



▶▶ Distributed Antenna Systems

Application & Product Guide
For Today's Extended Mobile Wireless Coverage



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▶▶ Connecting DAS to a Higher Standard

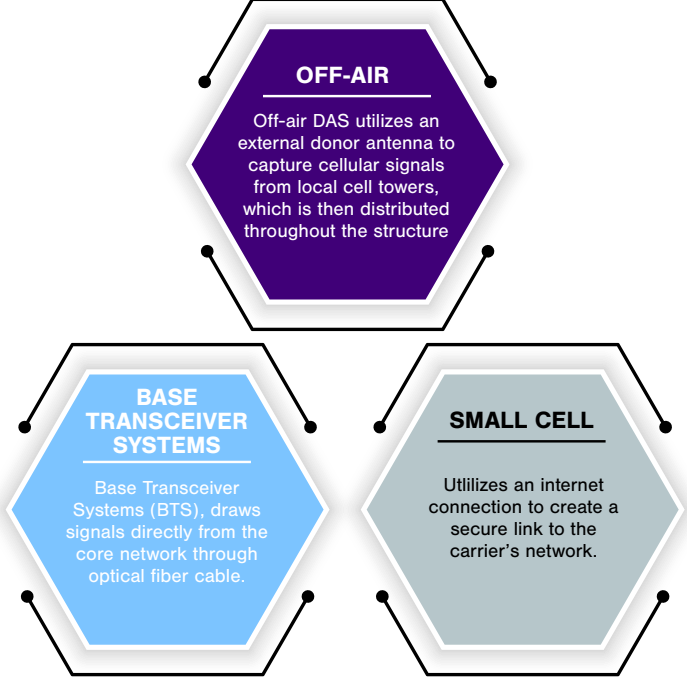
In today's constantly connected world, having reliable mobile wireless voice and data service is a must for any structure where large amounts of people gather. Even with the rise of 5G technologies sprouting across the world, there remains a connectivity issue while in an office building, sports arena or other structure where building materials block or interrupt cellular signals or wireless networks become overloaded. To overcome this, Distributed Antenna Systems (DAS) extend mobile wireless signals via a network of antennas distributed throughout a structure. Depending on the type of DAS, this network typically utilizes coaxial, high-speed balanced twisted-pair copper and/or optical fiber cabling to connect antennas and support the delivery of 4G and 5G wireless service.

As a leading global manufacturer of copper and fiber optic cabling systems, Siemon understands that high-performance cables and connectivity are paramount in building a DAS network with speed and reliability at the forefront. Our full line of cabling options is fully compatible with leading manufacturer's systems to complement DAS deployments of any size.

▶▶ Flawless Cellular Coverage

Large structures, such as office buildings, are usually built of a combination of steel, concrete and glass – all material that block mobile wireless signals. DAS delivers coverage to these spaces using a system of antenna nodes that amplify and distribute cellular signals throughout a structure, bringing clear coverage to all areas of a space from the office to the basement and the warehouse.

Regardless of the size of the environment, the first step in the distribution of cellular signals via DAS is determining how the signal will enter the facility, referred to as the signal source. The most common methods include:



Carrier services connect to a head-end (main hub) which receives the carrier signals and distributes them through to a series of intermediate (aka distributed or secondary) nodes placed within Telecommunications Rooms, typically located on each floor. Signals are boosted and distributed to the antennas (a.k.a. access points or remote units) located in key areas within the structure, delivering wireless services throughout the venue.

Part of Siemon's ConvergeIT Intelligent Building Solutions

Integrating low-voltage applications is happening as part of the intelligent building movement, and DAS is utilizing an IP-based platform for the distribution of cellular signals indoors, as are AV over IP, Wi-Fi, PoE lighting, security and building automation systems. Built on the same infrastructure as typical IP applications, DAS is quickly becoming an integral component of smart buildings, creating intelligent environments around the globe.

Siemon's ConvergeIT Intelligent Building Solutions include 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 DAS application 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, ensuring return on investment.

Understanding Your Choices

To accommodate the needs of all structures, three types of distribution systems are currently available – Passive, Active and Hybrid.

	Passive	Active	Hybrid
Backbone Cable	Coax	Fiber	Fiber
Horizontal Cable	Coax	Fiber or Copper	Coax
Cost	Lowest	Highest	Medium
Reach	Limited	Extended	Extended in Backbone
Advantages	<ol style="list-style-type: none"> 1. Lower cost as digital conversion is not needed. 2. Power is not required at the antennas. 	<ol style="list-style-type: none"> 1. Shares common building cabling system infrastructure. 2. Extended reach. 	<ol style="list-style-type: none"> 1. Less expensive than Active DAS. 2. Extended Backbone Lengths
Disadvantages	<ol style="list-style-type: none"> 1. Distance can be limited due to signal attenuation. 2. More difficult to design due to precise link budget calculations. 	<ol style="list-style-type: none"> 1. Dedicated power required at access points/antennas. 2. More expensive than passive or hybrid.* 	More complicated to install due to mix of media types and calculations.

*Costs are associated with materials only

As illustrated in the chart above, all three options consist of two types of cable structure; the backbone consists of cabling connecting the head-end unit to the intermediate, (a.k.a. distributed or secondary), while horizontal is the cable running from the intermediate to the antennas, (a.k.a. access points or remote units).



There are a variety of DAS systems available and understanding all the options and configurations are key to making informed choices based on structure, need and budget.

DAS is Everywhere

From small offices to skyscrapers or local college campuses to sports stadiums, Distributed Antenna Systems are essential for any area where building materials or number of users stand in the way of superior cellular voice and data services.

Applications can include:

