



# ▶▶ Wi-Fi

## Application & Product Guide

For Today's High-Throughput, High-Efficiency Wi-Fi



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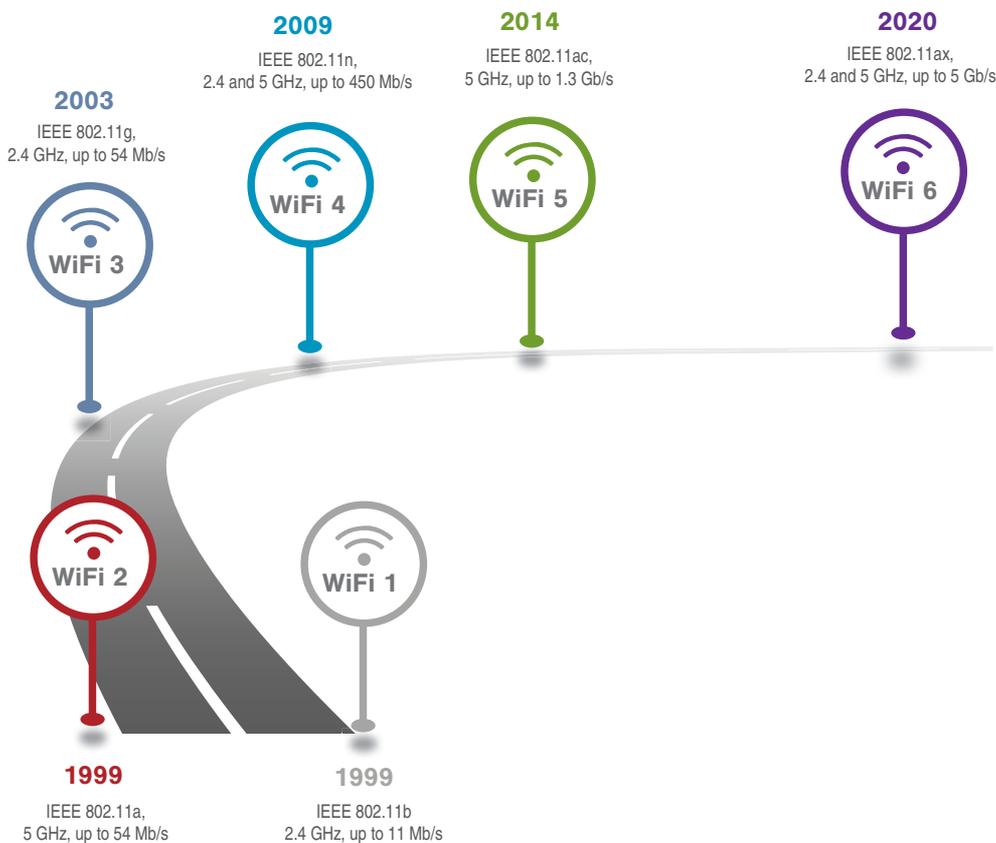
## ▶▶ **Connecting Today's Wi-Fi Systems to a Higher Standard**

With the increased use of mobile devices, Wi-Fi is now ubiquitous with broad reaching adoption across all types of facilities. With the growth of Wi-Fi has come significant developments in the underlying technology, advancing from 54 Mb/s, to 450 Mb/s, to high-throughput, high-efficiency gigabit speeds and beyond to support everything from mission critical business applications to streaming of ultra-high-definition video.

As a leading global manufacturer of low-voltage copper and fiber optic cabling systems, Siemon understands that high-performance cables and connectors play an important role in supporting today's high-throughput, high-efficiency Wi-Fi transmission and the delivery of Power over Ethernet (PoE) to Wi-Fi access points (WAPs). Successful Wi-Fi deployments also necessitate understanding the standards-based requirements needed to achieve greater than 5 Gb/s throughput and following design and installation best practices.

## ▶▶ A Technology Evolution

Wi-Fi has steadily advanced to keep up with bandwidth demand. The introduction of multiple input, multiple output (MIMO) technology that transmits over multiple send and receive antennas (i.e., spatial streams) has enabled speeds to increase from tens of Mb/s to greater than 5 Gb/s over the past two decades while maintaining backward compatibility within the same frequency band.



### Part of Siemon's ConvergeIT Intelligent Building Solutions

The integration of low-voltage applications is happening as part of the intelligent building movement, and Wi-Fi is converging over an IP-based platform along with AV, 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 ensures a robust, scalable standards-compliant infrastructure, from construction planning through implementation and delivery.

This Wi-Fi 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 the Requirements



The Wi-Fi Alliance released its Wi-Fi 6 certification program in late 2019, which will rapidly propel Wi-Fi-6 adoption and the need for two category 6A/class E<sub>A</sub> connections per WAP.

