated to field-terminated plugs (Z-PLUG™) and connected directly into the end device, essentially creating a one-connector channel. MPTLs often support applications-specific commissioning when the AV device is not expected to be moved or rearranged after deployment. For example, where AV displays are publicly mounted, an MPTL may be considered to improve aesthetics or security by eliminating patch cords that can be unsightly or intentionally or unintentionally disconnected.

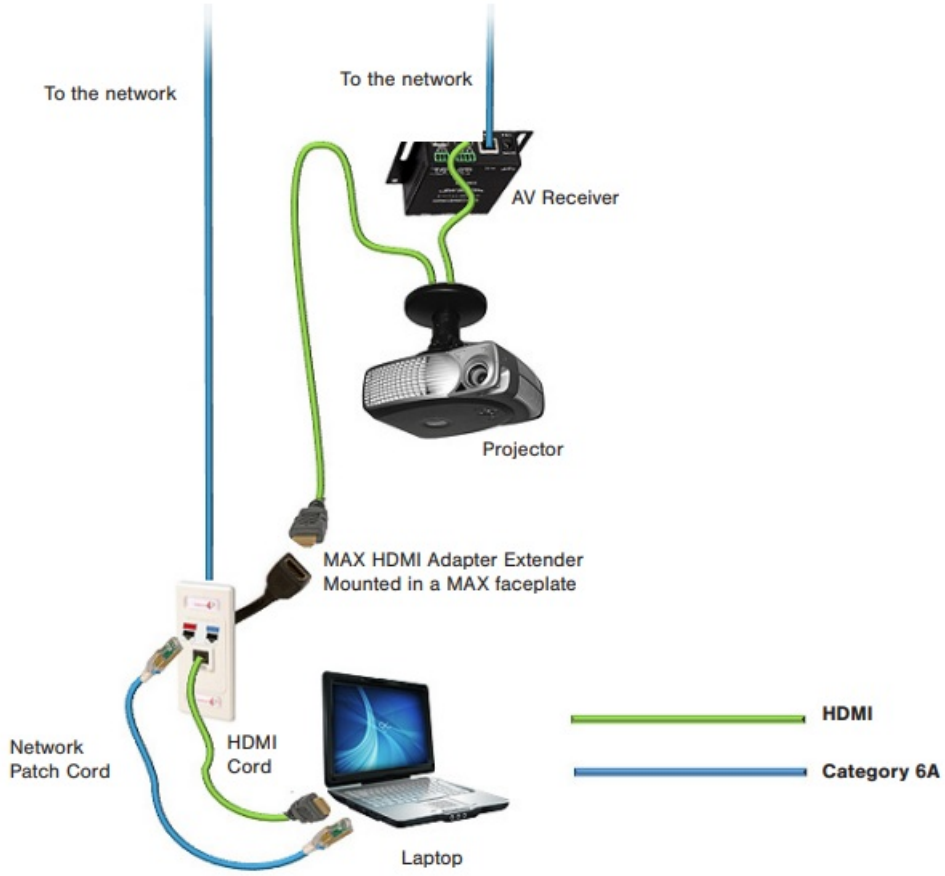
To facilitate moves, adds and changes, it is strongly recommended that an MPTL be deployed in a zone topology where field-terminated shorter links run

from outlets in a zone enclosure (24-Port MAX® Zone Enclosure) to the device. MPTL configurations using a zone topology are a two-channel configuration.



Modular Plug Terminated Link (MPTL) Configurations

Bring Your Own Device Configuration
To facilitate BYOD deployments, Siemon's MAX HDMI Adapter Extender can be mounted in a MAX faceplate along with network outlets. With a female HDMI connector on both ends, the MAX HDMI Adapter Extender enables a pass-through connection for extending cables from AV receivers/decoders, displays and smart screens to an easily-accessible HDMI interface. Ideal for use in conference rooms, classrooms or any space requiring an easily accessible BYOD interface for connecting laptops, DVRs or other devices, the MAX HDMI Adapter Extender extends the HDMI connection outside of the outlet box, eliminating the need to manage thicker HDMI cables within the box. Other multimedia outlet types are also available for mounting in faceplates in BYOD applications.