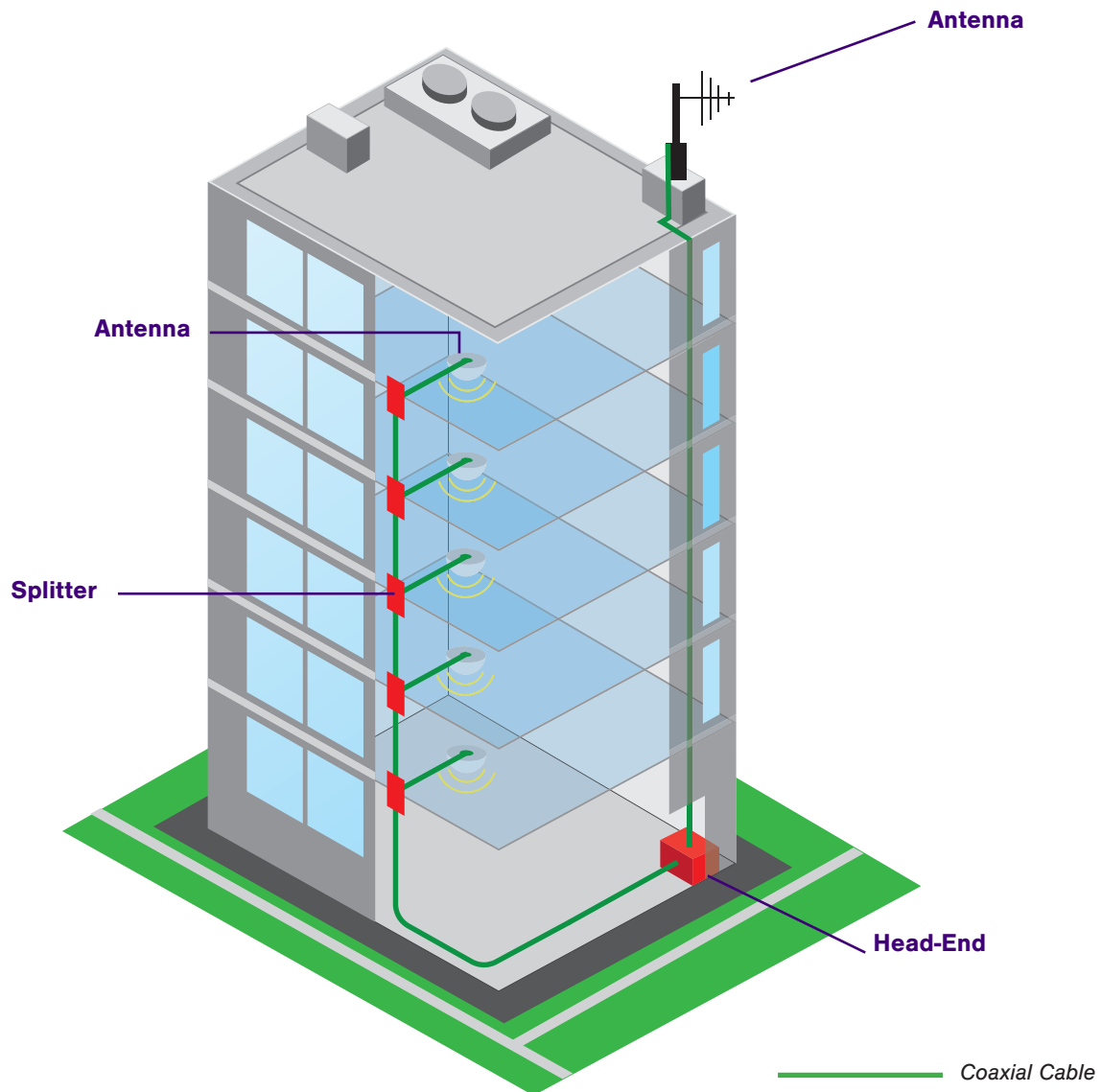
- Office Buildings
- Hotels
- Hospitals
- Subways
- Airports
- Outdoor Campuses
- Arenas/ Amphitheatres
- Stadiums

Passive DAS

Typically, spaces under 80,000 square feet, such as small office buildings, utilize a passive DAS for enhanced wireless service within a structure. A passive DAS uses an RF distribution system comprised of coaxial cable, splitters, repeaters or bi-directional amplifiers and antennas which distributes the signal throughout the structure.

Passive systems can be single or multi-carrier and are cost-effective solutions for smaller spaces. The disadvantage is attenuation; as the signal moves further away from the antenna and amplifiers, signal quality can suffer. Distribution via coax cabling also requires a more extensive design to properly manage signal amplification throughout the facility.

Typical Passive DAS Topology

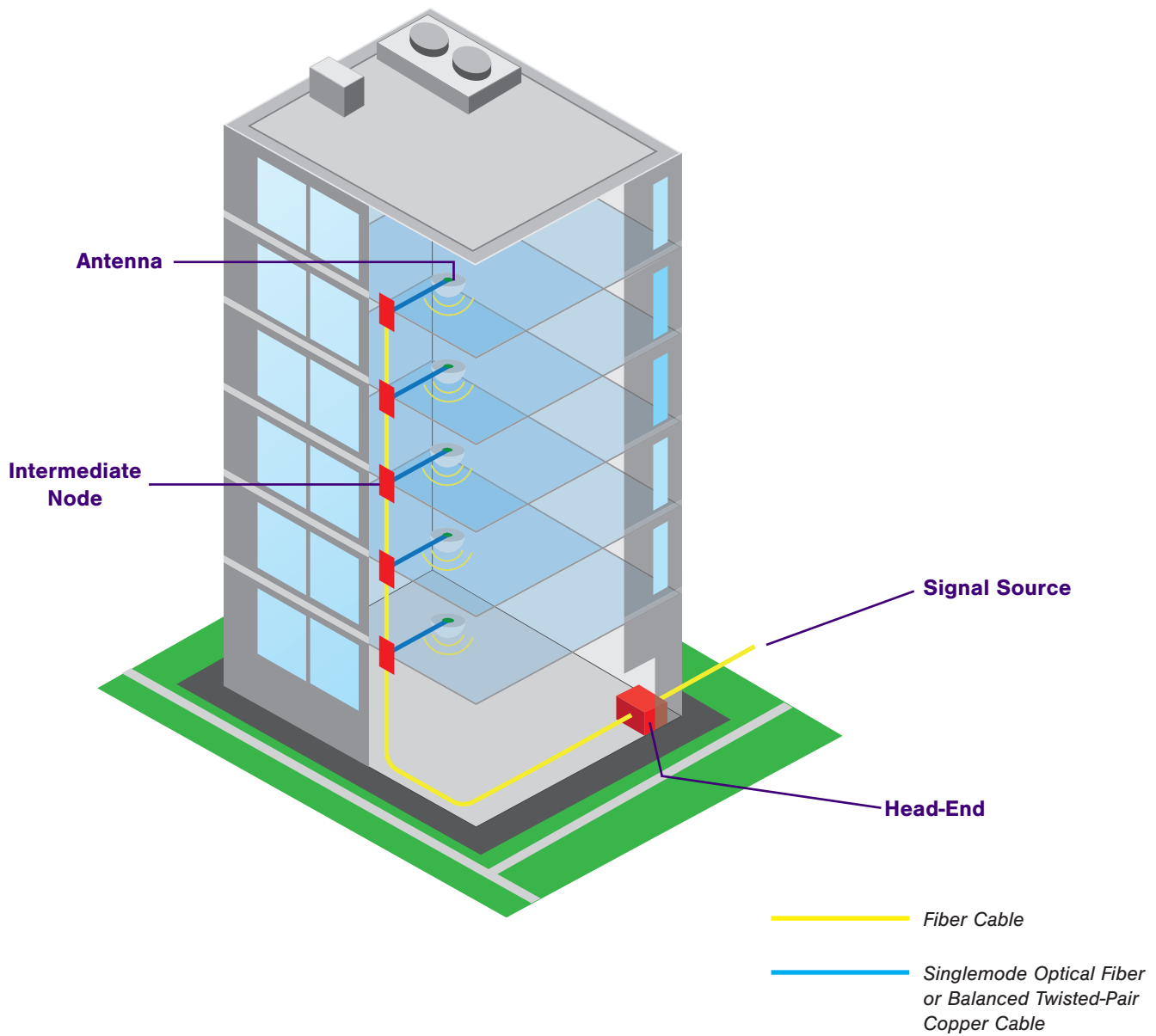


▶▶ Understanding Your Choices

Active DAS

Active systems are more complex and are deployed in high-rise office buildings, hotels, hospitals or stadiums where the distance from the signal source to the antennas are greater. This DAS uses a fiber optic head-end for extended length distribution to intermediate nodes which transmits over singlemode optical fiber or balanced twisted-pair copper cabling to a series of active (powered) access points (i.e.. antennas) located throughout the environment. As singlemode optical fiber has a significantly longer reach than coax or balanced twisted-pair copper, active DAS systems are ideal for providing coverage in large areas. Note that for active DAS systems, local power must also be provided to the access points.