To support Wi-Fi 5 and Wi-Fi 6, industry standards developed by the Telecommunications Industry Association (TIA) for North America and the International Organization for Standardization and the International Electrotechnical Commission (ISO/IEC) internationally recommend a minimum of 10 Gb/s capable balanced twisted-pair copper or optical fiber. For these reasons, industry standards recommend the use of category 6A/class E<sub>A</sub> or higher and OM3 (or higher) optical fiber cabling for WAPs to support higher data rates.

In the case of twisted-pair cabling systems, category 6A/class E<sub>A</sub> or higher shielded systems are also recommended by the standards to ensure a lower temperature rise when remote power is applied. TIA and ISO/IEC also recognize that the use of multiple horizontal links to a single WAP (link aggregation) may be required to support current and emerging WAP technologies.

	<b>Wi-Fi 4</b>	<b>Wi-Fi 5</b>	<b>Wi-Fi 6</b>
<b>Transmit Frequency</b>	2.4 or 5 GHz	5 GHz only	2.4 or 5 GHz
<b>Number of Spatial Streams</b>	3-4	3-8	3-8
<b>Maximum Data Rate per Stream</b>	144 Mb/s	866 Mb/s	1.2 Gb/s
<b>Theoretical Maximum Data Rate</b>	576 Mb/s	6.93 Gb/s	9.61 Gb/s
<b>Typical Achievable Speed</b>	450 Mb/s	1.3 Gb/s	5 Gb/s
<b>Ethernet</b>	1000BASE-T	2.5/5/10GBASE-T	10GBASE-T
<b>Power</b>	Up to 90W with PoE	Up to 90W with PoE	Up to 90W with PoE
<b>Infrastructure</b>	≥ Category 5e	≥ Category 6A*	≥ Category 6A
<b>Number of Connections</b>	1	2	2
<b>Distance</b>	100m	100m	100m

\* Existing category 5e/class D and category 6/class E may support 2.5/5GBASE-T but needs to be retested/recertified and may not adequately support future implementations of Wi-Fi 5.

## ▶▶ What About 2.5/5GBase-T?

In 2016, IEEE introduced 2.5GBASE-T (2.5 Gb/s) and 5GBASE-T (5 Gb/s) to potentially enable the installed base of category 5e/class D and category 6/class E cabling systems to support Wi-Fi 5 Wave 1 and Wave 2 devices. However, 2.5G/5GBASE-T is not intended to operate over the entire installed base, and existing category 5e/class D and category 6/class E infrastructure requires time-consuming re-testing and re-certification to verify support. Furthermore, TIA and ISO structured cabling standards recommend category 6A/class E<sub>A</sub> cabling as the minimum cabling for all new installations and only category 6A/class E<sub>A</sub> and higher cabling systems support 2.5GBASE-T, 5GBASE-T and 10GBASE-T without further characterization.



## ▶▶ Wi-Fi Cabling Configurations

TIA and ISO/IEC structured cabling standards are the foundation of IP-based networks supporting Wi-Fi applications. These standards allow for various cabling configurations to support Wi-Fi 5 and Wi-Fi 6 deployments, and Siemon's Technical Services Group can help you select the best configuration based on your specific need, application and environment.

### The primary cabling requirements for today's Wi-Fi applications are as follows:

- A category 6A/class E<sub>A</sub> connection is the only way to guarantee support for 1.3 Gb/s throughput for Wi-Fi 5 Wave 1 WAPs.
- Two category 6A/class E<sub>A</sub> connections are the only way to support management, redundancy and link aggregation needed to achieve greater than 5 Gb/s throughput for Wi-Fi 6 Wave 1 WAPs, while ensuring support for greater than 10 Gb/s for future Wi-Fi deployments.
- A minimum 25 Gb/s capable fiber backbone is recommended to support Wi-Fi 5 and Wi-Fi 6 uplink capacity.
- The use of optical fiber to connect WAPs can support extended distance requirements beyond 100 meters but may require media conversion and/or local power.



**Two category 6A/class E<sub>A</sub> connections are recommended for Wi-Fi 6**

### Wi-Fi is Everywhere

Wi-Fi deployments touch all environments, scenarios and businesses today – any environment needing to provide network access to mobile devices, laptops and other wireless-enabled devices.