BYOD Configuration using HDMI Adapter Extender

Shielded Cabling is the Best Choice

When considering industry standards, current and future AV applications, and the impact of higher-level PoH and PoE capable of powering video displays, category 6A/ class EA shielded cabling should be the minimum twisted-pair cabling deployed for any AV installation.

- TIA and ISO structured cabling standards recommend category 6A/class EA cabling as the minimum cabling for all new installations.
- Category 6A/class EA or Category 7A/Class FA cabling is required to support HDBaseT to a full 100 meters and for any current or future uncompressed 4K video signal, including SDVoE.
- Shielded category 6A/class EA or Category 7A/Class FA cabling offers increased headroom, excellent noise immunity and better crosstalk performance for clearer, reliable AV signal transmission.
- The use of category 7A/class FA cabling with category 6A/class EA connectivity provides a familiar RJ45 interface and can deliver greater energy efficiency, heat dissipation, enhanced video transmission and the potential for longer distance support depending on equipment/device vendor specifications.

Superior Remote Powering Support
Deploying a cabling infrastructure for today's converged networks that deliver remote power to a wide range of devices requires cables and connectivity designed to provide superior remote powering support – that's Siemon's PowerGUARD® technology.

- Siemon's Z-MAX®, MAX® and TERA® jacks with PowerGUARD technology feature a patented crowned jack contact shape allowing you to connect and disconnect to the latest remote powering applications with zero risk of connector damage from electrical arcing.
- Shielded category 6A/class EA or higher cabling systems with PowerGUARD® technology offers improved heat dissipation to reduce heat buildup within cable bundles delivering remote power that can lead to performance degradation.
- Siemon shielded category 6A/class EA and category 7A/class FA systems with PowerGUARD technology provide maximum support of remote powering applications with a higher 75°C operating temperature qualified for mechanical reliability in high temperature environments.

Industry Leading Solutions and Support

As an industry leader, Siemon participates global cabling standards development initiatives and is dedicated to understanding and supporting the unique needs of the market.
As an AVIXA and SDVoE Alliance member, as well as holding leading positions within industry standards bodies like TIA and ISO/IEC, Siemon offers technical support and expert guidance on designing and deploying high-performance, reliable cabling systems for the latest AV over IP-infrastructure systems.
With high performance copper cabling and innovative, easy-to-deploy connectivity solutions, Siemon delivers standards-based end-to-end AV systems with the performance and reliability to deliver clear HD and Ultra HD video, audio, control and power. Siemon's LightHouse™ Advanced Fiber Solutions and High-Speed Interconnects support backbone, switch and extended distance connections while our full range of racks, cabinets, enclosures, power distribution units and cable management solutions provide the support needed for housing and protecting active AV equipment and connections.
Application-specific cabling considerations are an integral part of Siemon's Digital Building Architecture.

End-to-End Copper Cabling Systems for AV over IP

Z-PLUG™ Field-Terminated Plug
Siemon's patented Z-PLUG field-terminated plug offers quick, reliable high-performance field terminations for custom length patch, interconnect and direct connections to video displays, digital signage or any other AV over IP device. Z-PLUG exceeds all category 6A performance requirements to easily support the latest high-speed/high-power AV applications.

- Terminates shielded and UTP, solid and stranded cable in conductor sizes from 22 to 26 gauge –all with a single part number
- Features shorter plug design with rounded edges and the ability to eliminate the boot and latch protector makes it ideal for connecting to devices with limited space
- User-friendly Z-PLUG termination tool and intuitive hinged lacing module eliminate cable feed through, enabling best-in-class termination speed and repeatable performance
- Dual-purpose latch protector clip is available in nine colors for easy identification of various applications and devices
- PowerGUARD® technology with fully-shielded, 360-degree enclosure and 75°C operating temperature improves heat dissipation for PoE and PoH

Z-MAX UTP and F/UTP Outlets

Z-MAX category 6 UTP and category 6A shielded and unshielded outlets combine exceptional performance with best-in-class termination time. Also available in a Z-MAX 45 category 6A version for terminating cable at a 45-degree angle in shallow back boxes or wall-mounted raceway systems. All Z-MAX products features PowerGUARD® technology to prevent erosion due to arcing when a plug is unmated while under dc remote power load.