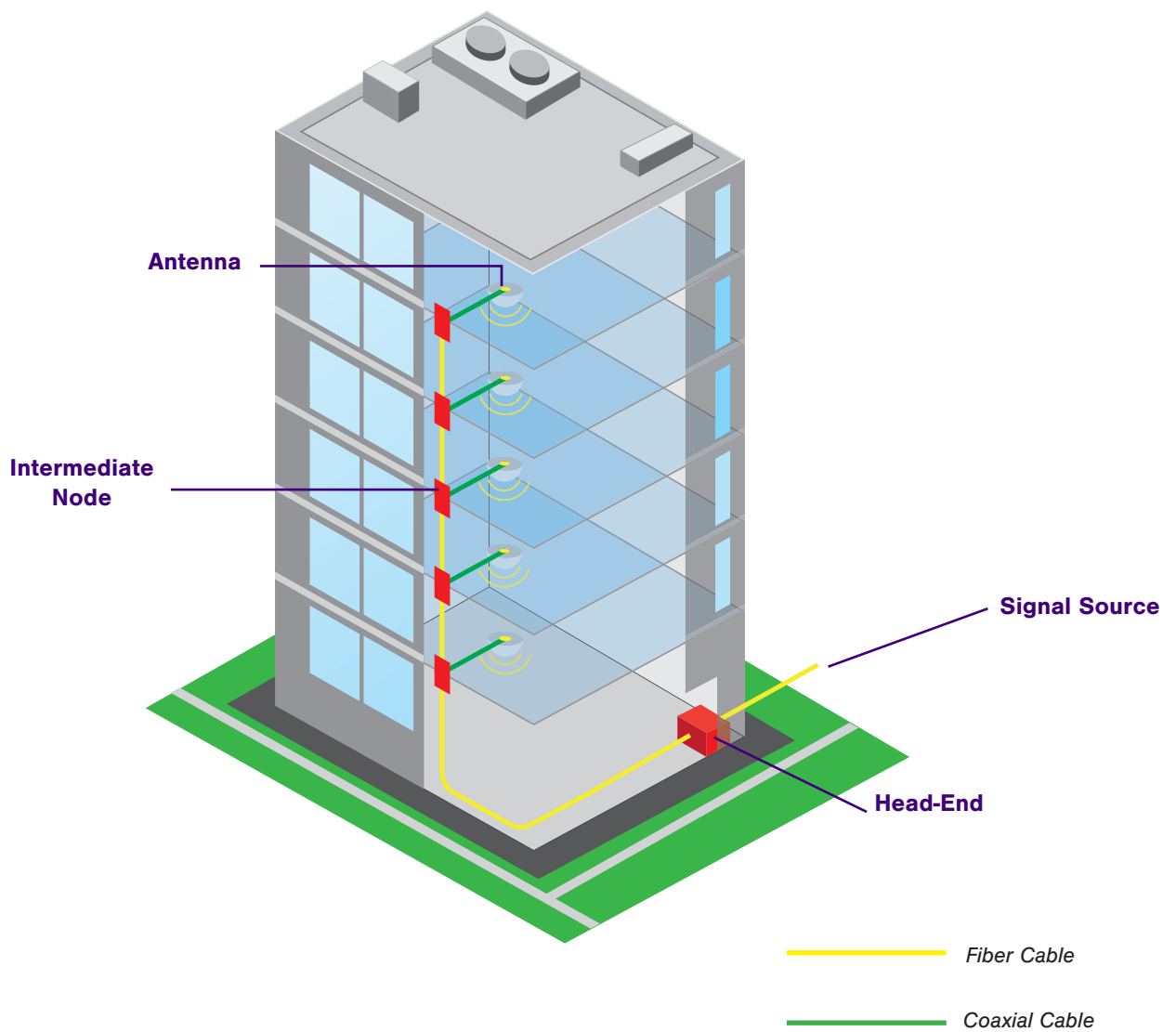
Typical Active DAS Topology



Hybrid DAS

Hybrid systems combine the use of active fiber backbone cable while sending the signal to internal passive antennas via coax cabling. This type of configuration is less cost prohibitive than an active system while allowing for extended reach in the backbone and eliminating the need to provide local power to the antennas.

Typical Hybrid DAS Topology



▶▶ DAS Means Structured Cabling

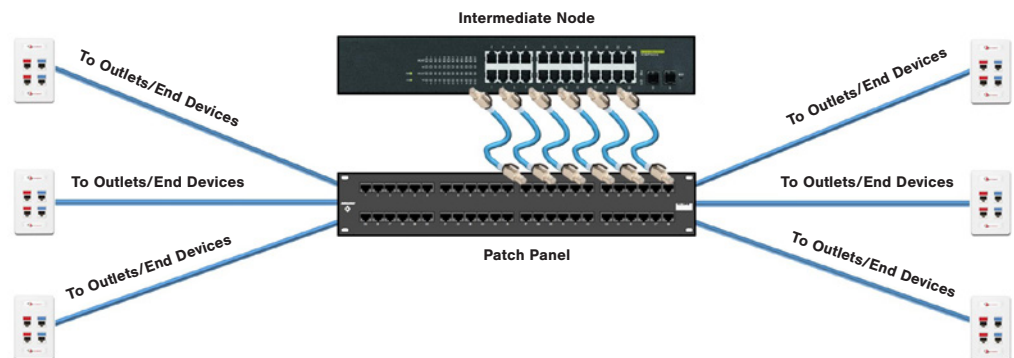


Structured cabling standards from TIA and ISO/IEC are the foundation of IP-based networks, establishing performance parameters and best practices that can reduce downtime and improve manageability.

Star Topology with Interconnect

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 intermediate node and a distribution patch panel, enabling easier management and moves, adds and changes.