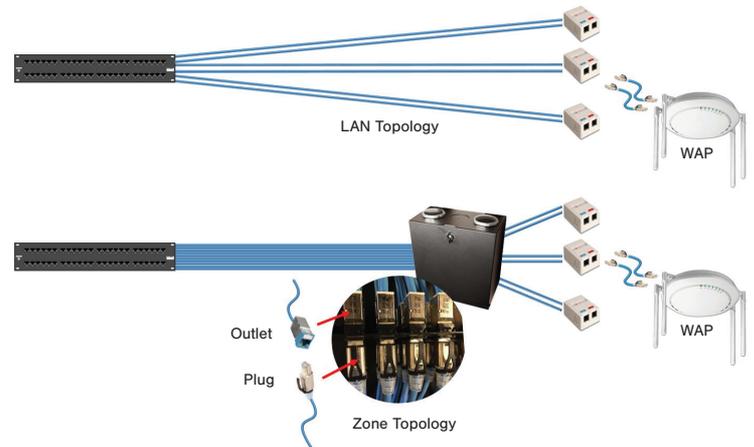
- Corporate office spaces for any enterprise business
- Hospitality and retail venues like hotels, restaurants and convention centers
- Indoor and outdoor public spaces such as airports, arenas and municipalities
- Methods of transportation such as airplanes, trains and buses
- Hospitals and healthcare facilities
- K-12 schools and universities

## ▶▶ Wi-Fi Cabling Configurations

### 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 telecommunications room (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 by isolating changes 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



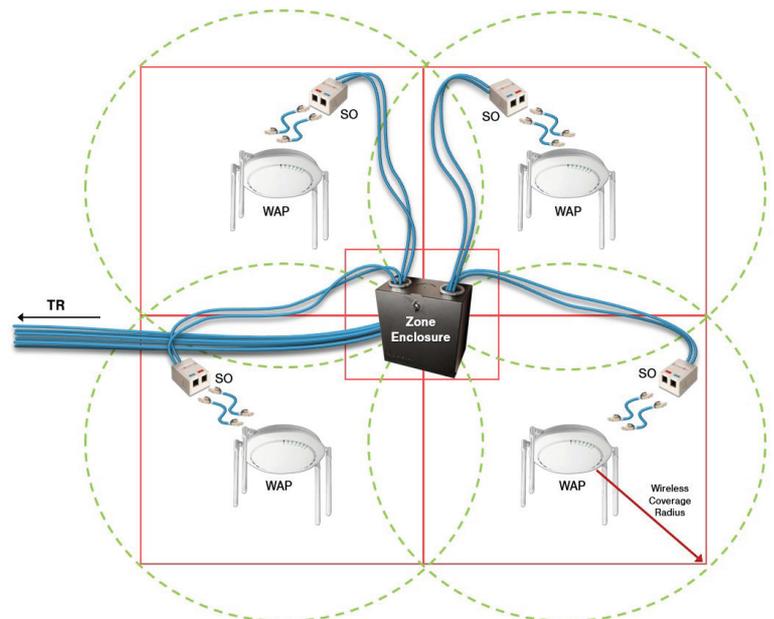
### Zone vs LAN Topology

Zone cabling is especially ideal for the deployment of grid-based Wi-Fi coverage areas. In this scenario, the diameter of wireless coverage is larger than the square grid pattern to ensure reliable wireless transmission across a facility with no gaps between coverage areas.

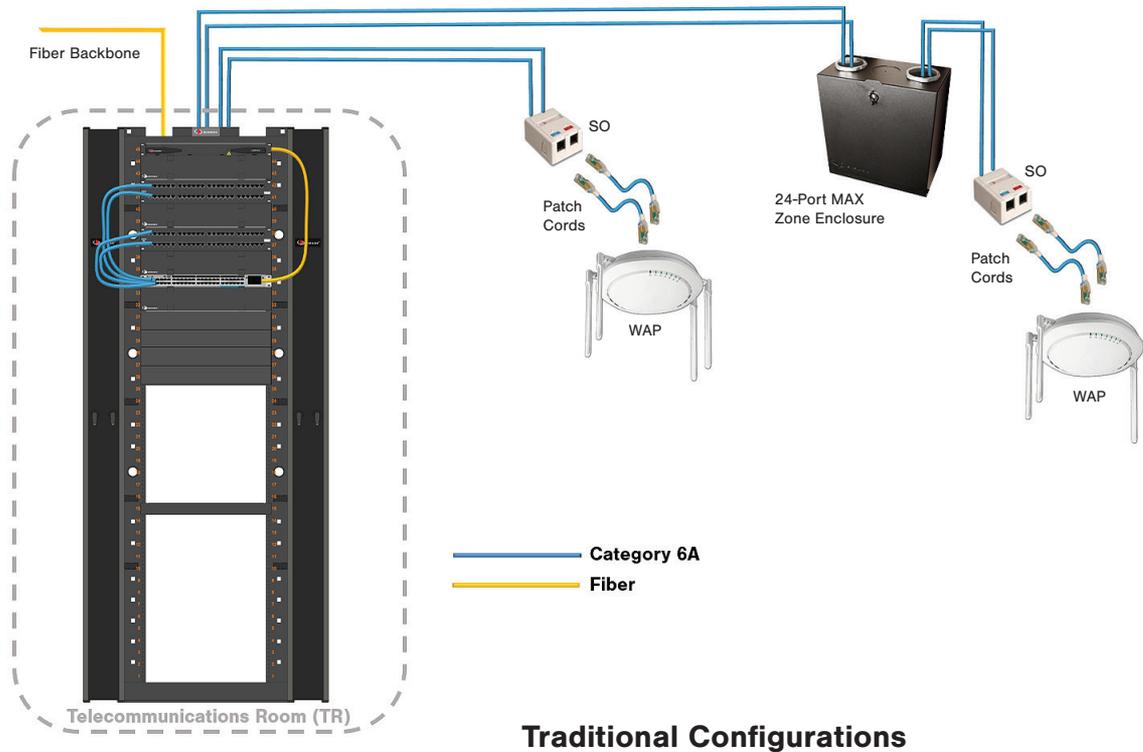
### Plenum Space Requirements for North America