TERA Category 7A Outlets

As the chosen standards-based interface for category 7A /class FA systems, TERA outlets are the highest-performing twisted-pair connectors available. When installed as part of a category 7A /class FA AV deployment, TERA offers superior delay skew performance for superior delivery of RGB video. Tera outlets feature PowerGUARD technology to prevent erosion due to arcing when a plug is unmated under remote power load.

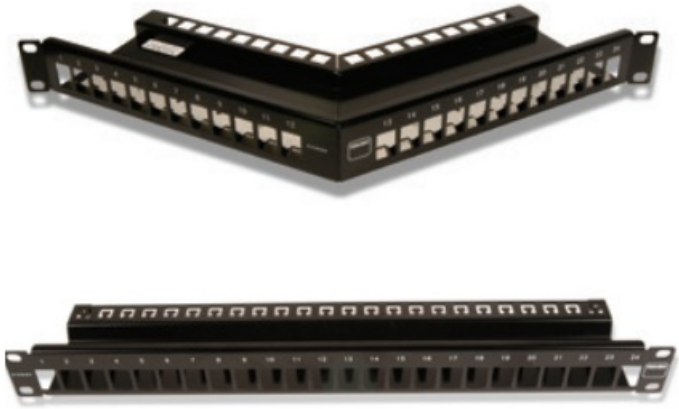
Z-MAX Category 6A Modular Patch Cords

Ideal for facilitating connections to audio and video devices at the work area or for patching audio equipment in the AV equipment room, Siemon Z-MAX category 6A UTP and shielded cords offer the unparalleled performance of an exclusive PCB-based smart plug, alien crosstalk resistant construction and a host of innovative end-user features.

TERA Category 7A Patch Cords

Category 7A TERA-to-TERA patch cords exceed bandwidth of category 7A/Class FA specifications when combined with the TERA outlet, offering superior noise immunity and delay skew performance for reliable HD and ultra HD video. Also available in a TERA to category 6A RJ45 plug for standard equipment interfaces.

TERA® – MAX® Patch Panels



Available in flat and angled versions, TERA-MAX patch panels provide outstanding performance and reliability in a modular solution for AV equipment rooms. Any combination of TERA or shielded Z-MAX modules (in flat orientation) can be configured in the TERA-MAX panels.

MAX Faceplates and Adapters

Available in double- and single-gang for housing up to 12 modules, durable MAX faceplates are designed to be used with angled or flat Z-MAX outlets. Universal modular furniture adapters are ideal for mounting modules into standard furniture openings.

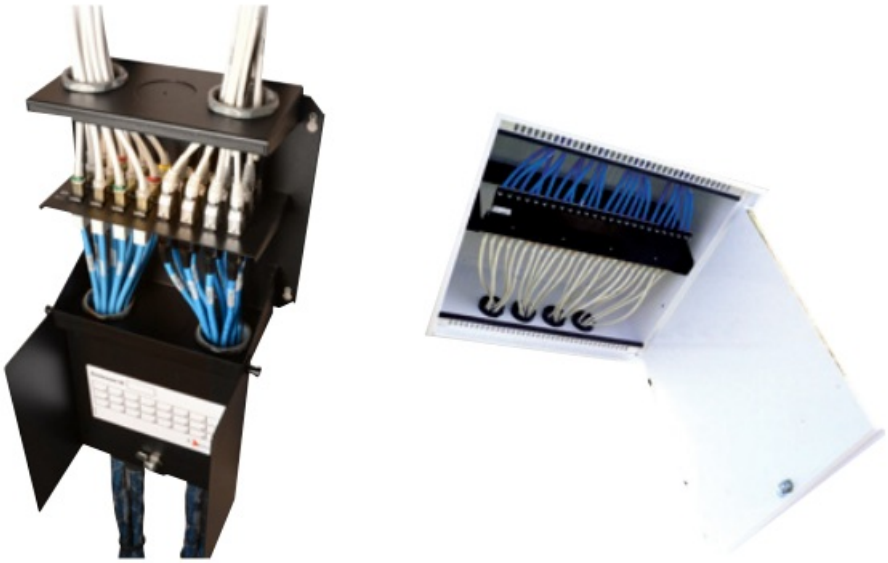
Z-MAX Surface Mount Boxes

Siemon’s surface mount boxes offer an option where an outlet cannot be recessed into a wall or floor box. They support Z-MAX outlets and come in 1, 2, 4 and 6-port configurations.