Star Topology with Interconnect



Horizontal Link Lengths

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

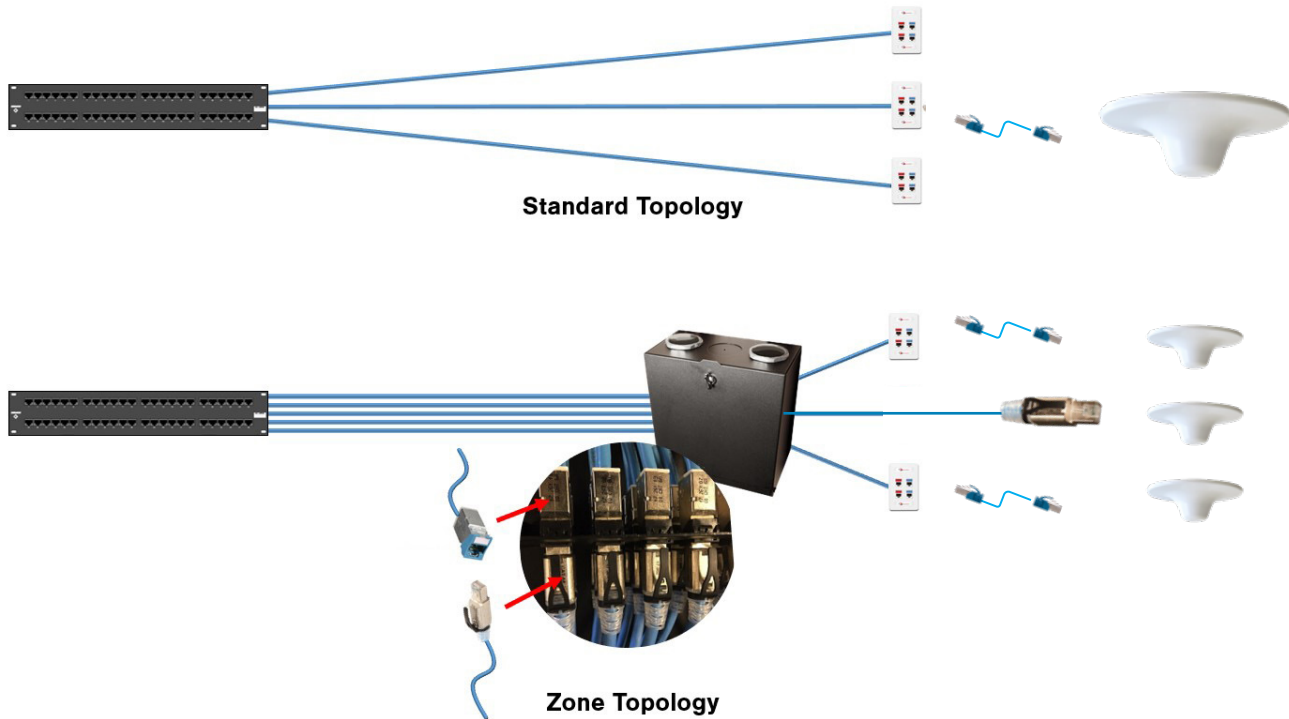
- 4-pair 100-ohm unshielded or shielded twisted-pair cabling
- 90m permanent link using solid conductor cable
- 10m of patch cords using solid or stranded conductor cable
- Maximum of 4 connectors within the channel

For environments that require longer cable runs, 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 7_A 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 DAS (and other intelligent building devices) within one enclosure



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 DAS device is not expected to be moved or rearranged after deployment. For example, where DAS devices 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.

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 air-handling spaces, including above drop ceilings and under raised floors.

Siemon's cable, zone enclosures, outlets, plugs, patch cords and surface mount boxes all meet UL 2043 requirements for providing connectivity in the plenum space to DAS devices that are ceiling mounted.