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 Wi-Fi access points that are typically ceiling mounted.



### Wi-Fi Coverage Areas via Zone Cabling



**Traditional 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 WAP. Patch cords are used to connect WAPs 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.

### Upgrading to Wi-Fi 6

When replacing earlier-generation WAPs with a Wi-Fi 6 WAP, it is important to consider the existing cabling infrastructure. There may be a need to add an additional link and/or upgrade the cabling to support redundancy and required bandwidth capacity.

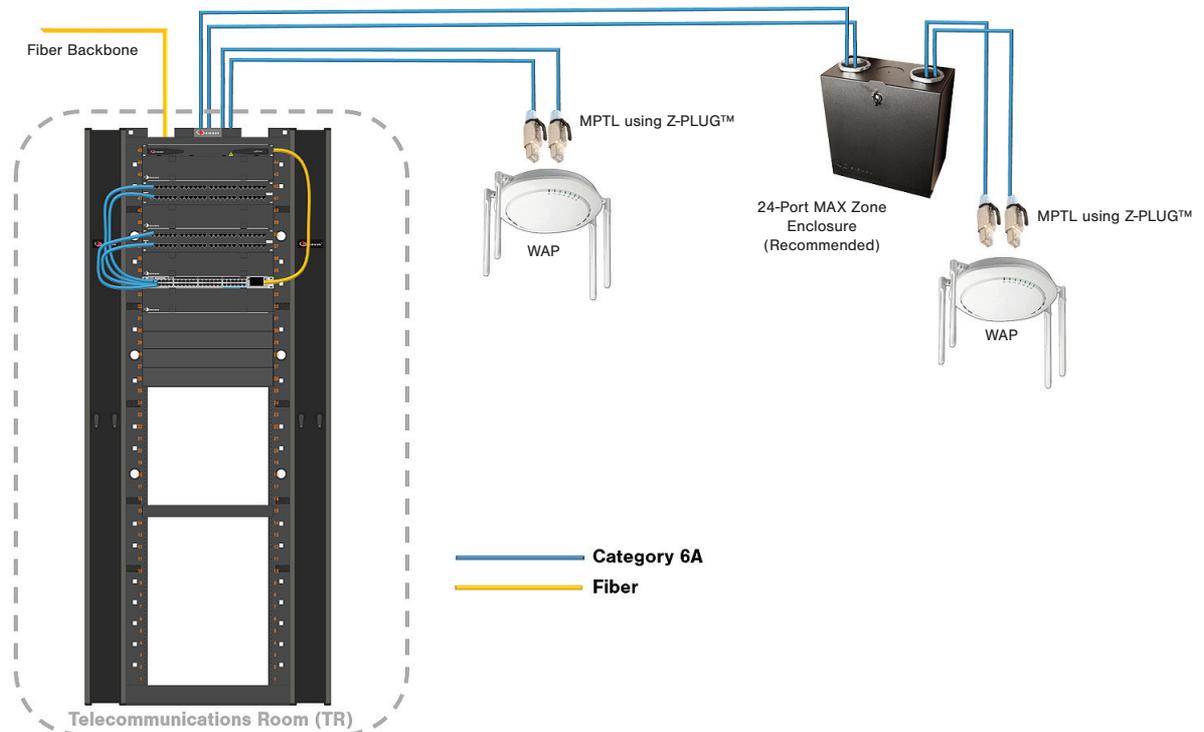
- Wi-Fi 6 WAPs require two category 6A/class E<sub>A</sub> links to achieve redundancy and greater than 5 Gb/s throughput for Wi-Fi 6 Wave 1 WAPs and ensure support for greater than 10 Gb/s for future Wi-Fi deployments.
- Existing category 5e/class D and category 6/class E cabling requires time-consuming re-testing and re-certification to verify support for 2.5GBASE-T and 5GBASE-T, and it does not ensure support for future Wi-Fi deployments.