MAX HDMI Adapter Extender Cable

For easy pass-through connection for extending cables from LCD projectors, monitors and smart screens to an HDMI interface, the MAX HDMI Adapter Extender Cable fits into a single 2-port opening in all Siemon MAX series faceplates. It is ideal for BYOD scenarios in conference rooms, classrooms or any area that requires an easy interface to connect video controllers to ceiling or wall mounted displays.

Zone Cabling Enclosures

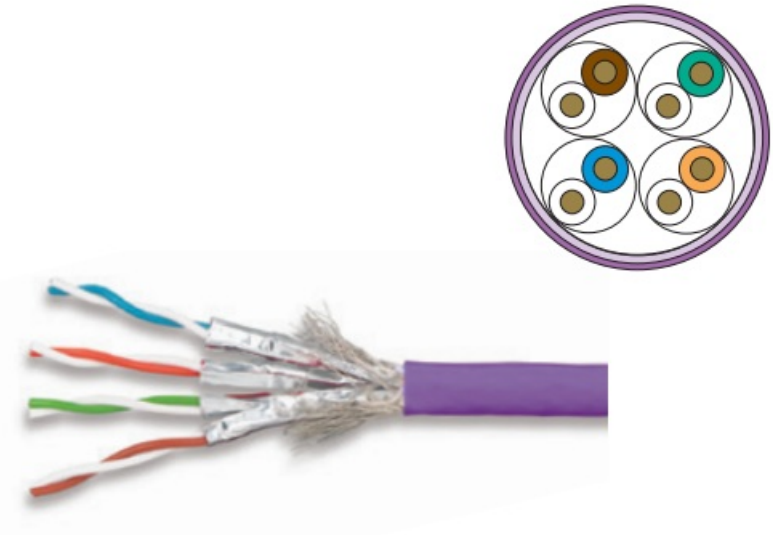


Ideal for supporting zone cabling topologies in AV over IP deployments, Siemon plenum-rated zone enclosures come in a 24-Port MAX Zone Unit Enclosure and a 96-Port Passive Ceiling Zone Enclosure that accept flat Z-MAX or TERA outlets.

Ruggedized Outlets, Plugs and Patch Cords

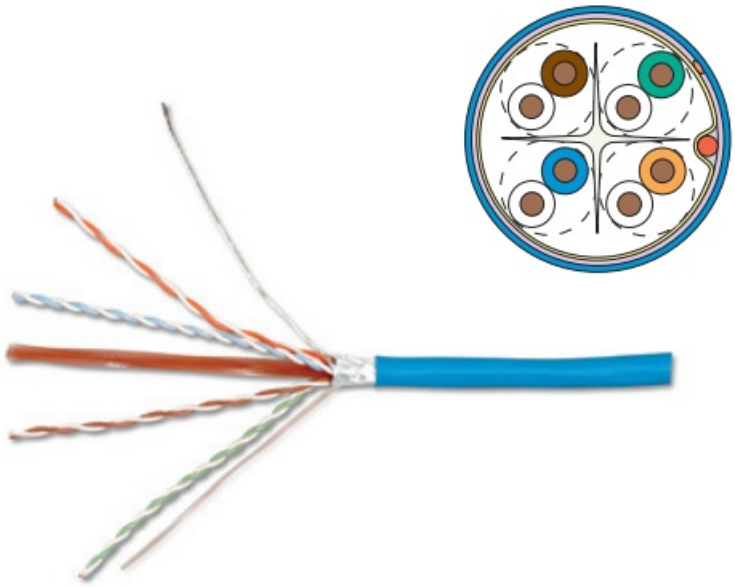
Siemon ruggedized category 6A outlets, plugs and patch cords are the answer for AV over IP applications in harsh environments such as laboratories, hospitals, cafeterias or any other place where audio/visual connections may be exposed to dust, moisture or chemicals.