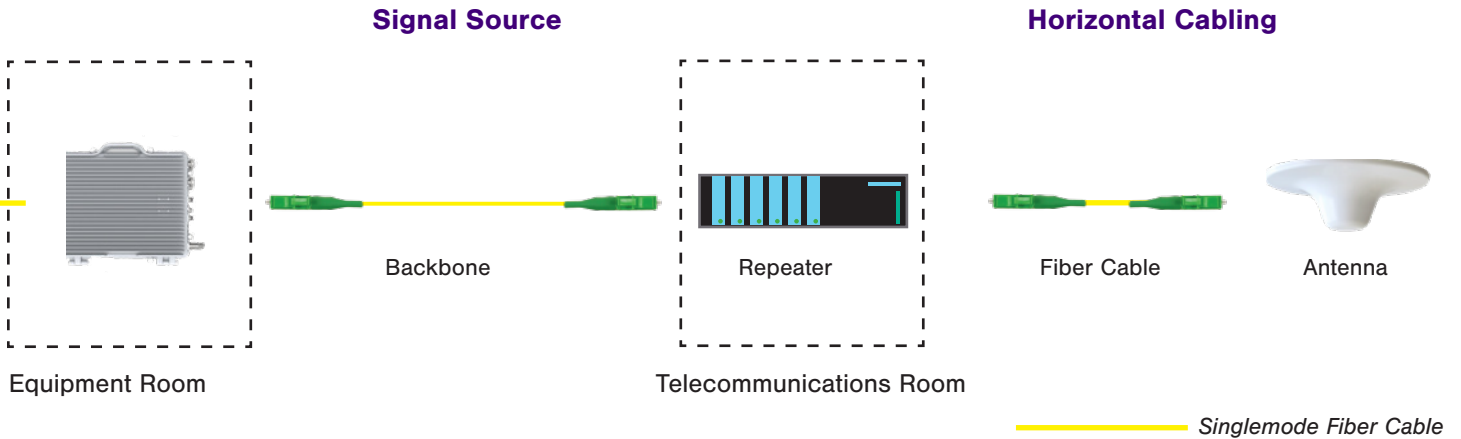
▶▶ DAS Configurations

Active Configurations

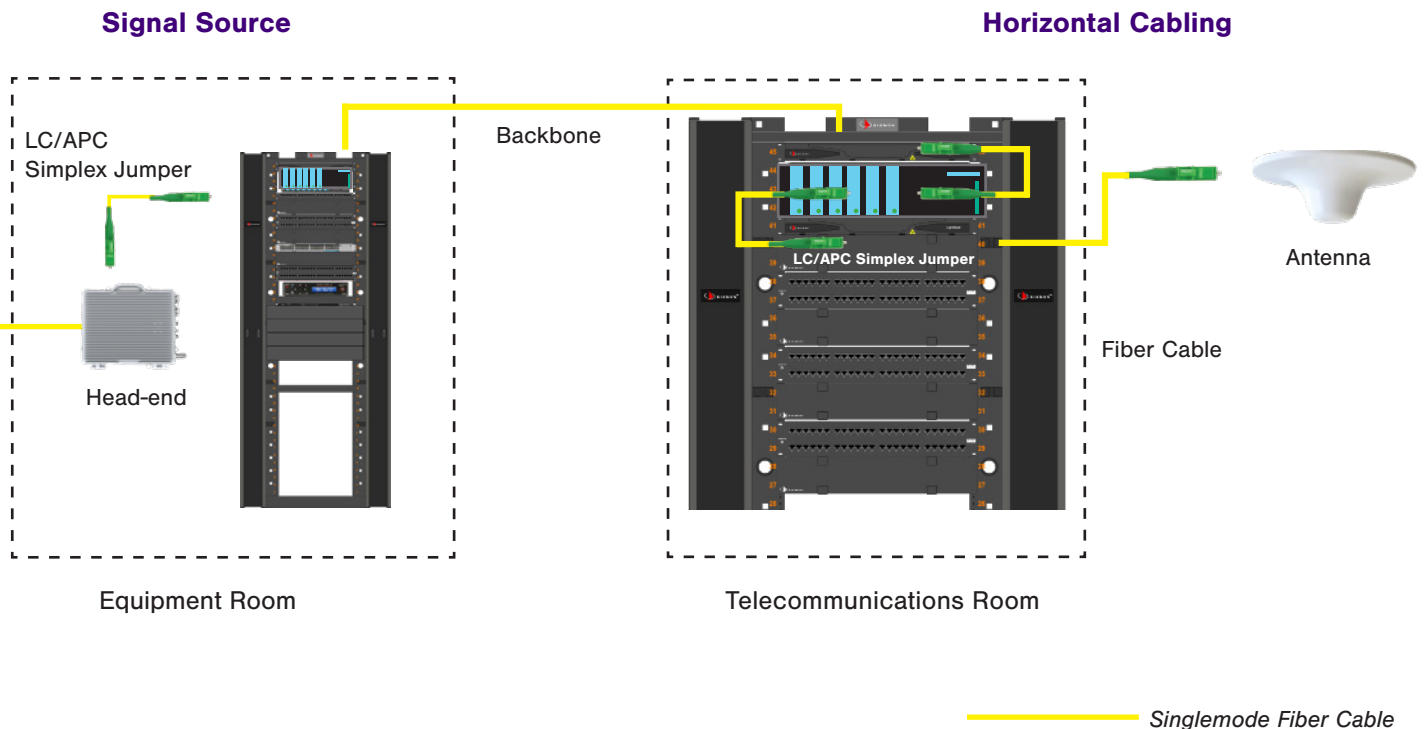
An active cabling configuration is built on a singlemode fiber backbone from the signal source with an LC/APC (shown) or SC/APC Fiber Jumper connection to the head-end or Repeater on each floor/location where antennas are located. Fiber or balanced twisted-pair copper cable is utilized for direct connection from the head end to the antennas located throughout the area.

An Active Structured Cabling configuration enables these connections by deploying over backbone and horizontal cabling terminated into enclosures using jumpers to connect to head-ends and repeaters.

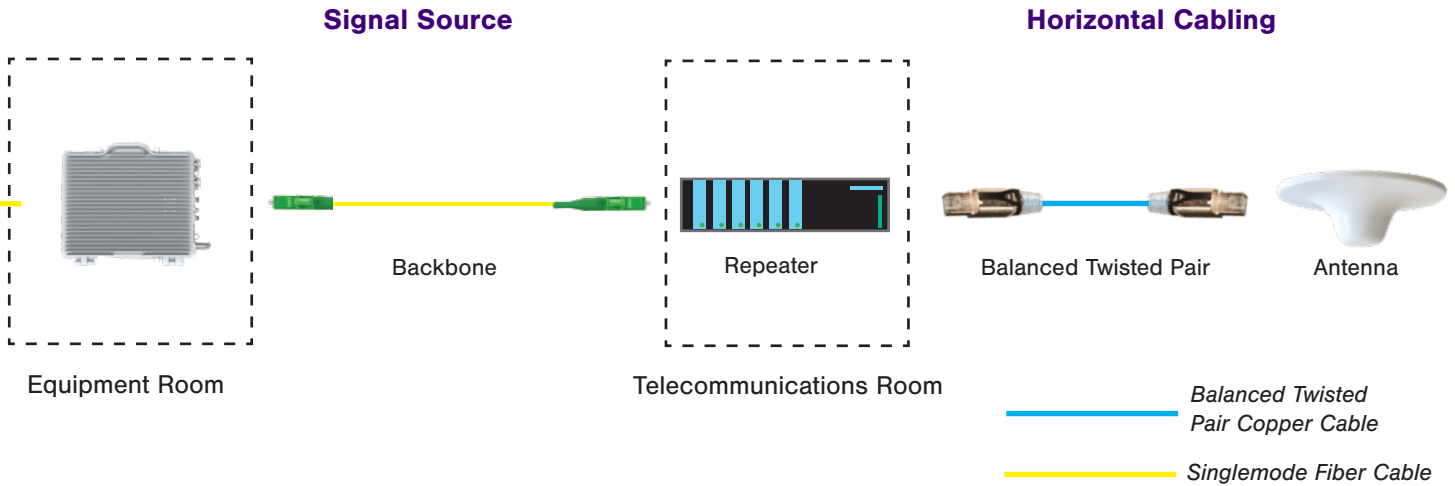
Typical Point to Point Active Fiber DAS Configuration



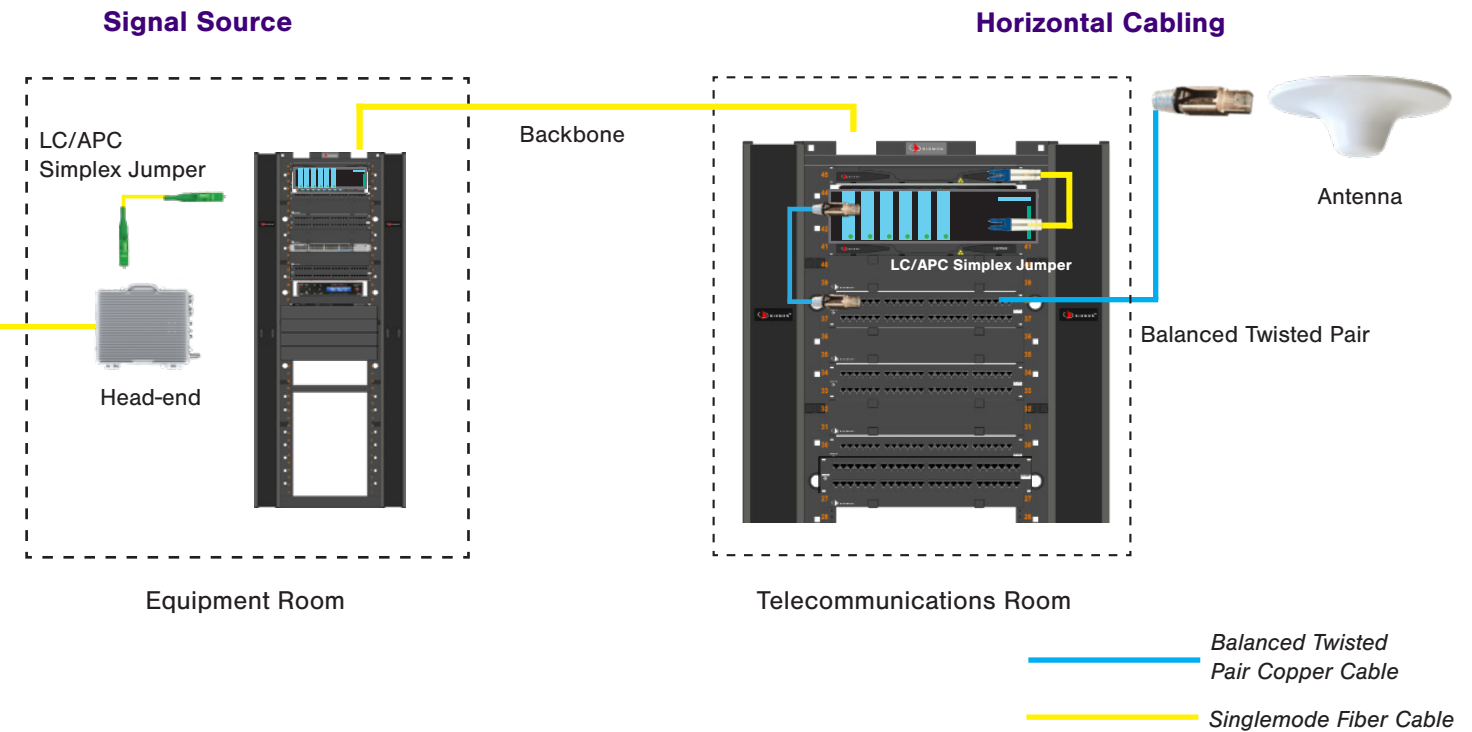
Typical Structured Cabling Active Fiber DAS Configuration