## ▶▶ Wi-Fi Cabling 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 WAP is not expected to be moved or rearranged after deployment. For example, where WAPs are publicly mounted, an MPTL may be considered to improve security by eliminating patch cords that can be 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.

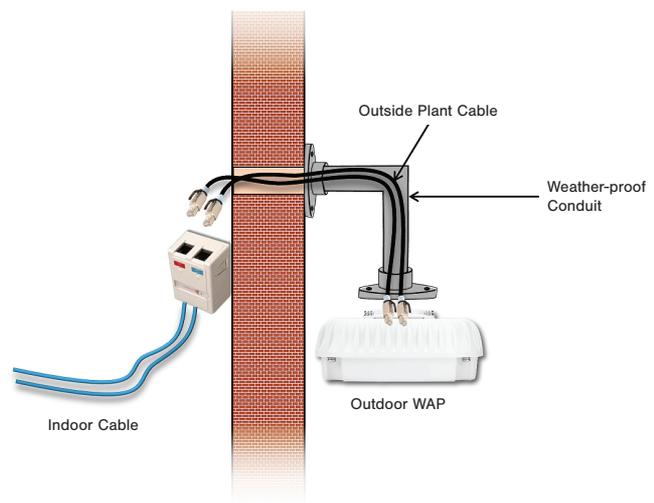
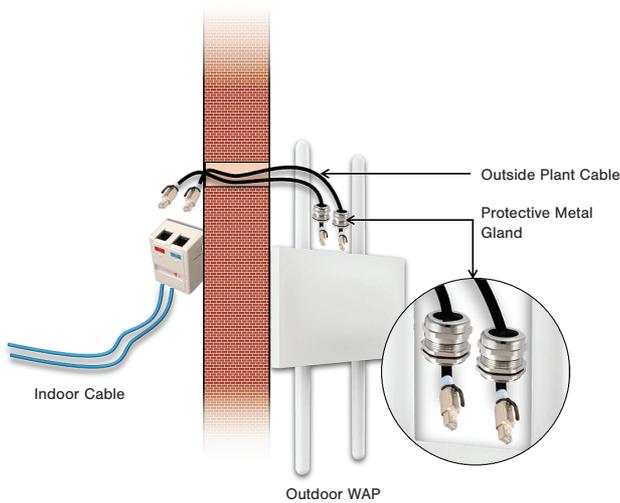


### Modular Plug Terminated Link (MPTL) Configurations

## Outdoor Wi-Fi Configuration

With Wi-Fi now ubiquitous across all environments and vertical markets, the demand for outdoor wireless access has increased significantly, especially where large numbers of people congregate outdoors, such as universities, amusement parks, stadiums and resorts. Connecting WAPs outdoors requires cables and connectivity that are protected from the elements. There are a variety of options for cabling outdoor WAPs mounted on the outside of buildings or poles.

Indoor/outdoor cable can be used to connect outdoor WAPs. However, if the link to the outdoor WAP requires cable to be deployed in a direct burial, lashed aerial or underground conduit application subject to moisture and UV radiation, outside plant (OSP) cable is required and must transition from indoor cable at the building entrance.

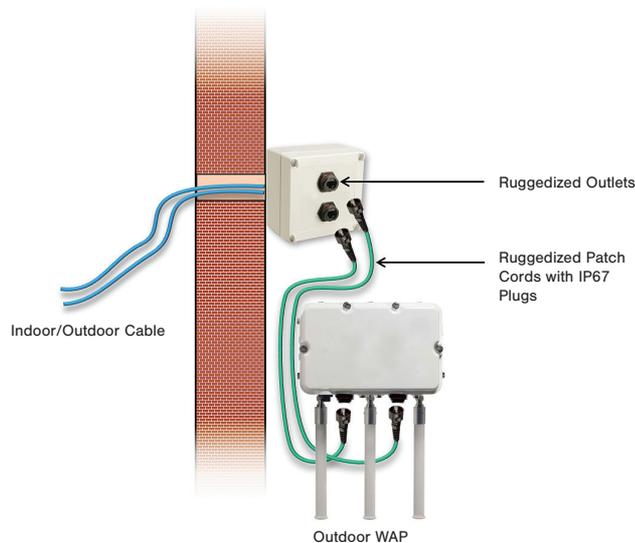


### Outdoor Wi-Fi Application using a Protective Metal Gland

Protective metal glands protect plugs that connect directly to the outdoor WAP, requiring field termination of the plug (e.g., Siemon's Z-PLUG) after the cable passes through the gland.