Category 7A S/FTP Cable



Category 7A fully shielded cable is an integral component in professional video distribution or broadcast centers. It is the highest-performing and most secure twisted-pair copper system available for connecting AV displays and other devices, featuring excellent delay skew performance and noise immunity for optimum HD video transmission. Category 7A cable can also be terminated to category 6A RJ45 connectivity.

Category 6A UTP and F/UTP Cable



Our category 6A UTP and F/UTP Cables feature the highest performance margins across all critical transmission parameters, which are the perfect solution for audio/video data centers where speed and reliability are paramount. Available in a wide range of constructions, shielding and jacket types.

LightBow™ Fiber Termination Kit

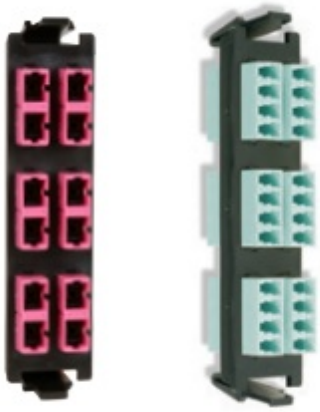
Fiber optic cabling is ideal for AV systems that require more bandwidth for sending HD and ultra HD video over longer distances, and Siemon's LightBow Mechanical Splice Termination System makes fiber deployments faster and easier than ever before without the cost and learning curve required for other fiber termination methods. LightBow's patented, easy-to-use termination simplifies fiber insertion and avoids connector damage, offering significant time savings and ensuring consistent, reliable performance.

- Factory assembled singlemode (UPC and APC) and multimode LC and SC simplex connectors
- Low-cost, simple robust termination process that combines splice activation and mechanical crimping to reduce termination time
- Built-in verification window on connectors for use with 0.5mW visual fault locator (VFL)
- Connectors can be adjusted after verification and reterminated
- Termination kit includes LightBow termination tool, strippers, precision cleaver, strip template, VFL and everything needed for termination – all in a convenient carrying case

RIC Fiber Enclosure

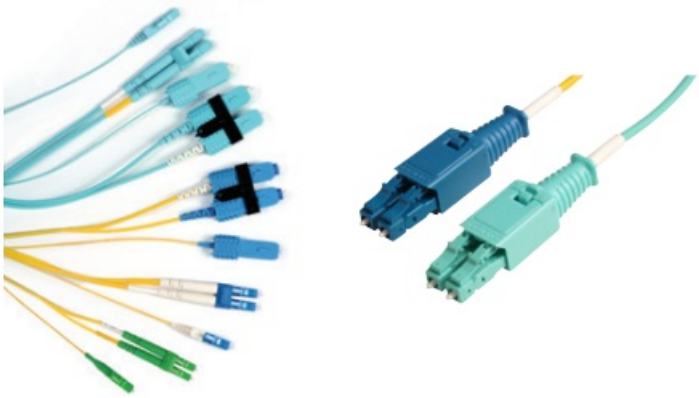
Siemon’s Rack Mount Interconnect Center (RIC) enclosures offer secure, superior fiber density without sacrificing protection and accessibility. Used with Siemon’s Quick-Pack® adapter plates, RIC enclosures are available in 2U, 3U and 4U, as well as in preloaded versions to save time.

Quick-Pack® Adapter Plates



Siemon’s Quick-Pack adapter plates are available in a wide range of fiber connector types, including LC, SC, ST and MTP, and can be easily installed into Siemon RIC enclosures
to facilitate backbone or extended distances for AV over IP applications.

LC BladePatch® and XGLO Fiber Jumpers



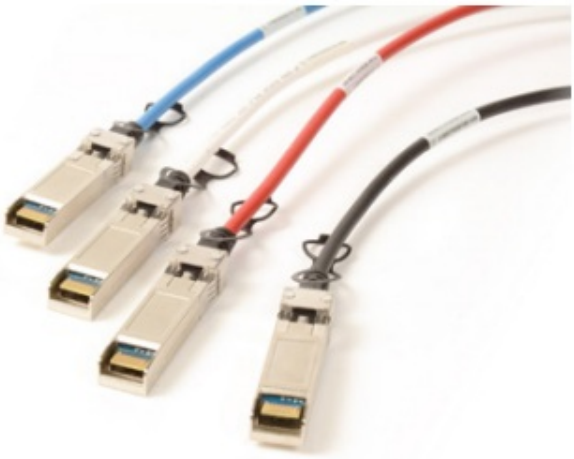
LC BladePatch OM4 multimode and singlemode LC fiber jumpers offer an innovative push-pull action for high-density environments, while XGLO Fiber Jumpers come in both standard SC and LC for connecting switches and devices.