Typical Point to Point Active Fiber/Copper DAS Configuration



Typical Structured Cabling Active Fiber/Copper DAS Configuration



►► Structured Cabling is the Best Choice

Selecting the proper cabling and connectivity to support DAS is essential in building fast, reliable, trouble-free configurations. Having enough bandwidth to distribute wireless signals throughout an entire complex while seamlessly integrating with the IP-based network is an important aspect in developing a well-functioning system.

When considering industry standards for current and future DAS applications, such as the emergence of 5G in metropolitan areas, high-performance optical fiber and category 6A/class E_A shielded balanced twisted-pair copper cabling coupled with easy field installable connectors should be the standard when deploying a successful DAS.



Application-specific cabling considerations are an integral part of Siemon's Digital Building Architecture.





Industry Leading Solutions and Support

As an industry leader, Siemon participates in global industry standards development initiatives and is dedicated to understanding and supporting the unique needs of the market.

We are proud to hold leading positions within industry standard bodies such as TIA and ISO/IEC and to offer expert guidance on the design and deployment of high-performance cabling systems for use in Distributed Antenna Systems.

Siemon's high-quality balanced twisted-pair copper and optical fiber cabling solutions are fully compatible with all DAS manufacturer's equipment to deliver a standards-based end-to-end copper- or fiber-based DAS, without sacrificing performance or reliability. Siemon's LightHouse™ Advanced Fiber Solutions and High-Speed Interconnects also support the DAS backbone and are integrable with the leading manufacturer's head ends while our full range of racks, cabinets, enclosures, power distribution units and cable management solutions provide the support needed for housing and protecting active systems.

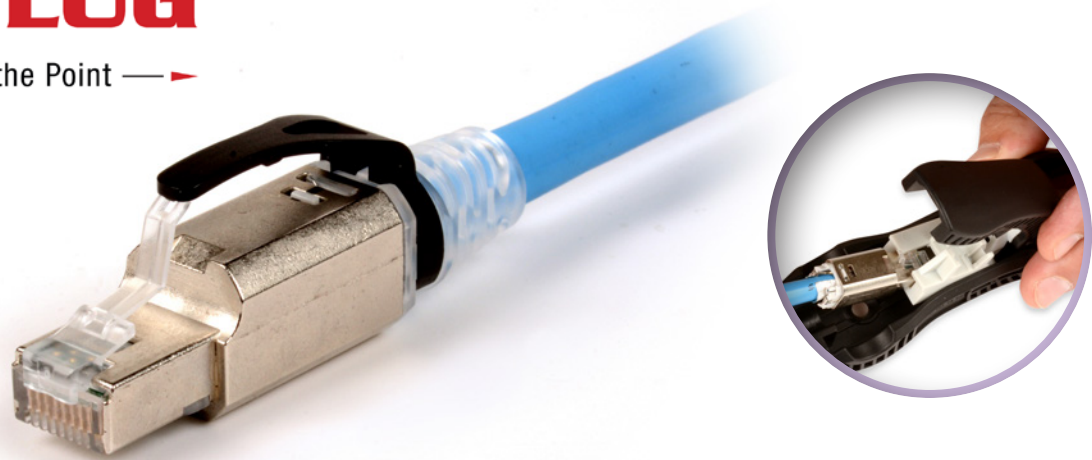


Superior Remote Powering Support

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 E_A or higher cabling systems with PowerGUARD® technology offers improved heat dissipation to reduce heat build-up within cable bundles delivering remote power that can lead to performance degradation.
- Siemon shielded category 6A/class E_A and category 7_A/class F_A 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.

▶▶ End-to-End Copper Cabling Systems for Distributed Antenna Systems



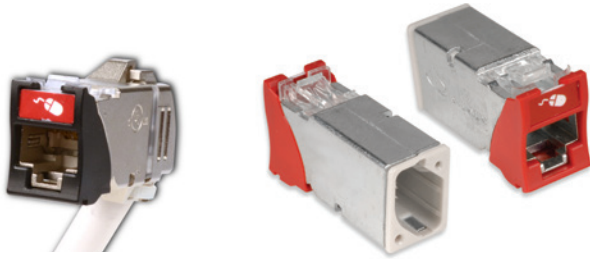
Z-PLUG™ Field-Terminated Plug

Siemon's patented Z-PLUG Field-Terminated Plug offers quick, reliable high-performance field terminations for custom length direct connections to Distributed Antenna System copper cabling.

The Z-PLUG exceeds all category 6A performance requirements to easily support 4G, LTE and 5G cellular signals.

- 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

go.siemon.com/DASZPlug



Z-MAX UTP and F/UTP Outlets

Z-MAX outlets available in Category 5e shielded, Category 6 UTP and Category 6A shielded and unshielded versions combine exceptional performance with best-in-class termination time. These outlets are also available in a Z-MAX 45 category 6A shielded version for terminating cable at a 45° angle in shallow back boxes or wall-mounted raceway systems. All Z-MAX technology feature PowerGUARD® to prevent erosion due to arching when a plug is unmated under remote power load.

go.siemon.com/DASCopperOutlets



TERA Category 7_A Outlets

As the chosen standards-based interface for Category 7A TERA Outlets are the highest-performing twisted-pair connectors available. When installed as a part of Category 7A /Class F_A deployment, TERA offers superior skew performance for superior signal delivery in Passive DOS environments. TERA outlets also feature PowerGUARD for protection against erosion under power load.

go.siemon.com/DASTERA



Z-MAX Category 6A Modular Patch Cords

Ideal for facilitating connections to modular antennas and nodes, Siemon Z-MAX category 6A UTP and shielded cords offer unparalleled performance, an alien crosstalk resistant construction and a host of innovative end-user features.

go.siemon.com/DASZMAX

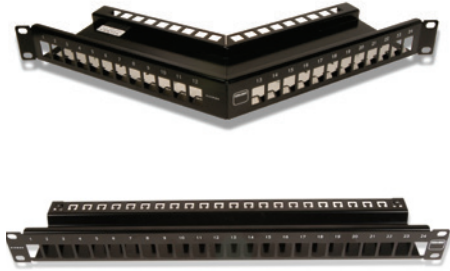


TERA Category 7_A Patch Cords

Category 7A patch cords exceed industry specifications for bandwidth when combined with TERA outlets, offering superior performance for the transmission of wireless signals throughout a structure. Also available in a TERA to Category 6A plug for standard equipment interfaces.

go.siemon.com/DASTERA

▶▶ End-to-End Copper Cabling Systems for Distributed Antenna Systems



TERA-MAX® and Z-MAX® Patch Panels

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

go.siemon.com/DASPanels



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 as well as TERA outlets.