### Outdoor Wi-Fi Configuration using Weather-proof Conduit

Ruggedized patch cords with IP66/IP67-rated plugs connect outdoor WAPs to ruggedized outlets housed in an IP66/IP67 (NEMA 4X) surface mount box.



### Outdoor Wi-Fi Configuration using Ruggedized Connectivity

Plug-terminated links or patch cords can pass through weather-proof conduit to connect outdoor WAPs.



## ▶▶ Shielded Cabling is the Best Choice

When it comes to supporting the latest Wi-Fi applications, there are additional considerations with respect to the cabling systems. Not only is it important to follow TIA and ISO structured cabling standards, but it is critical to consider support for remote powering technology as most WAPs are powered via PoE. When considering industry standards, and the impact of higher-level PoE capable of powering WAPs, category 6A/class E<sub>A</sub> shielded cabling should be the minimum twisted-pair cabling system deployed for Wi-Fi applications.

- Shielded category 6A/class E<sub>A</sub> or higher cabling systems offers increased headroom, excellent noise immunity and better crosstalk performance for more reliable wireless signal transmission.
- Deploy two category 6A/class E<sub>A</sub> or higher connections to support current and future Wi-Fi 5 and Wi-Fi 6 implementations.
- The use of category 7<sub>A</sub> cable with category 6A connectivity enables a familiar RJ45 interface and can deliver greater energy efficiency, heat dissipation 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 E<sub>A</sub> 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 E<sub>A</sub> and category 7<sub>A</sub>/class F<sub>A</sub> 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.



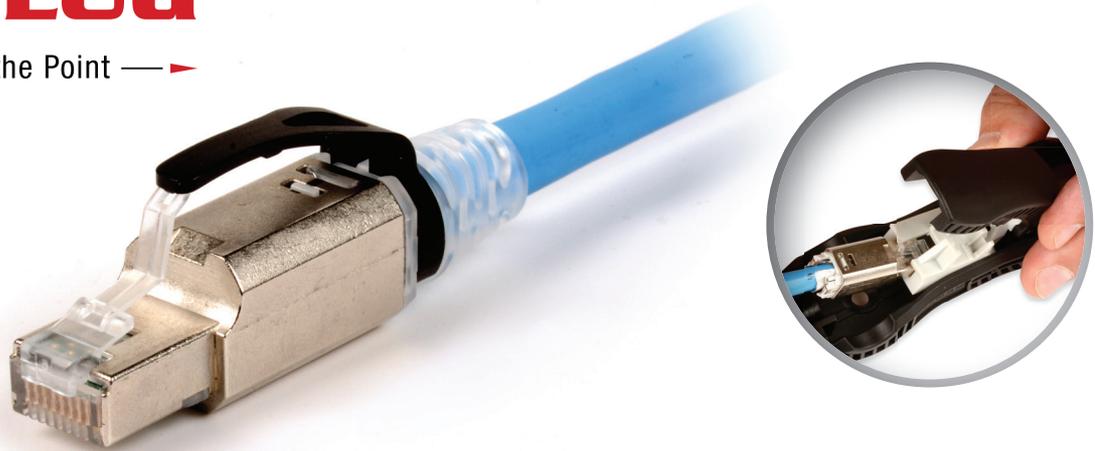
## ▶▶ Industry Leading Solutions and Support

As an industry leader, Siemon participates in global cabling standards development initiatives and is dedicated to understanding and supporting the unique needs of the market. Siemon offers technical support and expert guidance on designing and deploying high-performance, reliable cabling systems for the latest Wi-Fi applications.

With high performance copper cabling and innovative, easy-to-deploy connectivity solutions, Siemon delivers standards-based end-to-end cabling systems with the performance and reliability to support today's high-throughput, high-efficiency Wi-Fi. 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 for housing and protecting active equipment and connections.

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





### Z-PLUG WAP Protective Gland

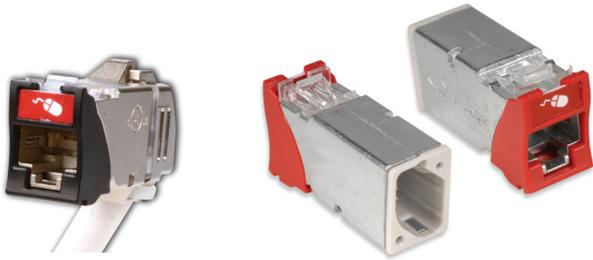
For outdoor-rated WAPs and available in multiple thread types, the Z-PLUG WAP protective metal gland with rubber seal is easily threaded onto the cable prior to terminating the Z-PLUG, protecting the plug-outlet WAP connection against ingress of moisture.