Singlemode and Multimode Fiber Cable

Siemon offers a full line of indoor, indoor/outdoor and outside plant bend-insensitive bulk singlemode and multimode cables available in tight buffer and loose tube and in a variety of jacket ratings for extended distances and campus-wide AV applications.

AV Equipment and Support Solutions

High-Speed Interconnects and Active Optical Cables



Ideal for high-speed direct attach connections in the AV equipment room, Siemon high-speed interconnects and active optical cables are available in a variety of QSFP28, SFP28, QSFP+, SFP+ form factors, and they come in ½ meter increments from 0.5m to 10m and in multiple colors.

Value Rack

Siemon’s Value Rack provides an economical, durable solution for mounting and securing cabling and AV equipment, featuring integrated bonding and grounding, visible U space markings and compatibility with Siemon’s full range of cable management solutions.

4-Post Rack

Siemon’s adjustable-depth, 4-Post Rack provides a stable platform for mounting extended depth/size active equipment.

Cabinets

Siemon offers a full range of free-standing and wall-mount cabinets in a variety of sizes and colors for housing and protecting AV equipment and connections. They are available with a variety of door, handle and latch styles, including high-security handles.

RouteIT Vertical Cable Managers

RouteIT vertical cable managers with field-replaceable, high-capacity fingers help manage the challenges of today's high-density cabling systems, providing a solution for easy routing and protection of horizontal cables and patch cords.

RouteIT Horizontal Cable Managers

RouteIT horizontal cable managers are available in multiple sizes and its high-capacity fingers can accommodate over 48 Category 6A cables.

PowerMax™ PDUs

Siemon's PowerMax line of PDUs range from basic and metered for simple and cost-effective power distribution, to a full line of intelligent PDUs that deliver real time power information with varying degrees of intelligent functionality.

Cabling Tools & Testers

From cable prep and easy-to-use, innovative termination tools for Siemon copper and fiber connectivity, to visual fault locators and versatile hand-held testers, Siemon offers a variety of cabling tools and testers to ensure fast, easy and reliable AV cabling systems.

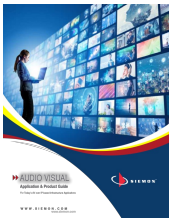
Want to Learn More About Audio Visual?

- Visit the Siemon.com Ruggedized Cabling application page: go.siemon.com/AudioVisual
- 24/7 Customer Support: Customer_Service_Representatives_Global@siemon.com
- Siemon Headquarters: (1) 860 945 4200
- North America Customer Service: (1) 866 548 5814 (toll-free US)
- Worldwide Office Numbers Listed Below
- View our distributor locator: go.siemon.com/AudioVisualDistributor

Because we continuously improve our products, Siemon reserves the right to change specifications and availability without prior notice.
Visit www.siemon.com for detailed part numbers and ordering information in our eCatalog.

North America
P: (1) 860 945 4200
Asia Pacific
P: (61) 2 8977 7500
Latin America
P: (571) 657 1950/51/52
Europe
P: (44) 0 1932 571771
China
P: (86) 215385 0303
India, Middle East & Africa
P: (971) 4 3689743
Siemon Interconnect Solutions P: (1) 860 945 4213
www.siemon.com/SIS
Mexico
P: (521) 556 387 7708/09/10
WWW.SIEMON.COM

Documents / Resources

	Siemon AUDIO VISUAL IP-based network cabling [pdf] User Guide AUDIOVISUAL, IP-based network cabling, network cabling

References

- Audio Visual Solutions | AV Solutions | AV Cabling Support |Siemon
- Distributors - Where to Buy| Siemon
- Siemon | High Performance IT infrastructure solutions
- Siemon | High Performance IT infrastructure solutions
- Siemon Interconnect Services