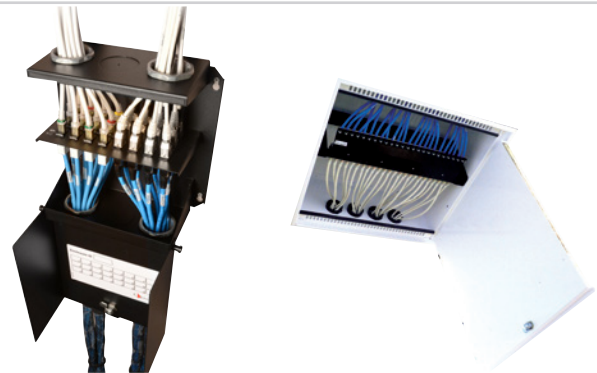
go.siemon.com/DASFaceplates



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 and TERA outlets and are available in 1, 2, 4 and 6-port configurations.

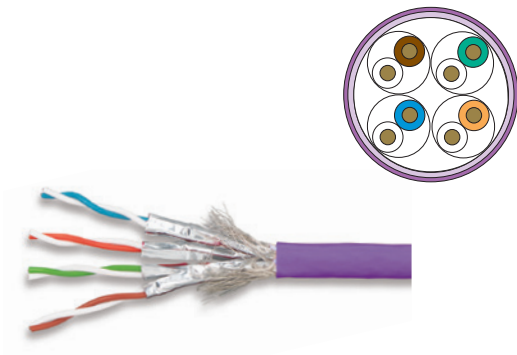
go.siemon.com/DASSurfaceMount



Zone Cabling Enclosures

Ideal for supporting zone topologies in DAS deployments, Siemon plenum-rated zone enclosures come in a 24-Port MAX Zone Unit Enclosure which accepts flat Z-MAX or TERA outlets and a 96-Port Passive Ceiling Zone Enclosure for mounting 19" panels.

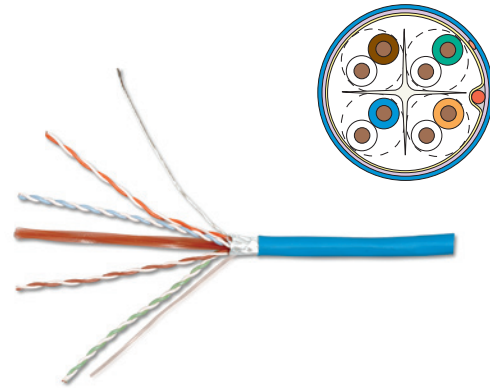
go.siemon.com/DASZone



Category 7_A S/FTP Cable

Category 7_A fully shielded cable is an integral component in the distribution of wireless signals in Passive DAS environments. This cable is the highest-performing and most secure twisted-pair copper system available for the delivery of cellular signals, featuring excellent delay skew performance and noise immunity. Category 7_A cable provides optimum signal transmission

go.siemon.com/DAS7a



Category 6A UTP and F/UTP Cable

Our Category 6A UTP and F/UTP Cable feature the highest performance margins across all critical transmission parameters, perfect for DAS applications. Available in a wide range of constructions, shielding and jacket types, this Category 6A cable gets the job done in any situation where copper cable is being utilized.

go.siemon.com/DAS6a



LightBow™ Fiber Termination Kit

Fiber optic cabling is the ideal option for large structures, campus or complexes which require an Active DAS. To make fiber deployments run faster and more smoothly, Siemon developed the LightBow Mechanical Splice Termination System for fast terminations, without the typical learning curve required for other fiber termination methods, which significantly reduces installation costs. 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 and robust termination process 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 re-terminated
- Termination kit includes LightBow termination tool, strippers, precision cleaver, strip template, VFL – everything needed for termination in a convenient carrying case

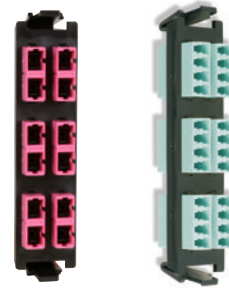
go.siemon.com/DASLightBow



RIC Fiber Enclosure

Rack Mount Interconnect Center Enclosures (RIC), 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 time-saving preloaded versions.

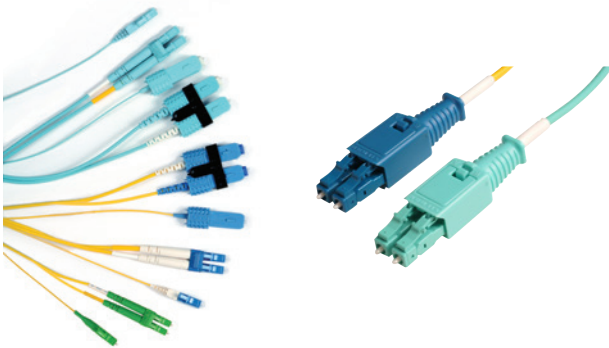
go.siemon.com/DASRIC



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 to RIC Fiber Enclosures for use in extended distances in DAS applications.

go.siemon.com/DASQuickPack



LC BladePatch® and XGLO Fiber Jumpers

LC BladePatch OM4 jumpers offer an innovative push-pull action for high-density environments and are available in multimode and singlemode LC versions. XGLO Fiber Jumpers, primarily used for connecting switched and devices, are available in both standard SD and LC versions.