### 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 WAPs. Z-PLUG exceeds all category 6A performance requirements to easily support the latest high-throughput, high-efficiency Wi-Fi 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 ability to eliminate the boot and latch protector makes it ideal for connecting to devices with limited space.
- The user-friendly Z-PLUG termination tool and intuitive hinged lacing module that eliminates cable feed through enables best-in-class termination speed and repeatable performance.
- Dual-purpose latch protector clip protects 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.

Visit [www.siemon.com](http://www.siemon.com) for detailed part numbers and ordering information in our eCatalog.



### Z-MAX UTP and F/UTP Outlets

Z-MAX 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-MAX and Z-MAX Patch Panels

Available in flat and angled versions, TERA-MAX and Z-MAX patch panels provide outstanding performance and reliability in a modular solution for equipment rooms. Shielded and UTP Z-MAX modules can be easily configured in the TERA-MAX and Z-MAX panels.



### Z-MAX Category 6A Modular Patch Cords

Ideal for facilitating connections to WAPs from a service outlet or for patching in the telecommunications 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. Z-MAX patch cords are available with both stranded and solid conductors (including plenum-rated) to support longer runs and PoE.



### 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. MAX modular furniture adapters are ideal for mounting modules into standard furniture openings.

Visit [www.siemon.com](http://www.siemon.com) for detailed part numbers and ordering information in our eCatalog.

## ▶▶ End-to-End Copper Cabling Systems for Wi-Fi



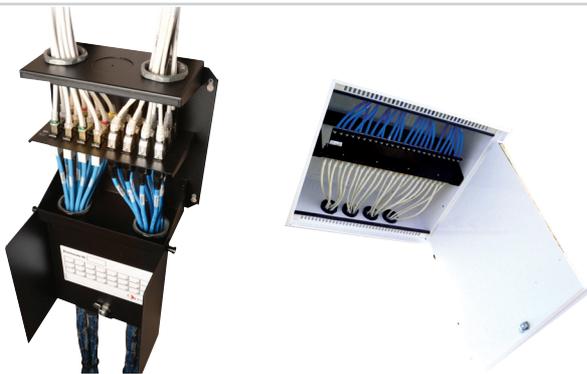
### Z-MAX Surface Mount Boxes

Siemon's plenum-rated 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 Wi-Fi Access Point Bracket Faceplate

Siemon's 2-port MAX WAP Bracket Faceplate is a WAP bracket with integrated recessed faceplate, enabling ceiling-mounted WAP locations to be pre-cabled early in projects. This allows the WAP to be added later without re-entering the air handling space. Designed for use with hybrid Z-MAX outlets, this low-profile faceplate mounts to single-gang US size mud rings and features mounting holes for common WAP mounting brackets.



### Zone Cabling Enclosures

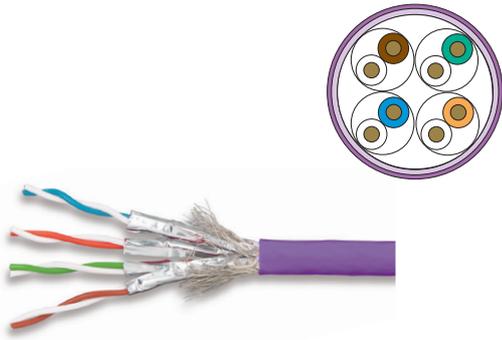
Ideal for supporting zone cabling topologies in grid-based Wi-Fi deployments, Siemon plenum-rated zone enclosures come in a 24-Port MAX Zone Unit Enclosure and a 96-Port Passive Ceiling Zone Enclosure that accept flat Z-MAX outlets.



### Ruggedized Outlets, Plugs and Patch Cords

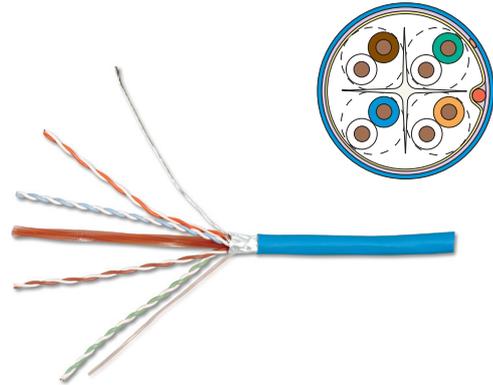
Siemon ruggedized category 6A outlets, patch cords and plugs are the answer for Wi-Fi deployments in harsh environments such as laboratories, hospitals, cafeterias or any other place where connections may be exposed to dust, moisture or chemicals.