go.siemon.com/DASLCBlade

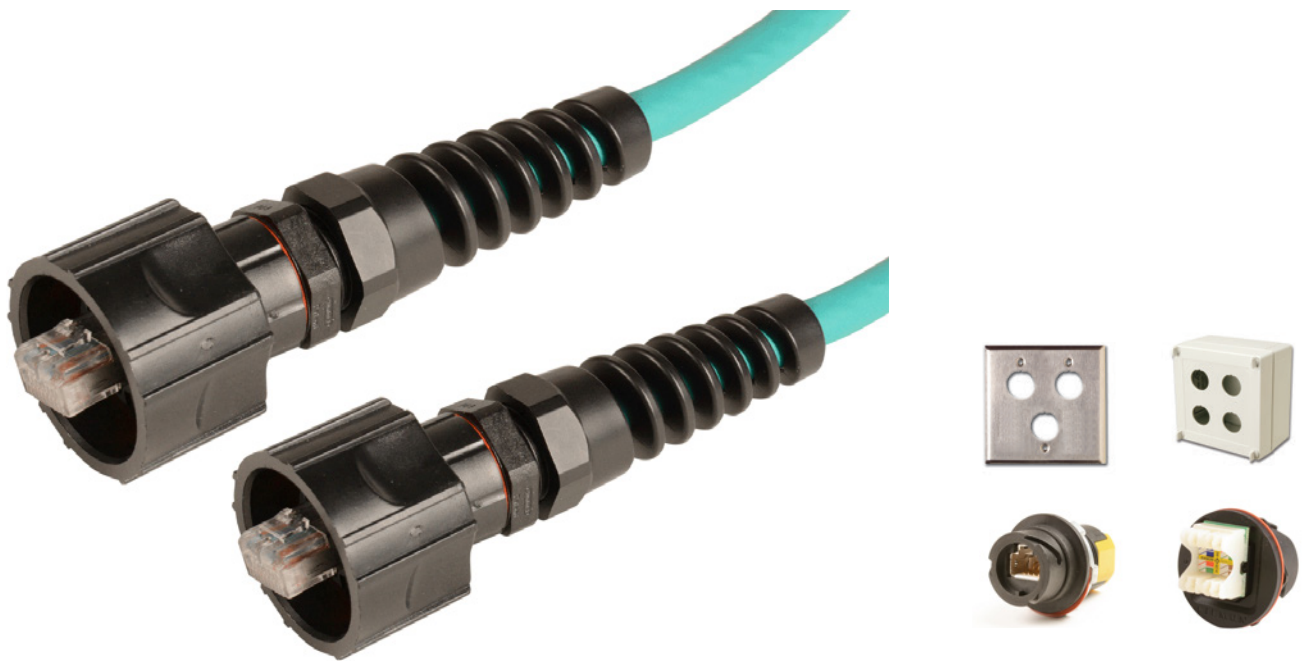


Fiber Cable

Siemon offers a full line of indoor, outdoor, indoor/outdoor and outside of plant bend-insensitive bulk singlemode and multimode fiber cabling. Available in tight buffer and loose tube and in a variety of jacket ratings to accommodate extended distances or campus-wide DAS applications.

go.siemon.com/DASFiberCable

▶▶ Ruggedized Cabling for Distributed Antenna Systems



Copper and Fiber Ruggedized Cabling

Siemon Ruggedized Infrastructure Solutions protect critical network connections from dust, moisture, industrial cleaning chemicals and vibration. Ruggedized infrastructure solutions are ideal for protecting valuable connections in laboratories, hospitals, food processing plants and other harsh environments.

- Copper plugs can be terminated in the field, allowing custom lengths to be assembled quickly on site
- Plug housing and dust caps feature ribs to provide additional gripping for mating and unmating
- Duplex multimode and singlemode LC fiber connectors feature patented Ruggedized housing with an innovative quarter-turn bayonet-style mating that ensures an IP66/IP67-rated seal
- Specialized fiber bend relief boot and heavy-duty strain relief crimp components

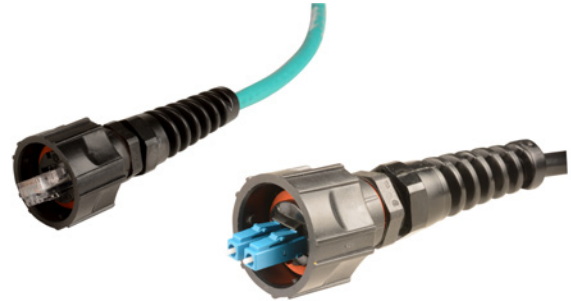
go.siemon.com/DASRuggedized



Ruggedized Faceplates

Mount Siemon's Ruggedized outlets and adapters into these stainless steel faceplates for a protective seal from moisture and debris. The faceplates are available in 1-, 2-, 3- and 4-port options with a rear sealing gasket and carry an IP44 rating.

go.siemon.com/DASRuggedized



Ruggedized Copper and Fiber Patch Cords

Siemon offers ruggedized Category 5e, Category 6 UTP and Category 6A patch cords as well as LC plugs for construction of fiber patch cords. Ruggedized fiber connectivity is ideal for protecting fiber for installations requiring extended distances, in close proximity to heavy sources of EMI, or where fiber active equipment is used.

go.siemon.com/DASRuggedized



Ruggedized Copper Outlets

When configuring a fiber-based DAS in harsh environments, Siemon Ruggedized Copper Outlets are the premier choice for connections in dusty, wet or areas where exposure to chemicals is commonplace. Designed to flawlessly perform in laboratories, hospitals, cafeterias and indoor or outdoor environments.

go.siemon.com/DASRuggedized

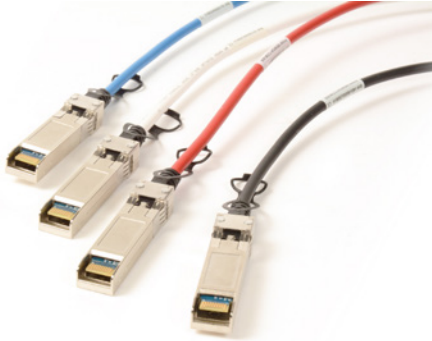


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go.siemon.com/DASRuggedized

► Support Products for Distributed Antenna Systems



High-Speed Interconnects and Active Optical Cables

Siemon High-Speed Interconnects and Active Optical Cables are an ideal choice for connections within the headend or racks and enclosures. Available in SFP+, QSFP+, QSFP28 and SFP28 form factors, ½- meter lengths, and multiple colors to match existing configurations.

go.siemon.com/DASInterconnects



Wall Mount Cabinets

Siemon offers a full range of wall-mount cabinets in a variety of colors and sizes for protecting and housing DAS equipment. These high-quality enclosures are available with many door, handle and latch styles, including lockable security handles.

go.siemon.com/DASWallMount



Value Rack

For an economical, durable solution for mounting and securing cabling and equipment in a DAS headend, look no further than Siemon's Value Rack. This affordable rack features integrated bonding and grounding, visible U space markings and compatible with our full range of cable management solutions.

go.siemon.com/DASValueRack



4 post rack

This adjustable depth 4-Post Rack provides a stable platform for mounting extended depth/size active equipment within the headend or data center and will keep equipment secure and safe.

go.siemon.com/DAS4Post



Value Vertical Cable Managers

The Value Vertical Cable Manager is an economical, full-featured solution with every aspect optimized to minimize assembly time and simplify steps.

go.siemon.com/DASValueVertical



Horizontal Cable Managers

The RouteIT (HCM-series) horizontal cable managers are specifically designed to readily manage the challenges proposed by today's high volume, high density cabling systems.

go.siemon.com/DASHCM



Want to Learn More About Distributed Antenna Systems?



Visit the Siemon.com Distributed Antenna Systems application page:
go.siemon.com/DistributedAntennaSystems



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/DistributedAntennaSystemsDistributor

Because we continuously improve our products, Siemon reserves the right to change specifications and availability without prior notice.

North America
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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

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