Visit [www.siemon.com](http://www.siemon.com) for detailed part numbers and ordering information in our eCatalog.



### Category 7<sub>A</sub> S/FTP Cable

Category 7<sub>A</sub> fully shielded cable is the highest-performing and most secure twisted-pair copper system available for connecting WAPs and other devices. It features excellent noise immunity and heat dissipation for optimum Wi-Fi transmission and remote powering support. A highly flexible cable option, category 7A cable can also be terminated to familiar category 6A RJ45 connectivity.



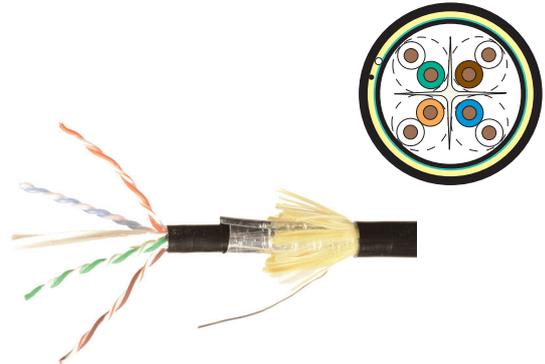
### Category 6A UTP and F/UTP Cable

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.



### Category 6A UTP and F/UTP Indoor/Outdoor Cable

Our category 6A UTP and F/UTP indoor/outdoor cables offer oil and sunlight resistance, as well as cold bend performance, for easily transitioning from indoor to outdoor environments when connecting outdoor WAPs where cable is not subject to long-term emersion and does not have to be direct buried.



### Category 6A UTP and F/UTP Outside Plant Cable

Our category 6A UTP and F/UTP OSP cables are designed to support the latest Wi-Fi applications in outside wet environments. Suitable for direct burial, lashed aerial, duct and underground conduit installations, the cable is filled with a non-conductive water-blocking gel to prevent moisture ingress and the outer jacket is oil and sunlight resistant.

Visit [www.simon.com](http://www.simon.com) for detailed part numbers and ordering information in our eCatalog.



### LightBow™ Fiber Termination Kit

Fiber optic cabling is ideal for Wi-Fi deployments that require greater than 100-meter 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 re-terminated
- Termination kit includes LightBow termination tool, strippers, precision cleaver, strip template, VFL and everything needed for termination – all in a convenient carrying case
- Compatible with Siemon and Corning Unicam® cleaver

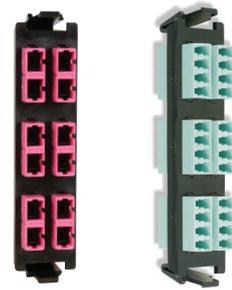
*Note: Unicam is a registered trademark of Corning Cable Systems*

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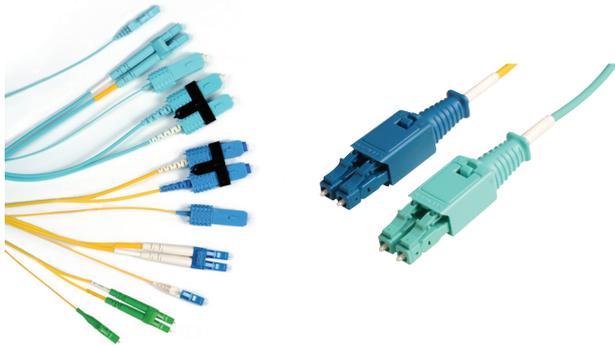
### RIC Fiber Enclosure

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 wireless LAN 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 Wi-Fi applications.

Visit [www.siemon.com](http://www.siemon.com) for detailed part numbers and ordering information in our eCatalog.



**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.



**Free Standing Cabinets**

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



**Wall Mount Cabinets**

Available in black, white or gray, Siemon's wall-mount cabinet comes in 12U, 18U and 24U and in 24 in. and 30 in. (610 mm and 762mm) depths with integrated cable management. It's ideal as a mini telecommunications room or for remote distribution and consolidations points to deliver Wi-Fi in open, unprotected spaces such as warehouses, retail facilities and schools.

Visit [www.siemon.com](http://www.siemon.com) for detailed part numbers and ordering information in our eCatalog.



### 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 cabling systems for Wi-Fi deployments.

Visit [www.siemon.com](http://www.siemon.com) for detailed part numbers and ordering information in our eCatalog.

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